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Baseline Assessment of Physical Characteristics, Aquatic Biota, and Selected Water-Quality Properties at the Reach and Mesohabitat Scale for Reaches of Big Cypress, Black Cypress, and Little Cypress Bayous, Big Cypress Basin, Northeastern Texas, 2010–11

Scientific Investigations Report 2013–5058

U.S. Department of the Interior
U.S. Geological Survey

Front cover:

Top right, Cypress knees, Big Cypress Creek, Texas, July 27, 2011. Photograph taken by James B. Moring, U.S. Geological Survey.

Top left, Electrofishing from a barge, Big Cypress Creek, Texas, July 27, 2011. Photograph taken by Erin C. Sewell, U.S. Geological Survey.

Bottom right, Electrofishing from a boat, Big Cypress Creek, Texas, July 27, 2011. Photograph taken by Justin A. McInnis, U.S. Geological Survey.

Bottom left, Measuring physical characteristics, Big Cypress Creek, Texas, July 26, 2011. Photograph taken by James B. Moring, U.S. Geological Survey.

Back cover, Cypress tree near Big Cypress Creek, Texas, July 27, 2011. Photograph taken by James B. Moring, U.S. Geological Survey.

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By Christopher L. Braun and James B. Moring

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SALLY JEWELL, Secretary

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	0.4047	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
square foot (ft2)	0.0929	square meter (m2)
	Volume	
gallon (gal)	3785	cubic centimeter (cm3)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
	Velocity	
foot per second (ft/s)	0.3048	meter per second (m/s)
	Flow rate	
cubic foot per second (ft3/s)	0.02832	cubic meter per second (cms)
	Mass	
ounce, avoirdupois (oz)	28.4	gram (g)
ounce, avoirdupois (oz)	28,353	milligram (mg)

SI to Inch/Pound

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
hectare (ha)	2.471	acre
square kilometer (km^2)	0.3861	square mile (mi^2)
square meter (m^2)	10.76	square foot (ft^2)
	Volume	
cubic centimeter (cm^3)	0.0002642	gallon (gal)
cubic meter (m^3)	0.0008107	acre-foot (acre-ft)
	Flow rate	
cubic meter per second (m^3/s)	35.31	cubic foot per second (ft^3/s)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
milligram (mg)	0.00003527	ounce, avoirdupois (oz)

Temperature in degrees Celsius (°C) might be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (mS/cm).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Baseline Assessment of Physical Characteristics, Aquatic Biota, and Selected Water-Quality Properties at the Reach and Mesohabitat Scale for Reaches of Big Cypress, Black Cypress, and Little Cypress Bayous, Big Cypress Basin, Northeastern Texas, 2010–11

By Christopher L. Braun and James B. Moring

Abstract

In 2010 and 2011, the U.S. Geological Survey (USGS), in cooperation with the Northeast Texas Municipal Water District and the Texas Commission on Environmental Quality, did a baseline assessment of physical characteristics and aquatic biota (fish and mussels) collected at the mesohabitat scale for reaches of Big Cypress, Black Cypress, and Little Cypress Bayous in the Big Cypress Basin in northeastern Texas, and measured selected water-quality properties in isolated pools in Black Cypress and Little Cypress. All of the data were collected in the context of prescribed environmental flows. The information acquired during the course of the study will support the long-term monitoring of biota in relation to environmental flow prescriptions for Big Cypress Bayou, Black Cypress Bayou, and Little Cypress Bayou. Data collection and analysis were done at mesohabitat- and reach-specific scales, where a mesohabitat is defined as a discrete area within a stream that exhibits unique depth, velocity, slope, substrate, and cover.

Biological and physical characteristic data were collected from two sites on Big Cypress Bayou, and one site on both Black Cypress Bayou and Little Cypress Bayou. The upstream reach of Big Cypress Bayou (USGS station 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas) is hereinafter referred to as the Big Cypress 02 site. The downstream site on Big Cypress Bayou (USGS station 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) is hereinafter referred to as the Big Cypress 01 site and was sampled exclusively for mussels. The sites on Black Cypress Bayou (USGS station 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) and Little Cypress Bayou (USGS station 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) are hereinafter referred to as the Black Cypress and Little Cypress sites, respectively.

A small range of streamflows was targeted for data collection, including a period of low flow during July and August 2010 and a period of very low flow during July 2011. This scenario accounts for variability in the abundance and distribution of fish and mussels and in the physical characteristics of mesohabitats present during different flow conditions. Mussels were not collected from the Little Cypress site. However, a quantitative survey of freshwater mussels was conducted at Big Cypress 01.

Of the three reaches where physical habitat data were measured in 2010, Big Cypress 02 was both the widest and deepest, with a mean width of 62.2 feet (ft) and a mean depth of 5.5 ft in main-channel mesohabitats. Little Cypress was the second widest and deepest, with a mean width of 49.9 ft and a mean depth of 4.5 ft in main-channel mesohabitats. Black Cypress was by far the narrowest of the three reaches, with a mean width of 29.1 ft and a mean depth of 3.3 ft in main-channel mesohabitats but it had the highest mean velocity of 0.42 feet per second (ft/s). Appreciably more fish were collected from Big Cypress 02 (596) in summer 2010 compared to Black Cypress (273) or Little Cypress (359), but the total number of fish species collected among the three reaches was similar. Longear sunfish was the most abundant fish species collected from all three sites. The total number of fish species was largest in slow run mesohabitats at Big Cypress 02, fast runs at Black Cypress, and slow runs at Little Cypress. The catch-per-unit-effort of native minnows was largest in fast runs at Big Cypress 02. More species of native minnows, including the ironcolor and emerald shiner, were collected from Little Cypress relative to all other mesohabitats at all sites.

Fifteen species and 182 individuals of freshwater mussels were collected, with 69.8 percent of the individual mussels collected from Big Cypress 02, 23.6 percent collected from Big Cypress 01, and 6.6 percent collected from Black Cypress. Big Cypress 01was the most species rich site with 13 species, and washboards were the most abundant species overall. Mussels were not collected from Little Cypress because there was no flow in this stream during the targeted sampling period in 2011.

On July 30, 2010, when the estimated streamflow at the site (based on daily mean discharge measured at the upstream gage in conjunction with powerplant withdrawals) was 45 cubic feet per second (ft^3/s), Big Cypress 02 had a mean width of 62.2 ft and a mean depth of 5.5 ft in main-channel mesohabitats. On July 27, 2011, when instantaneous streamflow at the site was 10 ft^3/s, the mean width and mean depth in main-channel mesohabitats decreased to 49.6 ft and 3.1 ft, respectively. Mean velocity in 2010 (0.31 ft/s) was approximately twice as high as 2011 (0.17 ft/s) in main-channel mesohabitats. About 14 percent more fish were collected from Big Cypress 02 in 2010 relative to 2011, and about 18 percent fewer fish species were identified in 2011at this site compared to 2010. Longear sunfish, which was the most abundant fish species collected in 2010, was second to western mosquitofish in 2011.

In the absence of flow during fall 2011, the reach at Black Cypress was reduced to four isolated pools, and the reach at Little Cypress was reduced to three isolated pools. Dissolved oxygen, temperature, pH, and specific conductance data were collected from the pools because it was hypothesized that these conditions would be the most limiting with respect to aquatic life. Dissolved oxygen concentrations ranged from 0.58 milligrams per liter (mg/L) to 4.79 mg/L at Black Cypress and from 0.24 mg/L to 5.33 mg/L at Little Cypress; both sites exhibited a stratified pattern in dissolved oxygen concentrations along transect lines, but the pattern was less pronounced at Black Cypress.

Introduction

In Texas, the Big Cypress Basin includes parts of Hopkins, Franklin, Titus, Morris, Cass, Wood, Upshur, Gregg, Marion, and Harrison Counties. The Big Cypress Basin in Texas extends from the southwestern part of Hopkins County to the Texas–Louisiana State line separating Harrison County, from Caddo Parish, Louisiana. The headwaters of the Big Cypress Basin include Big Cypress Creek (which turns into Big Cypress Bayou), Black Cypress Creek (which turns into Black Cypress Bayou), and Little Cypress Creek (which turns into Little Cypress Bayou). Whereas streamflow in Big Cypress Creek and Big Cypress Bayou (Big Cypress Creek becomes Big Cypress Bayou downstream from Lake O' the Pines) has been altered by the construction of reservoirs, streamflows in Black Cypress Creek, Black Cypress Bayou, Little Cypress Creek, and Little Cypress Bayou remain largely unregulated. Black Cypress Creek becomes Black Cypress Bayou when it enters Marion County, and Little Cypress Creek becomes Little Cypress Bayou when it enters Harrison County (fig. 1). The Black Cypress Bayou has been classified by the State of Texas as a least-impacted reference stream largely on the basis of diverse fish communities found in this stream (Crowe and Bayer, 2005). Fish species richness is larger in the Big Cypress Basin compared to most other parts of the State (Linam and others, 2002), and as many as 86 species of fish have been documented in the Big Cypress Basin (Hoover and others, 1989). Despite the relatively large fish species richness, some species are listed as threatened because of habitat alteration and degradation. For example, the paddlefish (*Polyodon spathula*) and the bluehead shiner (*Pteronotropis hubbsi*) are listed as "threatened" by the State of Texas (Texas Parks and Wildlife Department, 2012); the paddlefish has not been documented in many years, but populations of the bluehead shiner can be found (Thomas and others, 2007).

The most threatened and declining taxon of freshwater organisms in the Big Cypress Basin in Texas are mussels, a threatened and declining taxon throughout North America. For example, of the 297 known species of freshwater mussels in the United States, 207 are extinct, federally listed as threatened, or considered a species of concern (Williams and others, 1993; Vaughn and Taylor, 1999). Factors such as overharvesting, pollution, and invasive species pose a threat to freshwater mussels in North America; their precipitous decline during the last century is largely a result of habitat loss (Layzer and others, 1993; Williams and others, 1993) with a major contributing factor being the widespread impoundment of rivers (Vaughn and Taylor, 1999, Hardison and Layzer, 2001).

In the Big Cypress Basin in Texas, the Louisiana pigtoe (*Pleurobema riddellii*), documented by Mather and Bergmann (1994), is one of the rarest unionids (freshwater mussels of the family Unionidae) and is classified by the State as critically imperiled (State ranking of S1). Another critically imperiled unionid, the sandbank pocketbook (*Lampsilis satura*), also is thought to inhabit the Big Cypress Basin in Texas (Marsha Mays, Texas Parks and Wildlife Department, written commun., 2011) but has never been documented. At least 26 species of mussels have been identified in the Big Cypress Basin in Texas since 1913 (Howells, 1996).

The hydrology of a stream plays an important role in determining the composition, distribution, and diversity of aquatic communities, and a major part of instream and environmental flow studies is relating the biology of a stream to its flow regime (Bovee and others, 1998). The development of environmental flow recommendations or prescriptions often is based on recognizing the importance of the natural flows expressed as the stream's quantity, timing, and variability in flow over time, that is, its natural flow regime (Poff and others, 1997; Richter and others, 2011). Mesohabitats are discrete areas within a stream exhibiting unique depths, velocities, slopes, substrates, and cover for aquatic biota such as undercut banks and overhanging trees (Minnesota Department of Natural Resources, 2012). Prescriptions for environmental flows have been developed by the State in order to help maintain sufficient flows and to support biodiversity in the mesohabitats of Big Cypress Basin in Texas (Caddo Lake Institute, 2012). Accordingly, during 2010–11, the U.S. Geological Survey (USGS), in cooperation with the Northeast Texas Municipal Water District (NETMWD) and the Texas Commission on Environmental Quality (TCEQ), did

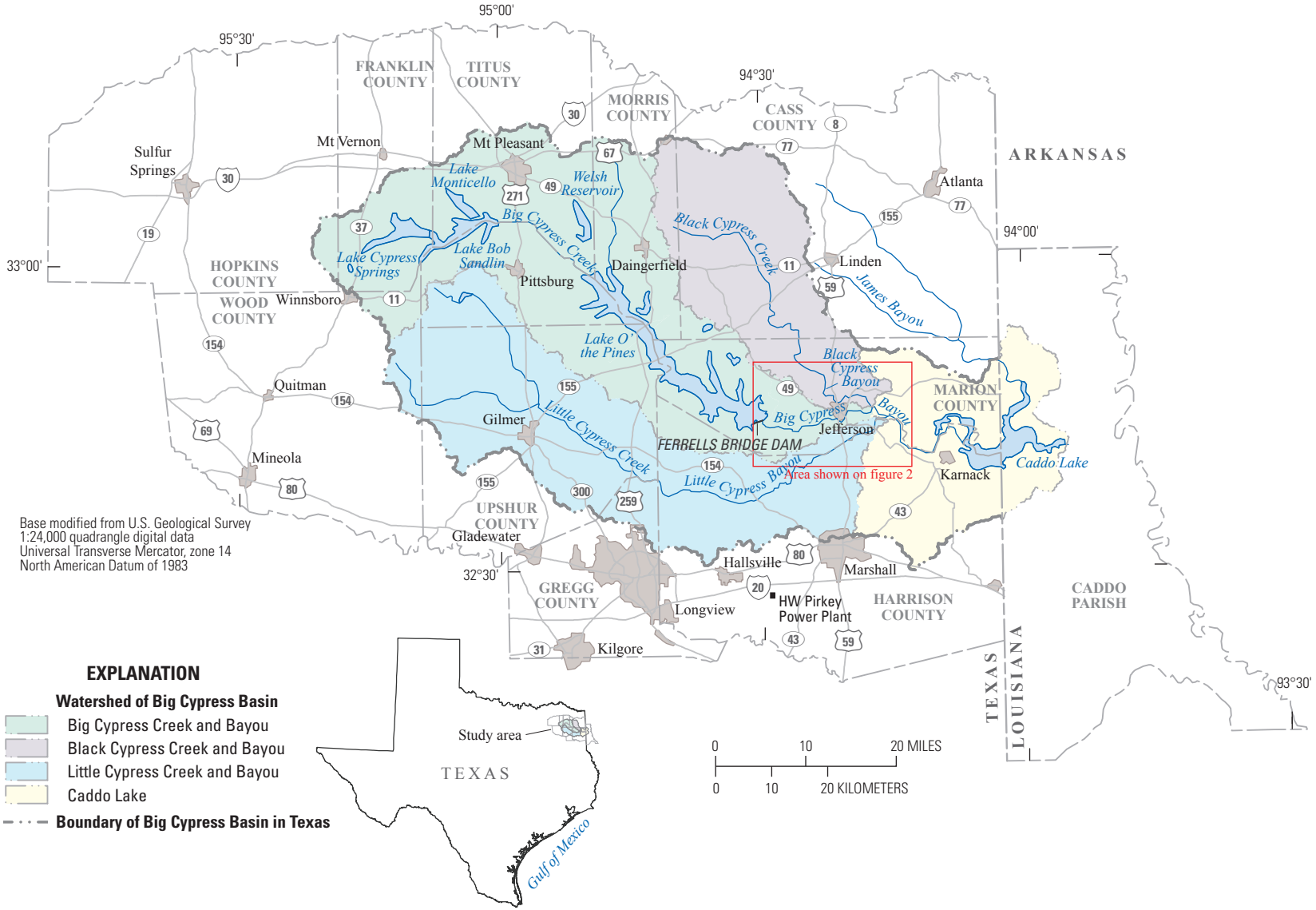

Figure 1. Location of study area, Big Cypress Basin, northeastern Texas.

a baseline assessment to document physical characteristics, water-quality properties, and aquatic biota in the Big Cypress Basin in Texas in relation to environmental flow prescriptions established for the Big Cypress, Black Cypress, and Little Cypress Bayous. The study was done in support of the Texas Clean Rivers Program, "a partnership between the TCEQ and regional water authorities to coordinate and conduct water quality monitoring, assessment, and stakeholder participation to improve the quality of surface water within each river basin in Texas" (Texas Clean Rivers Program website, Texas Commission on Environmental Quality, 2013).

Purpose and Scope

This report describes a baseline assessment of physical characteristics and aquatic biota (fish and mussels) collected at the mesohabitat scale for reaches of Big Cypress, Black Cypress, and Little Cypress Bayous in the Big Cypress Basin in Texas during 2010–11 in the context of prescribed environmental flows. Physical characteristics were measured in reaches of each stream to catalogue the properties of mesohabitats in the study area. Fish and mussel aquatic biota data were collected within the range of applicable low-flow environmental flow prescriptions. Water-quality properties were measured in isolated pools that remained in the Black Cypress and Little Cypress Bayous during no-flow conditions in October 2011 because the isolated pools were crucial for sustaining aquatic biota during periods of no flow.

Description of Study Area

Most of the Big Cypress Basin in Texas is characterized by gently rolling to hilly terrain intersected by terraces and relatively flat flood plains. The vegetation is dominated by pine and mixed-pine hardwood forests with pastures and cultivated land, bottomland hardwood forest, and Cypress swamp along backwater areas and tributaries (U.S. Army Corps of Engineers, 1998).

There are three large impoundments on Big Cypress Creek upstream from Big Cypress Bayou. In addition to Lake O' the Pines, flow in Big Cypress Creek also is regulated by Lake Cypress Springs (impounded in 1970) (Texas Parks and Wildlife Department, 2013) and Lake Bob Sandlin (impounded in 1978) (Texas State Historical Association, 2013,) (fig. 1). In addition to impounding Big Cypress Creek, Lake O' the Pines regulates flow in Big Cypress Bayou; Big Cypress Bayou begins where Lake O' the Pines releases discharge. Construction of Ferrells Bridge Dam, which impounds Big Cypress Creek to form Lake O' the Pines Reservoir (fig. 2), was completed in 1959. Dowell, (1964, p. 157) describes the history of impoundment:

> Construction [of Ferrells Bridge Dam] was started in January 1955 and completed December 11, 1959. The cofferdam closure was made August 21, 1957, and water flowed through the conduits September 25, 1957. Deliberate impoundment began in August 1958, and the lake was in full use by December 1959.

Since August 1957, the flow in Big Cypress Bayou has been characterized as completely regulated (U.S. Geological Survey, 2012b) and the flow regime in Big Cypress Bayou (monitored at U.S. Geological Survey streamflow-gaging station 07346000 Big Cypress Bayou near Jefferson Tex. [hereinafter Big Cypress Bayou gage]; figs. 2 and 3) has been altered. Following construction of the Lake O' the Pines, the streamflow discharge record displays less variability and reduced streamflow amounts compared to the streamflow record prior to construction of the reservoir (fig. 3). Prior to regulation, the annual maximum daily mean discharge was 57,100 cubic feet per second (ft^3/s) on April 1, 1945, but since the beginning of regulation (excluding the period from January 1, 1960, through September 30, 1979, when the Big Cypress Bayou gage was inactive), the highest annual maximum daily mean discharge has been 5,190 ft^3/s (April 29, 1958) (U.S. Geological Survey, 2012a). The mean, maximum, and minimum daily mean discharges at the Big Cypress Bayou gage for the period from October 1, 1979, to December 31, 2011, were 594, 3,450, and 0 ft^3/s, respectively.

Whereas flows in Big Cypress Bayou are regulated, flows in the Black Cypress Bayou and Little Cypress Creek Bayou are largely unregulated. Figure 4 depicts the daily mean discharge measured by the Big Cypress Bayou gage, USGS streamflow-gaging station 07346045 Black Cypress Bayou at Jefferson Tex. (hereinafter Black Cypress Bayou gage), and USGS streamflow-gaging station 07346070 Little Cypress Bayou near Jefferson Tex. (hereinafter Little Cypress Bayou gage) for the period of record they share in common (October 1, 1979, to December 31, 2011).

The natural variability of the flow regime for Black Cypress Bayou has remained largely unchanged during the period of concurrent streamflow records (October 1, 1979, to December 31, 2011) common on all three bayous from which data were collected for this report. Despite being classified as a major perennial tributary to Big Cypress Bayou (Northeast Texas Municipal Water District, 2007), Black Cypress Bayou can become intermittent during late summer, as observed from June through November 2011 (figs. 4*B* and 5*B*). During the period from October 1, 1979, to December 31, 2011, there was no flow at the Black Cypress Bayou gage for a total of 632 days. The mean, maximum, and minimum daily mean discharges at the Black Cypress Bayou gage for the period from October 1, 1979, to December 31, 2011, were 336, 11,400, and 0 ft^3/s, respectively.

The natural variability of the flow regime for Little Cypress Bayou has been largely unchanged during the common period of record (October 1, 1979, to December 31, 2011) with Big Cypress Bayou and Black Cypress Bayou. Little Cypress Bayou also is considered a major perennial tributary to Big Cypress Bayou (Northeast Texas Municipal Water District, 2007) but also can become intermittent during late summer, as observed from June through November 2011

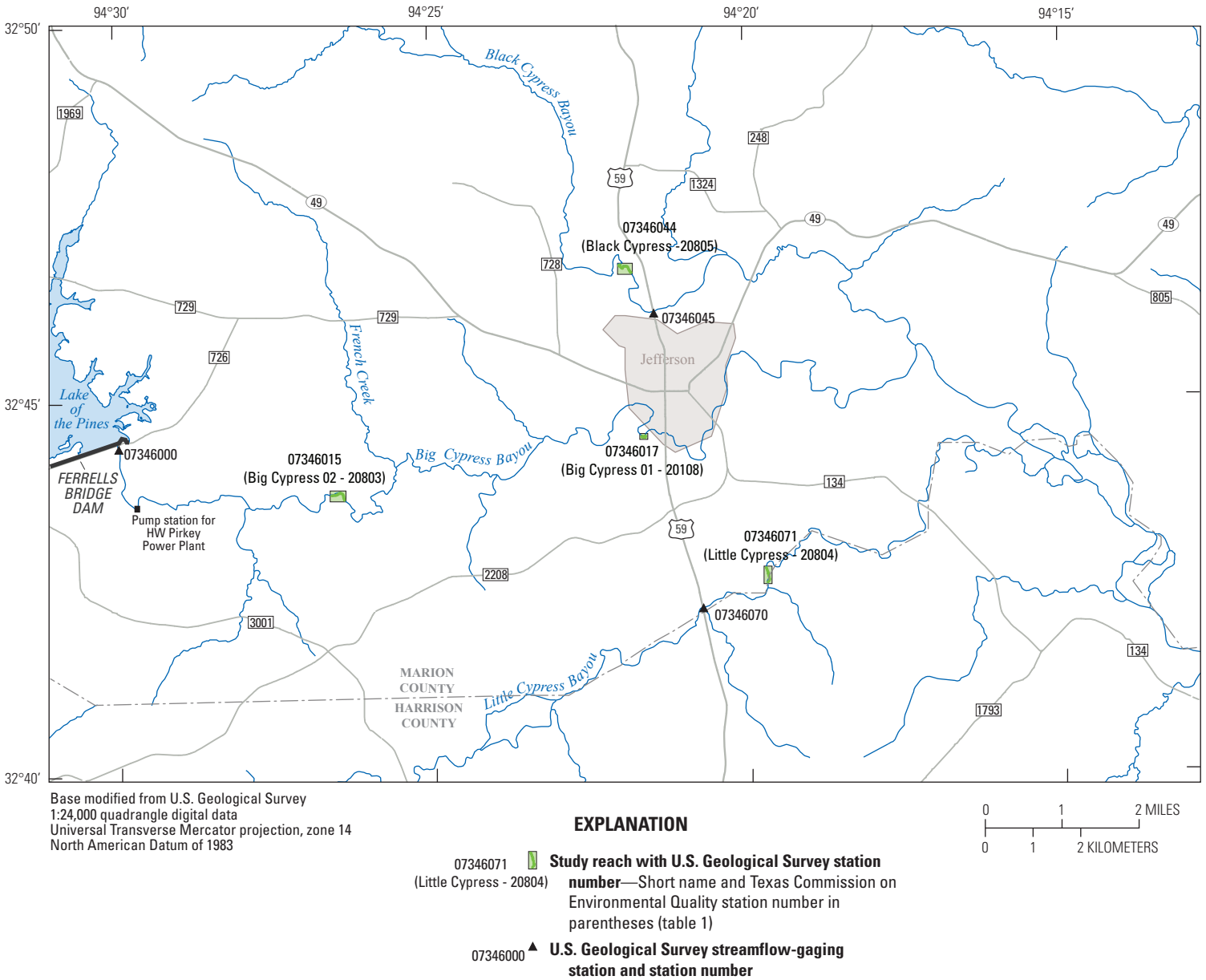

Figure 2. Study reach locations and U.S. Geological Survey streamflow-gaging station locations, Big Cypress Basin, northeastern Texas.

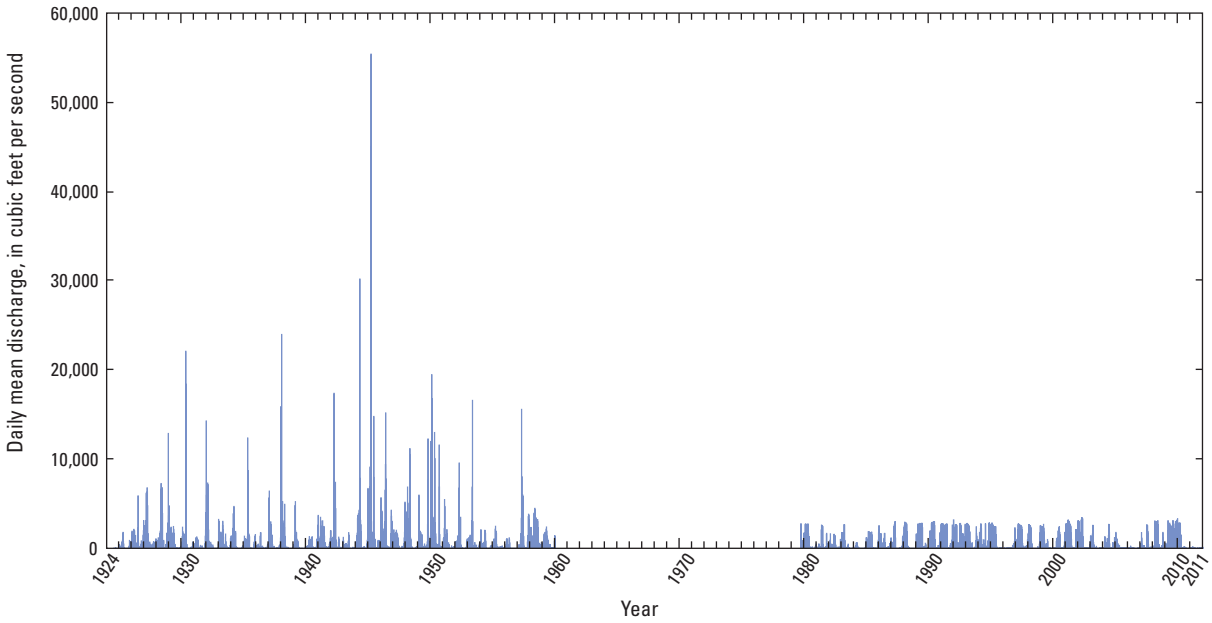

Figure 3. Daily mean discharge at U.S. Geological Survey streamflow-gaging station 07346000 Big Cypress Bayou near Jefferson, Texas, August 1, 1924–December 31, 2011.

(figs. 4*C* and 5*C*). During the period from October 1, 1979, to December 31, 2011, there was no flow at the Little Cypress Bayou gage for a total of 539 days. The mean, maximum, and minimum daily mean discharges at the Little Cypress Bayou gage for the period from October 1, 1979, to December 31, 2011, were 526, 18,600, and 0 ft^3/s, respectively.

Measured daily mean discharge values from Big Cypress Bayou, Little Cypress Bayou, and Black Cypress Bayou gages are plotted in figures 4*D* and 5*D* to demonstrate the relative contribution of each to flow in the Cypress Bayou Basin. Figure 4*D* shows streamflow during the common period of record (October 1, 1979 to December 31, 2011) for all three Bayous. Figure 5*D* shows streamflow during the course of a 3-year period (January 1, 2009 to December 31, 2011), which includes a period of mean to above mean flow conditions (January 1, 2009 to mid-2010) as well as a period of drought (mid-2010 to December 31, 2011).

Previous Studies and Background Information

This report was written in support of the Sustainable Rivers Project (SRP; U.S. Army Corps of Engineers, 2012) for Big Cypress Bayou, the Environmental Flows Project for Caddo Lake and its tributaries (Caddo Lake Institute, 2012), and the Texas Commission on Environmental Quality (TCEQ) Clean Rivers Program. The SRP was established in 2002 as a partnership between the U.S. Army Corps of Engineers (USACE) and The Nature Conservancy to alter existing operations at USACE dams in order to enhance habitat conditions for animals and plants that depend on flows downstream from the dams (U.S. Army Corps of Engineers and The Nature Conservancy, 2012). The SRP is active in eight river basins across the United States, including Big Cypress Bayou (Konrad, 2010).

The USACE and NETMWD are working together to determine the best strategy to implement prescribed environmental flows for Big Cypress Bayou downstream from the Lake O' the Pines, which is managed by USACE. The first prescribed environmental flow releases from Ferrells Bridge Dam occurred in March 2012 (Lee Thomas, Northeast Texas Municipal Water District, oral commun., 2012). Reservoirs provide a mechanism for managing the magnitude and timing of river flows in order to satisfy the needs of human and natural communities. The SRP emphasizes the use of a natural flow paradigm for the determination of environmental flow prescriptions or recommendations (U.S. Army Corps of Engineers, 2012).

The Caddo Lake Institute website describes the Environmental Flows Project (Caddo Lake Institute, 2012), noting it was started in 2004 as a partnership between the Caddo Lake Institute, The Nature Conservancy, USACE, and NETMWD to provide adequate instream flows to sustain the ecological, economical, and recreational values of the Big Cypress Basin in Texas. Instream flow prescriptions were developed for different flow conditions and different parts of the year for Big Cypress Bayou, Black Cypress Bayou, and Little Cypress Bayou (Caddo Lake Institute, 2010) to describe the minimum desirable low flows required to maintain aquatic biodiversity and hydrologic connectivity between in-channel habitats in the form of continuous flow connecting different mesohabitats.

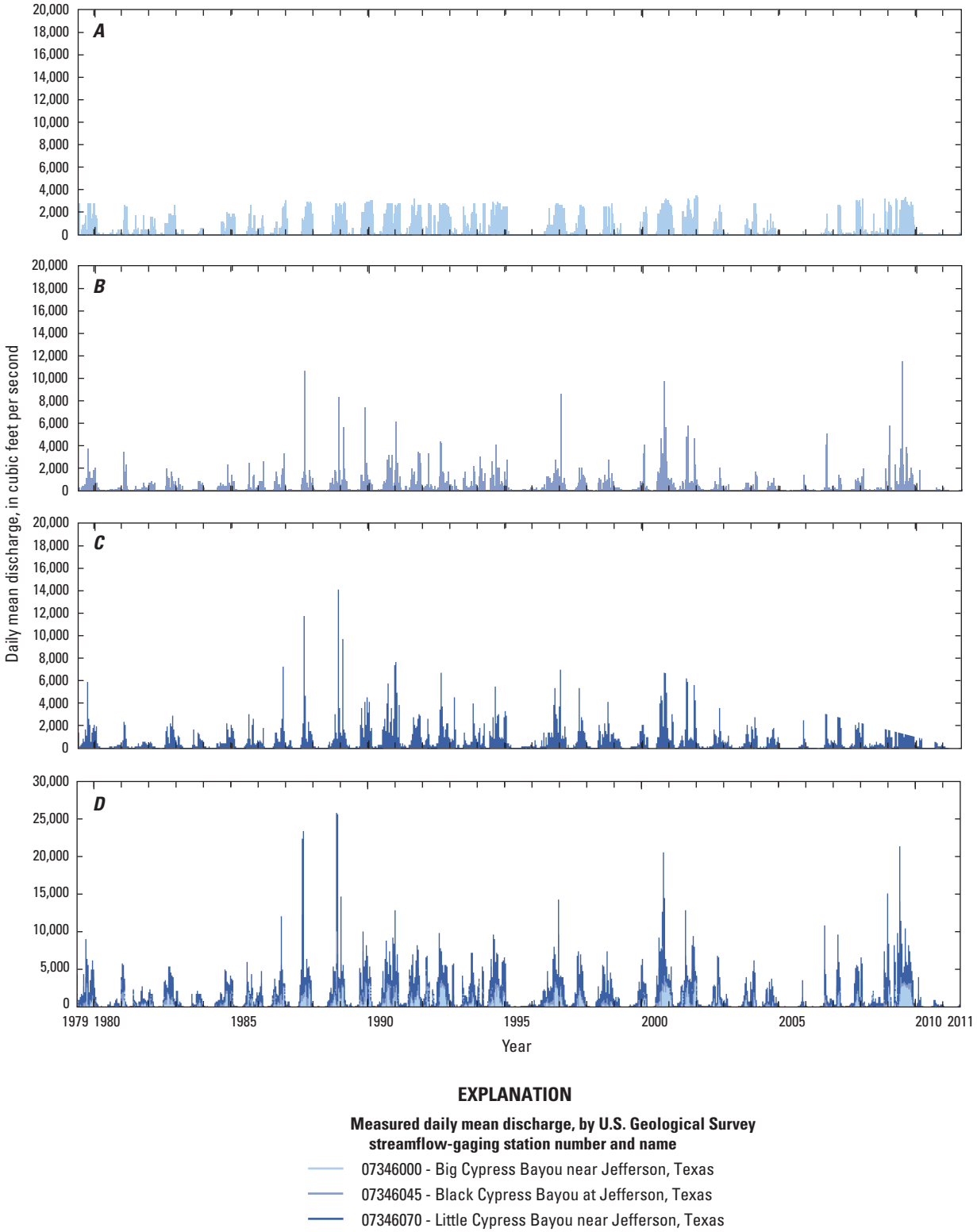

Figure 4. Daily mean discharge during October 1, 1979–December 31, 2011, at U.S. Geological Survey streamflow-gaging stations *A*, 07346000 Big Cypress Bayou near Jefferson, Texas, *B*, 07346045 Black Cypress Bayou at Jefferson, Tex., *C*, 07346070 Little Cypress Bayou near Jefferson, Tex., and *D*, measured daily mean discharge from stations 07346000, 07346045, and 07346070.

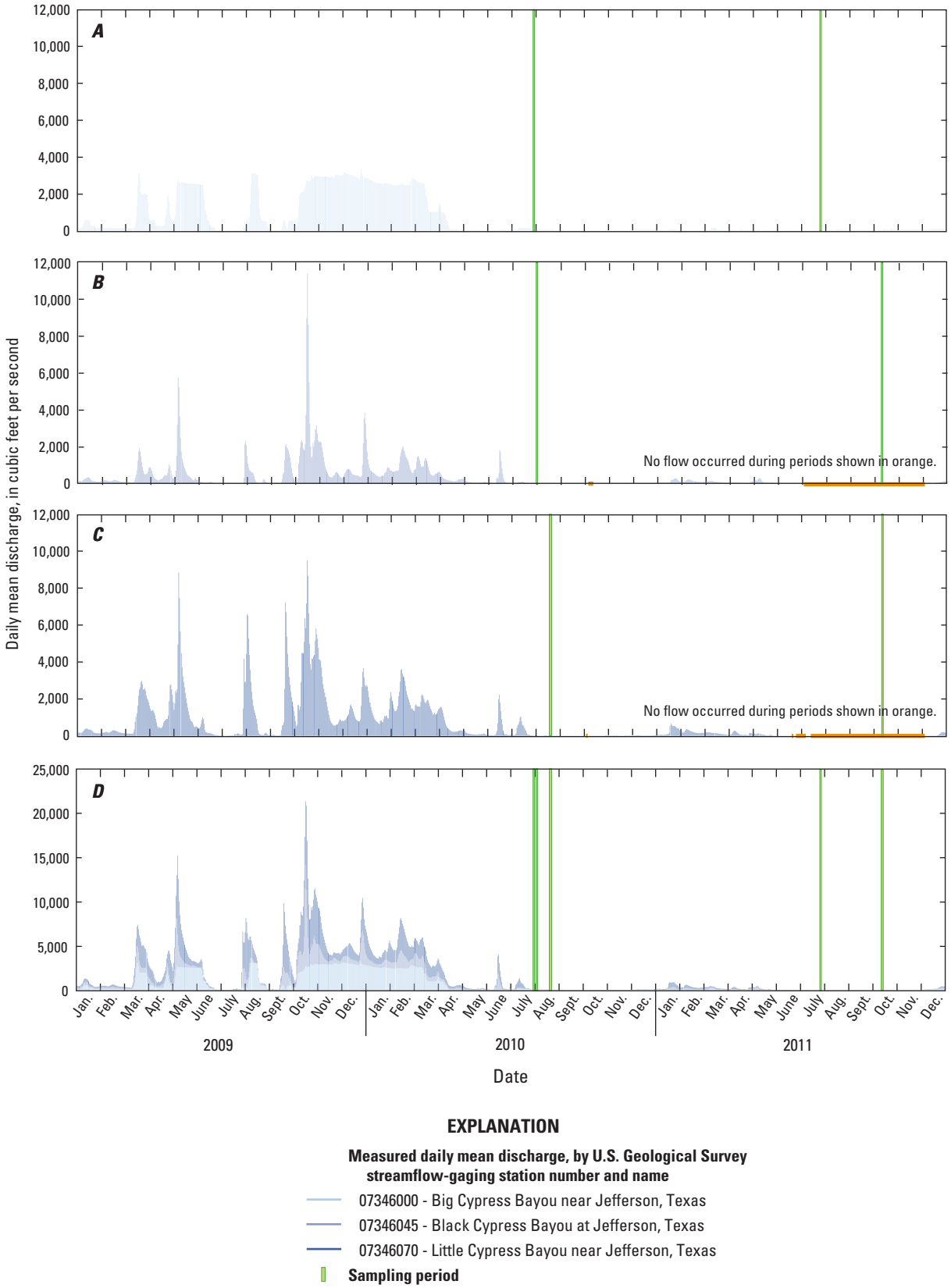

Figure 5. Daily mean discharge at U.S. Geological Survey streamflow-gaging stations *A*, 07346000 Big Cypress Bayou near Jefferson, Texas, *B*, 07346045 Black Cypress Bayou at Jefferson, Tex., *C*, 07346070 Little Cypress Bayou near Jefferson, Tex., and *D*, composite depiction of measured daily mean discharge from stations 07346000, 07346045, and 07346070, January 1, 2009–December 31, 2011.

Methods

Stream velocities were measured by using a hand-held acoustic Doppler velocity meter (SonTek, 2013). Standard USGS methods (Rantz and others, 1982; Turnipseed and Sauer, 2010) and methods described in the acoustic Doppler velocity meter operations manual (SonTek, 2003) were used to compute streamflow and measure stream velocities. Streamflow measurements were made at U.S. Geological Survey streamflow-gaging stations on the Big Cypress Bayou, Black Cypress Bayou, and Little Cypress Bayou and at the sites selected for aquatic biota sampling. In some cases, depths and velocities could not be measured at sites selected for aquatic-biota sampling because the water was too deep to use the hand-held acoustic Doppler velocity meter. In these instances, the depths and velocities were measured as close as possible to the sites selected for aquatic-biota sampling.

Aquatic biota data were collected within the range of applicable low-flow environmental flow prescriptions at three sites for fish representing different reaches on each stream (one site each on Big Cypress Bayou, Black Cypress Bayou, and Little Cypress Bayou) and three sites for mussels (two sites on Big Cypress Bayou and one on Black Cypress Bayou) in northeastern Texas. The dates and different types of data collected at each site in 2010 and 2011 are shown in table 1. Fish data were collected and analyzed at the mesohabitat and reach scale and mussel data were collected and analyzed at the reach scale. The mesohabitats characterized in this study (slow runs, fast runs, and various types of pools) are discrete channel features of relatively homogenous depth and flow that are distinguished from one another on the basis of localized slope, channel shape and structure, varying degrees of velocity, orientation relative to flow, and inclusion with or exclusion from the main channel (Hawkins and others, 2011) (table 2). Runs were characterized as slow or fast on the basis of relative stream velocity; designations as slow and fast runs were specific to each stream because a high velocity in one stream might not be characterized as a high velocity in another. Pools include main channel pools that are relatively deep and low velocity features, and margin pools (forewaters, backwaters, and embayments) that are low velocity features that vary considerably in their depth. Forewaters are oriented parallel and into the principal direction of flow, whereas backwaters are oriented parallel but in the opposite direction of the principal flow; embayments are oriented perpendicular to the principal flow direction. In this report, forewaters, backwaters, and embayments were collectively referred to as a "margin pool" mesohabitat because the physical characteristics (depth, velocity, and bed substrate) of the three mesohabitats were so similar. Because of the large variation in stream types, mesohabitat typing was based on relative changes in each stream. Each reach typically contained many or all of the mesohabitat types present in the entire segment; the objective was to categorize major habitat types present in each segment of stream. This type of stream habitat classification facilitates an understanding of biota-habitat relations that provide an effective approach to evaluating the effects of environmental change, such as changes in flow, on stream ecosystems (Hawkins and others, 2011).

Site Selection and Environmental Flow Prescriptions

Representative reaches for use as data-collection sites were first identified during an initial field reconnaissance in 2009. The upstream and downstream extent of each reach was determined following TCEQ's Surface Water Quality Monitoring (SWQM) procedures for reach establishment (Texas Commission on Environmental Quality, 2007). The stream reaches representing data-collection sites on the Big Cypress, Black Cypress, and Little Cypress Bayous were selected in a manner consistent with TCEQ protocols (Texas Commission on Environmental Quality, 2007). The reach at each site was about 40 channel widths in length. To the extent possible, sites were selected near existing USGS streamflow-gaging stations so that discharge obtained from these stations could be related to the data collected during this study (fig. 2). USGS station numbers and TCEQ station numbers were established for each site (table 1).

The upstream site on Big Cypress Bayou (USGS station 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.) is hereinafter referred to as the Big Cypress 02 site (TCEQ station number is 20803). The downstream site on Big Cypress Bayou (USGS station 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) is hereinafter referred to as the Big Cypress 01 site (TCEQ station number is 20108). The Big Cypress 01 site was sampled exclusively for mussels. The sites on Black Cypress Bayou (USGS station 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) and Little Cypress Bayou (USGS station 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) are hereinafter referred to as the Black Cypress and Little Cypress sites, respectively. The TCEQ station numbers for the Black Cypress and Little Cypress sites are 20805 and 20804, respectively (fig. 2; table 1).

Physical-characteristic and aquatic-biota data were collected at three data-collection sites (Big Cypress 02, Black Cypress, and Little Cypress) for selected low-flow conditions found within the established environmental flow prescription ranges for dry and average years during the July to September critical period that were adopted at the December 2008 Cypress Basin Flows Workshop in Jefferson, Tex. (Caddo Lake Institute, 2010) for each stream. Low-flow prescriptions during dry and average years during the July to September critical period ranged from 6 to 40 ft^3/s for Big Cypress Bayou, 4 to 32 ft^3/s for Black Cypress Bayou, and 5 to 26 ft^3/s for Little Cypress Bayou (table 3). Physical-characteristic and aquatic-biota data collection was intended to include two sampling events targeting the higher part and lower part of the flow-prescription ranges (referred to herein as low flow and very low flow, respectively) established for each of the

Table 1. Study sites and sampling dates in the Big Cypress Basin, northeastern Texas, 2010–11.

[TCEQ, Texas Commission on Environmental Quality; ft, feet; --, no data]

Sites sampled in 2010							
U.S. Geological Survey station number and name	Short name	TCEQ station number	Reach length (ft)	Aquatic habitat	Fish	Estimated discharge based on daily mean discharge and power plant withdrawals	Mussels
07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Big Cypress 01	20108	--	--	--	--	July 30
07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.	Big Cypress 02	20803	1,558	July 30–31	July 31	July 30–31	July 31 and Aug. 2
07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Black Cypress	20805	1,050	Aug. 3–4	Aug. 3–4	--	Aug. 3–4
07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Little Cypress	20804	1,607	Aug. 18	Aug. 19	--	--[1]

Sites sampled in 2011							
U.S. Geological Survey station number and name	Short Name	TCEQ station number	Reach length (ft)	Aquatic habitat	Fish	Instantaneous discharge measured in the field	Water-quality properties[2]
07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.	Big Cypress 02	20803	1,558	July 26–27	July 27	July 26	--
07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Black Cypress	20805	1,050	--	--	--	Oct. 12
07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Little Cypress	20804	1,607	--	--	--	Oct. 13

[1]Mussels not collected because of scheduling conflicts in 2010 and an extended period of no flow in 2011.

[2]Water-quality properties: dissolved oxygen, pH, specific conductance, and temperature.

Table 2. Mesohabitat types used to describe the study reaches and physical characteristics measured in the Big Cypress Basin, northeastern Texas, during 2010–11 (mesohabitat descriptions are modified from Hawkins and others, 2011).

[ft, feet; ft/s, feet per second]

	Mesohabitat type	Main channel mesohabitat? (yes or no)	Description
	Slow run	Yes	Relatively moderate velocity feature with laminar flow and a nonturbulent surface, average and median depths of 5.2 ft and 4.8 ft, respectively, and average and median velocities of 0.15 ft/s and 0.12 ft/s, respectively
	Fast run	Yes	Relatively moderate velocity feature with laminar flow and a nonturbulent surface, average and median depths of 2.0 ft and 1.8 ft, respectively, and average and median velocities of 0.48 ft/s and 0.43 ft/s, respectively
	Channel pool	Yes	Relatively deep, low velocity feature in main channel of the stream
Margin pool	Forewater	No	Slackwater feature connected to the main channel, oriented into the principal direction of flow
Margin pool	Backwater	No	Slackwater feature connected to the main channel, oriented in an opposing direction to the principal flow direction
Margin pool	Embayment	No	Slackwater feature located adjacent to the channel and oriented perpendicular to flow
	Isolated pool	Yes	Feature with highly variable depth and no velocity

Table 3. Low-flow prescriptions (in cubic feet per second) for Big Cypress Bayou, Black Cypress Bayou, and Little Cypress Bayou based upon a variety of ecological objectives during dry and average years (Caddo Lake Institute, 2010).

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Dry year	Fish habitat		Spawning habitat				Maintain aquatic diversity			Fish habitat		
Big Cypress Bayou	90	90	218	198	114	49	13	6	6	40	90	90
Black Cypress Bayou	125	201	242	140	80	42	11	4	4	4	19	91
Little Cypress Bayou	112	186	219	158	86	38	12	5	5	5	18	68
Average year	Fish habitat		Benthic drift and dispersal, fish spawning				Fish habitat			Fish habitat		
Big Cypress Bayou	268	347	390	330	150	79	35	40	40	40	90	117
Black Cypress Bayou	222	300	306	205	156	95	32	5	4	13	74	209
Little Cypress Bayou	242	471	415	287	155	96	26	10	10	19	65	144

three bayous. The sampling event during the July–September critical period in 2010 targeted the higher end of the range, while the sampling event during the critical period in 2011 targeted the lower end of the range. In 2011, the study area was affected by the widespread severe drought in Texas (University of Nebraska-Lincoln, 2012). Compared to 2010, appreciably drier conditions prevailed during the targeted July through September period during 2011, with no flow during July–September 2011 in either Black Cypress or Little Cypress except for a few days during July 2011 in Little Cypress. Sampling was delayed until October 2011 at the Black and Little Cypress sites; if sustained streamflows had returned by October 2011, it would have enabled sampling during very low flow conditions. Sustained streamflow did not return to either site until December 2011(fig. 5), and when it did, both the Black and Little Cypress sites remained outside of the range of dry-to-average year low-flow prescriptions adopted by the Cypress Basin Environmental Flows Stakeholders group (table 3; Caddo Lake Institute, 2010); as a result, the second assessment in 2011 did not include sampling for fish and mussels at either of these sites.

Streamflows for environmental flow prescription classification were calculated as an average of discharge measurements from the USGS streamflow-gaging station nearest to each site where biological and physical data were collected during the 2-day period when biological and physical data were collected. In 2010, low flows ranged from an estimated daily mean discharge of 45 ft^3/s at Big Cypress 02 during July 30–31, 2010, to measured daily mean discharges of 25 ft^3/s at Black Cypress during August 3–4, 2010, and 4.7 ft^3/s at Little Cypress during August 18–19, 2010. During July 30–31, 2010, a daily mean discharge of 45 ft^3/s was estimated at Big Cypress 02 as the difference between the daily mean discharge of 63 ft^3/s measured at the Big Cypress Bayou gage and withdrawals of 18 ft^3/s made by the H.W. Pirkey Power Plant in Hallsville, Tex. (fig. 1; table 4). The Big Cypress Bayou gage is about 5.5 miles upstream from the Big Cypress 02 site; the H.W. Pirkey Power Plant pump station (fig. 2), about 1 mile downstream from the Big Cypress Bayou gage, removed 1,110.19 acre-ft of water from Big Cypress Bayou in July 2010 (Lee Thomas, Northeast Texas Municipal Water District, written commun., 2012), which equates to a continuous 18 ft^3/s during the entire month of July 2010 (table 4). On July 26, 2011, the instantaneous discharge measured at Big Cypress 02 was 10 ft^3/s (table 4), which was characterized as a very low flow.

Physical Characteristics

The areal extent of mesohabitats within the stream reach at each data-collection site was surveyed by using a Sokkisha Set 4A laser-operated total station (a theodolite and electronic distance-measurement instrument used to read slope distances from the instrument to a particular point) (Sokkia, 2012). Physical characteristics, including the area of each mesohabitat type, were determined for each data collection site (appendix 1). A detailed map of the reach at each data collection site was produced and includes the type and area of each mesohabitat at Big Cypress 02, Black Cypress, and Little Cypress (figs. 6–8). Some of the small margin pools at Big Cypress 02 were not surveyed.

Representative points for physical measurements were selected randomly across each mesohabitat by establishing five transects perpendicular to the direction of flow (appendix 1). The five transects were intended to collectively represent the given mesohabitat within a reach and were approximately evenly spaced. When the mesohabitat was less than 33 ft long, three approximately evenly spaced transects were established perpendicular to the direction of flow. The transects listed in appendix 1 are not shown on figures 6–8 and should not be confused with the "surveyed transect points" used to collect to collect water-quality properties during October 2011 (figs.7*B* and 8*B*; appendix 2).

Table 4. Measured daily mean streamflows at the U.S. Geological Survey streamflow-gaging stations nearest to study sites and instantaneous discharge measured in the field, Big Cypress Basin, Texas, 2010–11.

[TCEQ, Texas Commission on Environmental Quality; USGS, U.S. Geological Survey; ft^3/s, cubic feet per second; ft, feet; --, no data]

Sites sampled in 2010								
Study sites where physical characteristics, aquatic biota, and selected water quality properties were collected (U.S. Geological Survey station number and name)	Short name	TCEQ station number	Date	Station number of the nearest USGS streamflow-gaging station	Measured discharge at nearest USGS streamflow-gaging station for the specified day or range of days			Estimated discharge based on daily mean discharge and power plant withdrawals (ft^3/s)
					Minimum discharge (ft^3/s)	Maximum discharge (ft^3/s)	Mean discharge (ft^3/s)	
07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Big Cypress 01	20108	July 30	07346000	61	63	62	--
07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.	Big Cypress 02	20803	July 30–31	07346000	61	63	63	[1]45
07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Black Cypress	20805	Aug. 3–4	07346045	19	35	25	--[2]
07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Little Cypress	20804	Aug. 18–19	07346070	3.7	5.8	4.7	--[2]

Sites sampled in 2011								
Study sites where physical characteristics, aquatic biota, and selected water quality properties were collected (U.S. Geological Survey station number and name)	Short name	TCEQ station number	Date	Station number of the nearest USGS streamflow-gaging station	Measured discharge at nearest USGS streamflow-gaging station for the specified day or range of days			Instantaneous discharge measured in the field (ft^3/s)
					Minimum discharge (ft^3/s)	Maximum discharge (ft^3/s)	Mean discharge (ft^3/s)	
07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.	Big Cypress 02	20108	July 26–27	07346000	26	39	32	[3]10
07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Black Cypress	20805	Oct. 12–13	07346045	0	0	0	0
07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Little Cypress	20804	Oct. 13–14	07346070	0	0	0	0

[1]Estimated as the difference between mean discharge of 62 ft^3/s measured at USGS streamflow-gaging station 07346000 Big Cypress Bayou near Jefferson Tex. and withdrawals made by the H.W. Pirkey Power Plant. The USGS streamflow-gaging station is about 5.5 miles upstream from the data collection site; the H.W. Pirkey Power Plant, pump station located 1 mile downstream from the gage, removed 1,110.19 acre-ft of water from Big Cypress Bayou in July 2010, which equates to 18 ft^3/s (Lee Thomas, Northeast Texas Municipal Water District, written commun., 2012).

[2]Instantaneous discharge not measured because the site was in close proximity to an existing USGS streamflow-gaging station.

[3]Large differences in streamflow between the instantaneous discharge measured in the field and the mean discharge measured at the nearest upstream gaging station are largely because of the withdrawals associated with the H.W. Pirkey Power Plant.

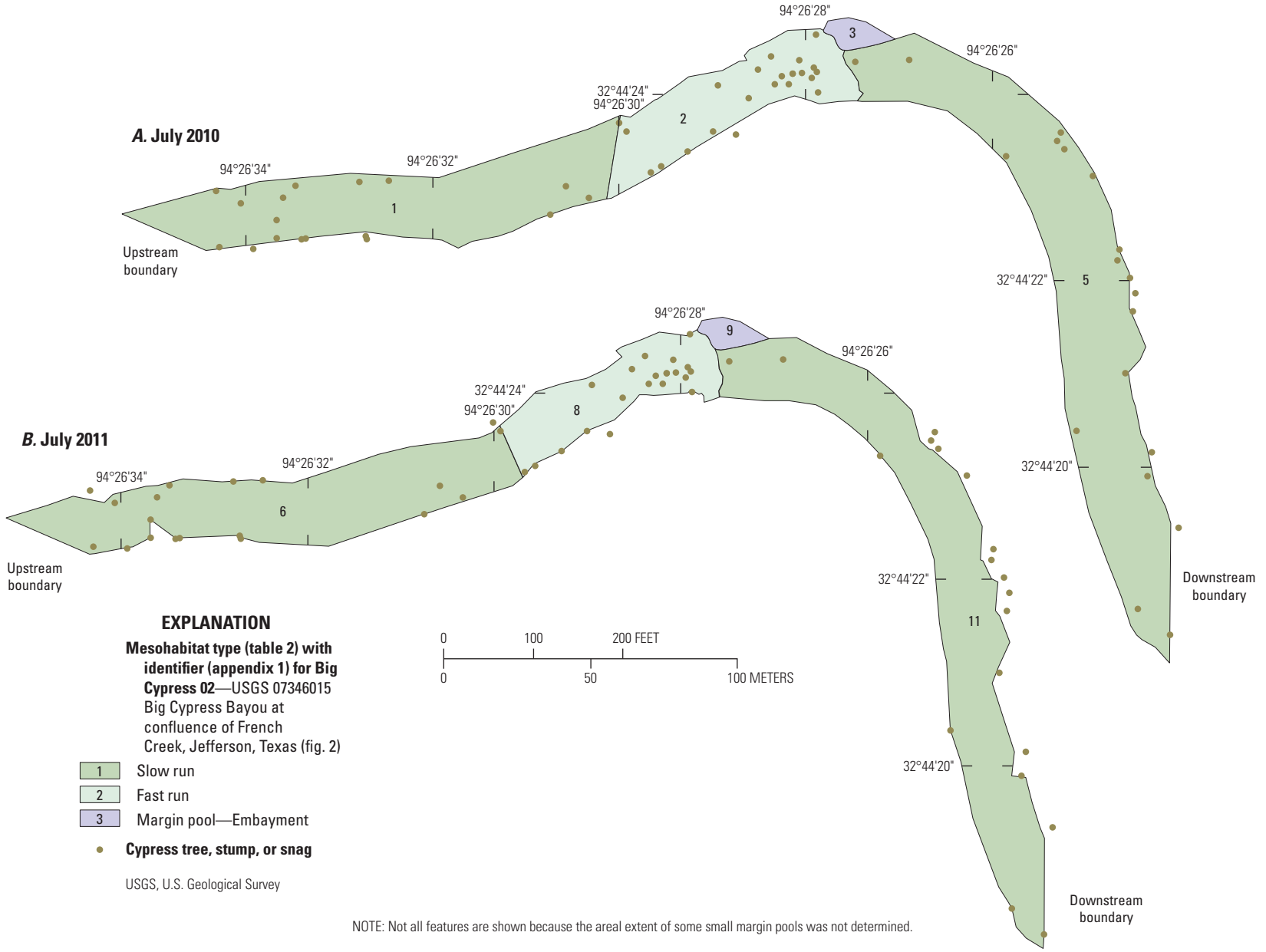

Figure 6. Mesohabitat extents and channel features surveyed *A*, July 2010, and *B*, July 2011, at U.S. Geological Survey station 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas.

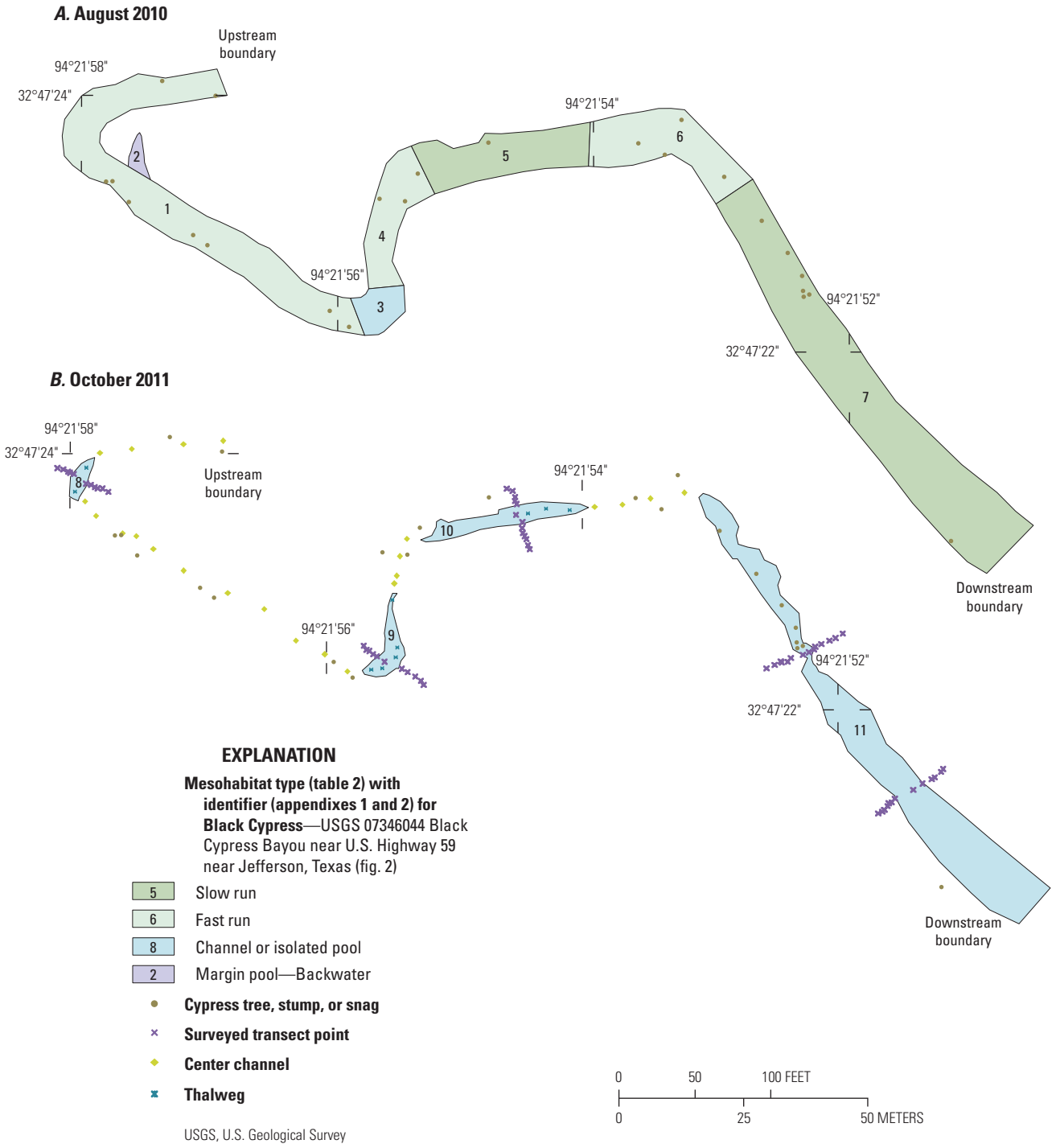

Figure 7. Mesohabitat extents and channel features surveyed *A*, August 2010, and *B*, October 2011, at U.S. Geological Survey station 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Texas (Texas Commission on Environmental Quality station 20805).

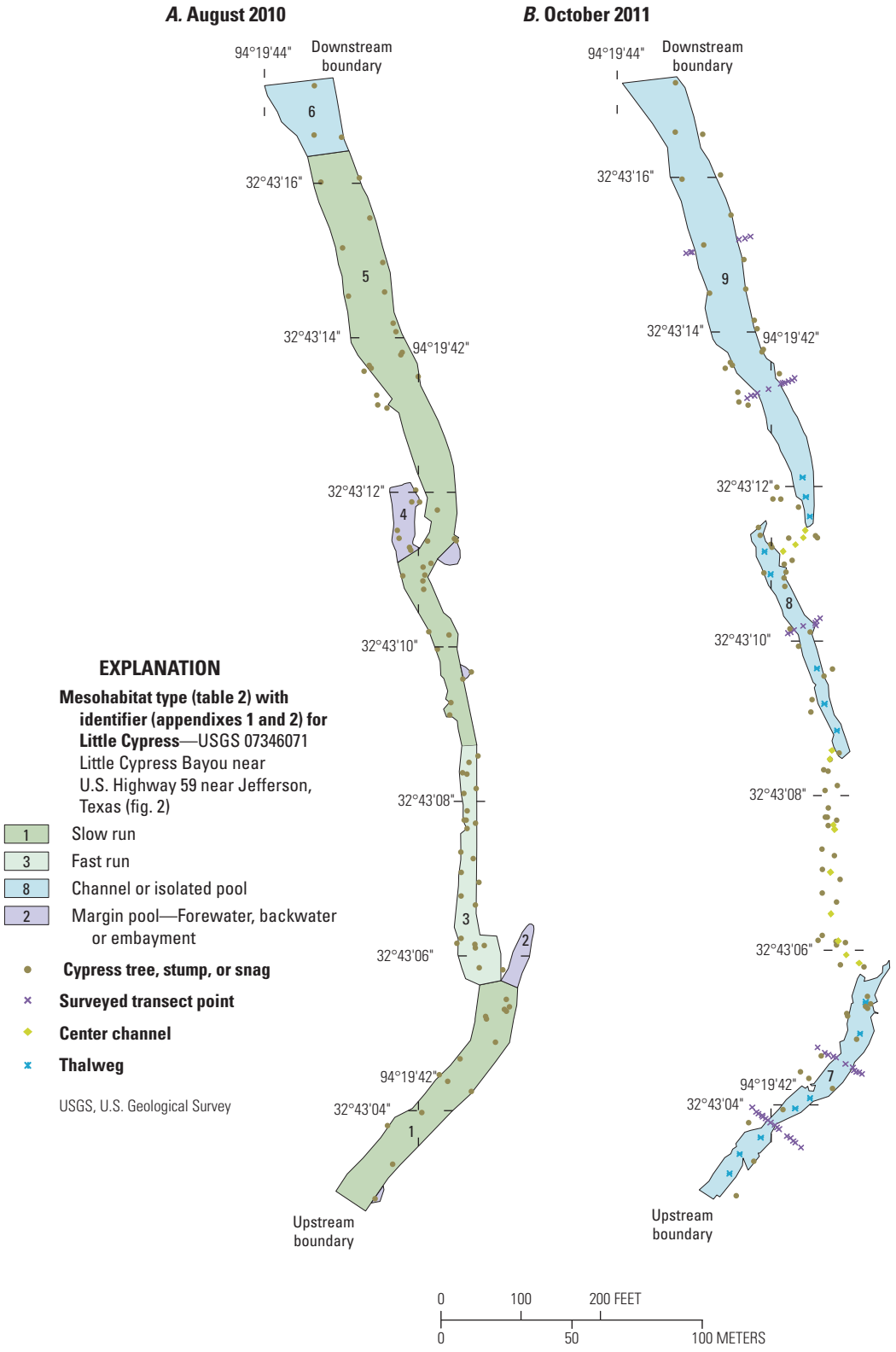

Figure 8. Mesohabitat extents and channel features surveyed *A*, August 2010, and *B*, October 2011, at U.S. Geological Survey station 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Texas (Texas Commission on Environmental Quality station 20804).

Physical measurements were made at one of three different locations (left, center, or right) along each transect. At the first transect within a mesohabitat, physical measurements were made at a randomly selected location; the measurement location for each subsequent transect was selected based on a progression from left to right. The following physical measurements were made at each location: width, depth, velocity, dominant substrate type and size, and percentage of embeddedness (appendix 1). The following measurements also were made at the center transect of each mesohabitat: bankfull width and height, left and right bank angle; left and right bank buffer width, left and right bank canopy closure, left and right bank densitometer readings, and channel bearing at the thalweg (appendix 1). Fish cover types and relative abundance (appendix 1) were estimated for approximately a 3-ft wide buffer along each transect.

Aquatic Biota Collection

Fish Surveys

Fish surveys were completed following TCEQ protocols (Texas Commission on Environmental Quality, 2007). The fish surveys were done in the reaches represented by the Big Cypress 02, Black Cypress, and Little Cypress sites in 2010, and at the Big Cypress 02 site in 2011 (the Black Cypress and Little Cypress sites were not surveyed for fish during 2011 because these streams were not flowing at that time). In addition, reaches at each site were subsampled for fish at the mesohabitat scale using methods described in the "Texas Instream Flow Studies—Technical Overview" (Texas Water Development Board, 2008). Fish were collected at Big Cypress 02, Black Cypress, and Little Cypress from late July through August 2010, and again at Big Cypress 02 in late July 2011. Fish sampling methods included boat, barge and backpack electrofishing, and trap netting using a seine. A minimum of 15 minutes (900 seconds) was spent electrofishing each reach. Mesohabitat boundaries (mapped prior to fish sampling) were marked, and each was electrofished in its entirety using a boat for deeper mesohabitats and a barge or backpack unit for shallower, wadeable mesohabitats. Each mesohabitat was electrofished twice, and the time (in seconds) was recorded, except at Big Cypress 02 in July 2011, when the time was inadvertently omitted from the field notes. The results from the two electrofishing surveys at each site were compiled for each mesohabitat. Block-netting between adjoining mesohabitats was used as needed to minimize fish movement between mesohabitats during sampling. A minimum of 10 seine hauls, distributed among mesohabitat types, were collected in the wadeable mesohabitats after completion of electrofishing. A 3.0 by 3.0-meter (m), 0.17-centimeter (cm) mesh, flat-panel seine was used. All electrofishing and seining activities were done during daylight hours.

All collected fish were transferred to aerated holding tanks, and the fish collected from each mesohabitat were held separately. Each fish was weighed to the nearest gram and measured to the nearest millimeter to determine its total length. Fish that could be identified in the field were returned to the stream. Fish that could not be identified in the field were preserved in 10 percent buffered formalin, labeled by mesohabitat, and returned to the USGS Texas Water Science Center for preliminary identification. Fish preserved onsite in 10 percent formalin were transferred to 70 percent ethanol as soon as possible (generally within 2 weeks) for long-term preservation.

Fish that were identified in the field on the day of sampling were identified to the lowest taxonomic level possible (generally species). The following information was recorded for each mesohabitat sampled: species, number of individuals by species, and mesohabitat type (appendix 3). A photograph was taken onsite of an individual fish representing each species identified in the field, and all photograph-vouchers are maintained by the USGS Texas Water Science Center in Austin. All retained fish specimens were preserved in 70 percent ethanol after decanting the 10 percent buffered formalin. All retained fish, represented by at least one sample for each species collected at each site, were deposited with the Curator of Ichthyology at the University of Texas Natural Science Center in Austin, Tex., for species (taxa) verification and permanent deposition (University of Texas, 2012). Voucher specimens for all fish species were retained in accordance with the protocols detailed in TCEQ's SWQM protocols (Texas Commission on Environmental Quality, 2007).

Mussel Surveys

Mussels were collected from the freshwater mussel communities at the Big Cypress 01, Big Cypress 02, and Black Cypress sites in summer 2010 (appendix 4). Mussels were not collected from the Little Cypress site. The survey of freshwater mussels planned for 2010 at Little Cypress was not completed because of scheduling conflicts and was rescheduled for July–September 2011. The freshwater mussel survey at the Little Cypress site (rescheduled for 2011) was not possible because of an extended period with little to no flow at this site during the targeted July–September 2011 sampling period.

Sampling involved a stratified approach using a 0.25 square meters (m^2) quadrat (Wisconsin Department of Natural Resources, 2005). Each study site was initially stratified into high- and low-density habitats based on preliminary mussel surveys. Stratification as high- or low-density habitats was based on the occurrence of distinct mussel beds (high density) or the lack of these beds (low density). Only high-density habitats were sampled at the three sites because the low-density habitats were too deep to sample using the equipment available and the preliminary surveys indicated mussels were more abundant in the shallower,

high-density habitats. One high-density habitat was sampled at each site. Each high-density habitat was sampled with an aligned systematic sampling design utilizing three random starts. A systematic sampling design with multiple random starting points provides good spatial coverage and allows for the calculation of population density and variance estimates (Strayer, 2008). Random starting points were selected at the downstream end of each high density area, and subsequent sampling locations were located at fixed distances in both the upstream and transverse channel directions. The distance between sampling quadrats was calculated using the following formula:

$$d = \sqrt{\frac{L * W}{n / k}}$$

where

d is the distance between sampling quadrats, in meters;
L is the strata length, in meters;
W is the mean strata width, in meters;
n is the number of quadrats sampled; and
k is the number of random starting points.

The targeted number of quadrats ("n" in the equation above) was 100 for each site, but the actual number of quadrats sampled at each site was less than 100; some quadrat locations could not be sampled because of in-channel debris such as snags or stumps. In these instances, the quadrat was not sampled, and the sampling crew moved to the next quadrat. The number of quadrats varied by site from 81 at Black Cypress, 77 at Big Cypress 02, and 64 at Big Cypress 01 (appendix 4). At each site, a 0.25 m^2 quadrat was placed on the streambed, and the streambed was searched for mussels by hand. The streambed was excavated to a depth of approximately 15 cm during the search. Mussels found alive were identified to the lowest taxonomic category possible (generally species) onsite, and total length along the long (anterior-posterior) axis of the valve was measured. Depth, velocity, and dominant substrate type were collected from the center of each quadrat after mussel sampling was completed in the same quadrat. Velocity was measured in each quadrat as close to the streambed as possible. Bed sediment bulk density was determined from the collection of a shallow core sample (2.5 to 10 cm deep) from the streambed directly below the center of the quadrat. A high-density butyrate tube (10.0 cm long and with a radius of 2.35 cm) was used to collect each core; the tube was pushed into the streambed by hand. The collection of sediment cores was distributed among the different streambed substrate types present at each site (appendix 4), and each core was collected in a quadrat where one or more live mussels were found. Therefore, there are bed sediment bulk density data for only a subset of mussel species from each site. Bed sediment bulk density was calculated by dividing the dry weight in grams of the sediment from each core by the volume in cubic centimeters of each core (appendix 4). Sediment dry weight was used because the wet weight of sediment would introduce bias depending on the degree of saturation of each sample. Sediment dry weight was determined for each core by oven-drying the sediment sample for 24 hours and weighing the sample to the nearest tenth of a gram.

Freshwater mussels were identified in the field to species by a qualified biologist. Freshwater mussels are highly endemic organisms that are long-lived with slow growth rates and complex reproduction methods (Strayer, 2008). As a consequence, freshwater mussel populations have a slow recovery following population reduction. Additionally, many species are rare or endangered (U.S. Fish and Wildlife Service, 2012), and therefore, each freshwater mussel species was vouchered by photographic documentation or by the collection of spent valves (valves from dead mussels) unless the species could not be identified in the field. Voucher photographs and labeled spent valves are maintained at the USGS Texas Water Science Center in Austin.

Selected Water-Quality Properties

Selected water-quality properties (dissolved oxygen, pH, specific conductance, and water temperature) were measured in isolated pools in Black Cypress Bayou and Little Cypress Bayou during October 2011 when these streams were not flowing by using a YSI 600XL multiparameter sonde (Xylem Inc., 2012). There were long periods of no flow during June–September 2011 in the Black Cypress and Little Cypress Bayous, and the targeted low flow conditions during June–September 2011 were unavailable in these streams. The isolated pools were crucial for sustaining aquatic biota during periods of no flow.

The sonde was calibrated in the field each day prior to the measurement of water-quality properties (appendix 2). Water-quality properties were measured in four isolated pools on Black Cypress Bayou and three isolated pools on Little Cypress Bayou. At each pool, measurements were made along a transect line: midchannel, equidistant between midchannel and the left edge of water, and equidistant between midchannel and the right edge of water (except at transect D-D' on Black Cypress Bayou, where data were only collected midchannel). Typically, water-quality measurements were made at three discrete depth intervals at each location along the stream (transect lines). When transact lines intersected pools that were less than 1 ft deep or less than 10 ft wide, the water-quality properties were measured at one or two discrete depth intervals. At transects where water-quality measurements were made at three different depth intervals, measurements were made at the midpoint of the water column, a few inches above the streambed, and a few inches below the water surface. At measurement locations where water-quality properties were measured at a single depth interval, the measurements were typically made at the midpoint of the water column.

Cross-sectional representations of dissolved oxygen concentrations along surveyed transect lines at the Black and Little Cypress sites were hand-contoured using linear interpolation between as many as nine measured values and extrapolation outside of these values. Cross-sectional representations of measured dissolved oxygen concentration were not prepared for transects *C–C′* and *D–D′* at the Black Cypress site because there were insufficient data points.

Quality Assurance

Quality-assurance procedures for aquatic biota data followed the guidelines detailed in TCEQ's SWQM protocols (Texas Commission on Environmental Quality, 2007). Field identifications were conducted by trained biologists familiar with the types of fish and freshwater mussel species found in the Big Cypress Basin in Texas with the aid of appropriate taxonomic keys. Unidentified fish species were provided to the Curator of Ichthyology at the University of Texas Natural Science Center in Austin, Tex., for species verification and permanent deposition (University of Texas, 2012). Unidentified mussel species were identified with the help of experts from Texas Parks and Wildlife. All collected voucher specimens (fish and mussel were labeled onsite and will be retained at the USGS laboratory in Austin or the University of Texas Natural Science Center in Austin for a minimum of 5 years. Dissolved oxygen, pH, specific conductance, and water temperature were measured in the stream by using a calibrated water-quality sonde; calibration was done at the site prior to measuring water-quality properties following procedures described in the "National Field Manual for the Collection of Water-Quality Data" (U.S. Geological Survey, variously dated).

Physical Characteristics and Aquatic Biota at the Reach and Mesohabitat Scale for Reaches on Big Cypress, Black Cypress, and Little Cypress Bayous During Summer 2010

Physical Characteristics

Of the three stream sites, Big Cypress 02 was the widest, with a mean mesohabitat width across all mesohabitat types of 46.3 ft and a median mesohabitat width of 59.1 ft on July 30, 2010. The mean and median widths were 62.2 and 62.3 ft, respectively when only main channel mesohabitats were considered (that is, the mesohabitats adjacent to [but not part of] the main channel [margin pools] were excluded). The second widest reach was measured at the Little Cypress site, which during August 18–19, 2010, had mean and median widths across all mesohabitat types of 43.7 ft and 42.7 ft, respectively; the mean and median widths were 49.9 ft and 49.2 ft, respectively, when only main-channel mesohabitats were considered (appendix 1). The reach at the Black Cypress site was the narrowest with a mean width across all mesohabitat types of 26.9 ft and a median width of 28.1 ft; mean and median widths were 29.1 ft and 28.5 ft, respectively when accounting for only main-channel mesohabitats.

In 2010, Big Cypress 02, on average, tended to be the deepest of the three sites followed by Little Cypress, and although the reach at Black Cypress, on average, was the shallowest reach, a pool in the reach at the Black Cypress site contained the deepest point (14.8 ft) measured from all three reaches. In July 2010, Big Cypress 02 had mean and median depths of 4.2 ft and 3.6 ft, respectively, across all mesohabitat types and mean and median depths of 5.5 ft and 4.8 ft, respectively, when accounting for only main-channel mesohabitats. The mean and median depths at the Little Cypress site were 3.9 ft and 3.2 ft, respectively, across all mesohabitat types and mean and median depths of 4.5 ft and 4.0 ft, respectively, when accounting for only main-channel mesohabitats. Black Cypress had mean and median depths of 3.1 ft and 2.3 ft, respectively, across all mesohabitat types and mean and median depths of 3.3 ft and 3.0 ft, respectively when accounting for only main-channel mesohabitats.

Mean and median velocities in 2010 were highest at the Black Cypress site (0.37 and 0.33 feet per second [ft/s], respectively, across all mesohabitat types and 0.42 and 0.35 ft/s, respectively, for main-channel mesohabitats, exclusively). Mean and median velocities were lowest at the Little Cypress site (0.13 and 0.09 ft/s, respectively, across all mesohabitat types and 0.15 and 0.10 ft/s, respectively, for main-channel mesohabitats, exclusively). Mean and median velocities at Big Cypress 02 (in 2010, 0.22 and 0.14 ft/s, respectively, across all mesohabitat types and 0.31 and 0.21 ft/s, respectively, for main-channel mesohabitats, exclusively) were between velocities observed at the Black Cypress and Little Cypress sites. Velocities exceeded 1 ft/s at only two locations within a single mesohabitat (the most upstream fast run in Black Cypress) out of all the mesohabitats where habitat data were collected in the three reaches.

Physical characteristics associated with the reaches at each site were compared on the basis of four distinct mesohabitat types: slow runs, fast runs, channel pools, and margin pools (fig. 9; table 2). Slow runs from the three reaches differ from one another on the basis of depths and widths, exhibiting relatively distinct groups among each of the three reaches. Fast runs in Little Cypress and Black Cypress seem similar on the basis of depths and widths, while fast runs in all three reaches seem similar on the basis of depths and velocities. There were insufficient data regarding the channel pool or margin pool mesohabitat types to draw any noteworthy conclusions.

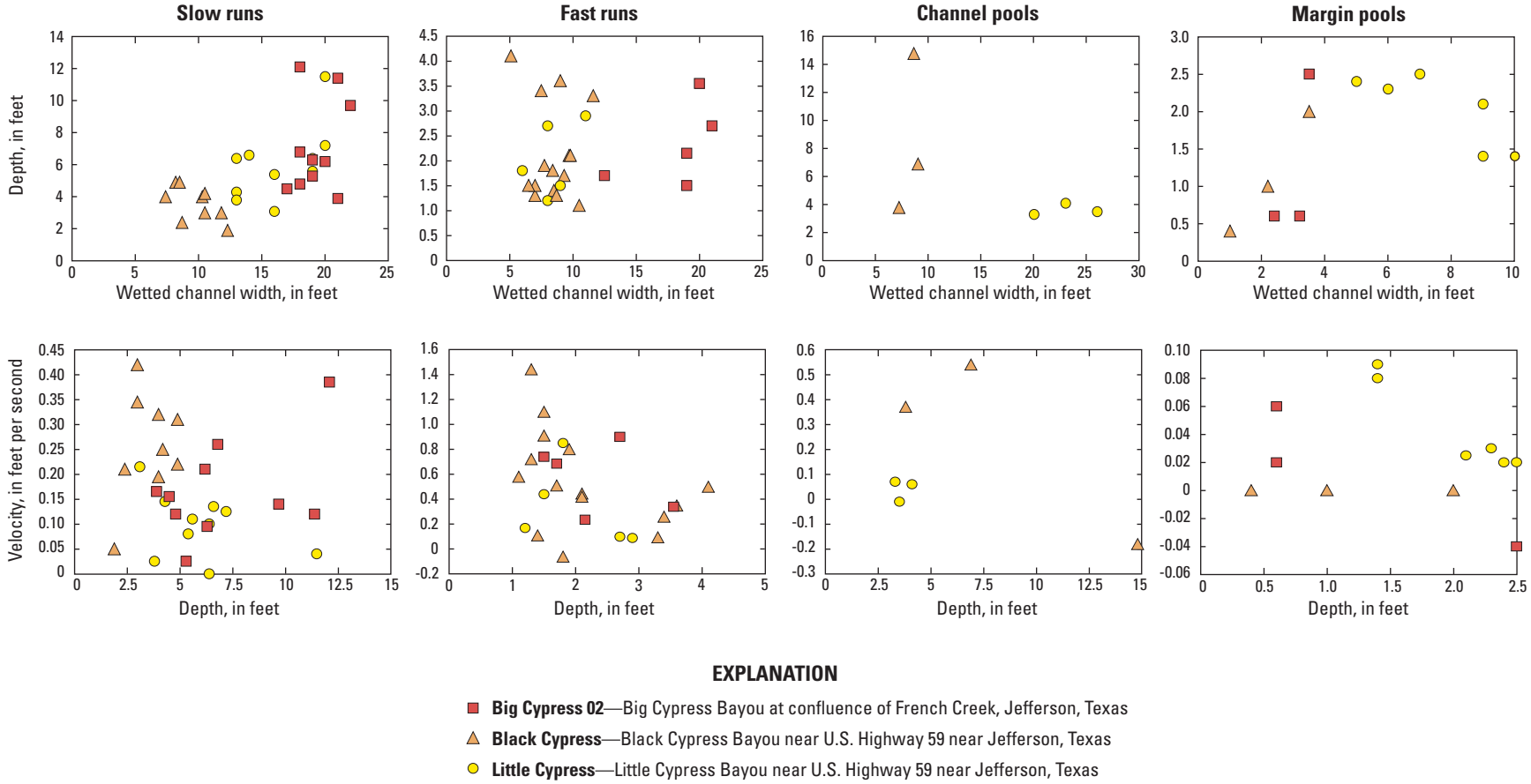

Figure 9. Physical parameters in different mesohabitats collected in 2010 from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.

Fish Surveys

More fish were collected from Big Cypress 02 in 2010 compared to the Black Cypress or Little Cypress sites (table 5; appendix 3). Five hundred and ninety-six fish were collected from the Big Cypress 02 site in 2010 compared to 273 fish at the Black Cypress site and 359 at the Little Cypress site. Although the number of fish collected from Big Cypress 02 was considerably larger than the number of fish collected from the other two sites, the total number of fish species collected among the three sites was similar (table 5). Thirty-four fish species were collected from Big Cypress 02 in 2010 compared to 26 species from Black Cypress and 33 species from Little Cypress. The larger number of fish collected from Big Cypress 02 was influenced by the large number of sunfish (Centrarchidae) species, especially longear sunfish (*Lepomis megalotis*) (appendix 3). Menhinick index of species richness (hereinafter referred to as Menhinick index), calculated as the number of fish species divided by the square root of the total number of fish collected from each site (table 5), is a biological metric that expresses species diversity (Menhinick, 1964). In general, the more species, and the fewer individuals per species, the greater is the diversity (Ludwig and Reynolds, 1988). Menhinick index values were larger for Black Cypress (1.57) and Little Cypress (1.74) than for Big Cypress 02 (1.39 in 2010 and 1.22 in 2011). The larger index values for Black Cypress and Little Cypress indicate more evenness in the number of species in relation to the number of individuals collected from these sites.

The alteration of natural flow regimes below dams can reduce the diversity of native fishes and can increase the occurrence of introduced species (Marchetti and Moyle, 2001; Propst and Gido, 2004). The common carp (*Cyprinus carpio*), western mosquitofish (*Gambusia affinis*), and redbreast sunfish (*Lepomis auritus*) were the only species (out of 48) collected that were introduced species (table 6; appendix 3). Common carp and redbreast sunfish only occurred in Big Cypress 02, downstream from the Ferrells Bridge Dam on Lake O' The Pines reservoir. Western mosquitofish were collected from both the Big Cypress site and the Black Cypress site. Longear sunfish (*Lepomis megalotis*) was the most abundant fish species collected from all three sites in summer 2010 (table 6). Species of the sunfish family Centrarchidae tended to be more common than other fish families at all sites. Blacktail shiners (*Cyprinella venustus*) were the second most abundant fish collected from Big Cypress 02 and fourth and ninth in rank relative abundance at Black Cypress and Little Cypress, respectively. The number of tied ranks based on relative abundance (six at Big Cypress 02 in 2010, six at Black Cypress, and eight at Little Cypress) were dominated by ranks based on the collection of only a few individuals of several species. Low rank relative abundance was common for rare species like bowfin (*Amia calva*), longnose gar (*Lepisosteus osseus*), spotted gar (*Lepisosteus oculatus*), bullhead minnow (*Pimphales vigilax*), flathead catfish (*Pylodictus olivaris*), and several species of darters (Percidae) at all three sites. The family Percidae includes darters and perches; although no perches were collected, the category of darters and perches was used in this report (table 6; appendix 3). Bowfin, gar, and flathead catfish are op-tier large piscivorous (fish eating) fish and are typically less abundant in lotic (stream) ecosystems compared to smaller species that feed on invertebrates or algae (Dodds, 2002).

Table 5. Selected fish metrics from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas (2010–11), 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (2010), and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (2010).

USGS station number	USGS station name	Short name	Date	Total number of individuals	Number of species	Total catch per unit of electrofishing effort[1]	Menhinick index[2]
07346015	Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.	Big Cypress 02	7/31/2010	596	34	5.08	1.39
07346015	Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.	Big Cypress 02	7/27/2011	525	28	Not calculated[3]	1.22
07346044	Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Black Cypress	8/3–4/2010	273	26	2.73	1.57
07346071	Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.	Little Cypress	8/19/2010	359	33	3.01	1.74

[1]Catch per unit of electrofishing effort is determined by dividing the total number of individuals collected by the total time (in seconds) electrofished multiplied by 30 to report the catch per 30 seconds of effort.

[2]Menhinick index is calculated as the number of species divided by the square root of the total number of individuals of that species that were collected.

[3]Total catch per unit effort could not be calculated because the total time electrofished was not recorded.

Table 6. Presence or absence of fish species and rank abundance based on the relative abundance of each species collected from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas (2010–11), 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (2010), and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (2010).

[--, no individual organisms were collected, so rank abundance is not applicable]

Family	Family common name	Species	Species common name	Status	Rank abundance			
					Big Cypress 02[1] (2010)	Big Cypress 02[1] (2011)	Black Cypress[2] (2010)	Little Cypress[3] (2010)
Lepisosteidae	Gars	*Lepisosteus oculatus*	Spotted gar	Native	10	15	--	11
		Lepisosteus osseus	Longnose gar	Native	--	15	--	--
Amiidae	Bowfin	*Amia calva*	Bowfin	Native	14	15	--	14
Clupeidae	Herrings	*Dorosoma cepedianum*	Gizzard shad	Native	--	--	--	7
		Dorosoma petenense	Threadfin shad	Native	13	14	--	--
Cyprinidae	Minnows	*Cyprinella lutrensis*	Red shiner	Native	13	--	11	7
		Cyprinella venustus	Blacktail shiner	Native	2	3	4	9
		Cyprinus carpio	Common carp	Introduced	15	--	--	--
		Hybopsis amnis	Pallid shiner	Native	--	--	--	14
		Lythrurus fumeus	Ribbon shiner	Native	12	--	3	8
		Notropis atherinoides	Emerald shiner	Native	--	--	--	8
		Notropis chalybaeus	Ironcolor shiner	Native	--	--	--	9
		Notropis maculatus	Taillight shiner	Native	13	--	--	--
		Notropis shumardi	Silverband shiner	Native	--	--	11	--
		Notropis texanus	Weed shiner	Native	--	--	--	11
		Pimphales vigilax	Bullhead minnow	Native	14	5	--	14
Atherinopsidae	Silversides	*Labidesthes sicculus*	Brooke silverside	Native	12	10	5	10
Fundulidae	Topminnows and Killifishes	*Fundulus notatus*	Blackstripe topminnow	Native	7	4	4	3
Catostomidae	Suckers	*Minytrema melanops*	Spotted sucker	Native	14	13	9	6
Ictaluridae	Catfishes	*Ameiurus natalis*	Yellow bullhead	Native	--	15	--	--
		Ictalurus punctatus	Channel catfish	Native	9	12	--	12
		Noturus gyrinus	Tadpole madtom	Native	--	--	11	--
		Noturus nocturnus	Freckled madtom	Native	16	--	11	--
		Pylodictis olivaris	Flathead catfish	Native	14	13	--	12
Esocidae	Pickerels	*Esox americanus*	Redfin pickerel	Native	--	--	10	13
Aphredoderidae	Pirate perch	*Aphredoderus sayanus*	Pirate perch	Native	11	9	8	12
Poecilidae	Mosquitofishes	*Gambusia affinis*	Western mosquitofish	Introduced	14	1	11	--

Table 6. Presence or absence of fish species and rank abundance based on the relative abundance of each species collected from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas (2010–11), 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (2010), and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (2010).—Continued

[--, no individual organisms were collected, so rank abundance is not applicable]

Family	Family common name	Species	Species common name	Status	Rank abundance			
					Big Cypress 02[1] (2010)	Big Cypress 02[1] (2011)	Black Cypress[2] (2010)	Little Cypress[3] (2010)
Percidae	Darters and Perches	*Percina macrolepida*	Bigscale logperch	Native	15	--	10	--
		Percina sciera	Dusky darter	Native	14	15	11	14
		Etheostoma asprigene	*Mud darter*	Native	16	14	--	14
		Etheostoma chlorosoma	*Bluntnose darter*	Native	--	15	11	--
		Etheostoma gracile	*Slough darter*	Native	--	--	--	14
		Etheostoma histrio	*Harlequin darter*	Native	15	--	11	13
		Percina maculata	*Blackside darter*	Native	--	--	--	14
		Etheostoma proeliare	*Cypress darter*	Native	16	15	11	14
Centrarchidae	Sunfishes	Lepomis macrochirus	*Bluegill*	Native	3	6	2	2
		Lepomis cyanellus	*Green sunfish*	Native	--	--	9	--
		Micropterus salmoides	*Largemouth bass*	Native	8	10	6	5
		Lepomis megalotis	*Longear sunfish*	Native	1	2	1	1
		Lepomis auritus	*Redbreast sunfish*	Introduced	16	--	--	--
		Lepomis marginatus	*Dollar sunfish*	Native	15	11	10	--
		Lepomis microlophus	*Redear sunfish*	Native	5	8	7	4
		Lepomis miniatus	*Redspotted sunfish*	Native	4	7	7	13
		Lepomis symmetricus	*Bantam sunfish*	Native	16	--	--	--
		Micropterus punctulatus	*Spotted bass*	Native	16	13	11	9
		Lepomis gulosus	*Warmouth*	Native	6	14	8	6
		Pomoxis annularis	*White crappie*	Native	8	14	--	11
Scianidae	Drums	Aplodinotus grunniens	*Freshwater drum*	Native	14	14	--	14

[1]Big Cypress Bayou at confluence of French Creek, Jefferson, Tex.

[2]Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.

[3]Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.

Fish data from the various mesohabitat types were combined into four mesohabitat categories for analysis: slow run, fast run, channel pool, and margin pool. Comparisons among sites and mesohabitat types were made by using the total number of species collected or catch per unit effort (CPUE) expressed as the number of fish collected in 30 seconds of electrofishing. The CPUE was calculated by dividing the number of fish collected in a mesohabitat by the number of seconds electrofished in the same mesohabitat; the resulting quotient is then multiplied by 30 seconds. Thirty seconds were used because it was the shortest duration of electrofishing in any of the mesohabitats among all sites. Comparing mesohabitat fish data expressed in CPUE standardized the number and species collected in each mesohabitat regardless of differences in area sampled between mesohabitats. The use of CPUE to standardize fish data allows for direct comparisons between stream reaches or in-channel habitats of different size, and CPUE is a common practice among aquatic biologists (Nielsen and Johnson, 1983).

Fish species richness (number of distinct species) was compared among the three sites by using data obtained in 2010 when the streams at all sites were flowing. Fish species richness for slow runs ranged from 13 to 26 distinct species. Fish species richness in fast runs was less variable and ranged from 19 to 24 distinct species (appendix 3). The number of fish species was larger in margin pools at Little Cypress compared to this mesohabitat at the other two sites, and channel pools had the smallest number of fish species out of all mesohabitat types (fig. 10). Fast runs were dominated by longear sunfish, blacktail shiners, and several other species of sunfish and cyprinids at Big Cypress 02 and by longear sunfish, bluegill, and blackstripe topminnows at Black Cypress (appendix 3). Fast runs also were dominated by longear sunfish and blackstripe topminnows at Little Cypress.

Fish metrics that are commonly included in the calculation of an index of biotic integrity (IBI) for fish include the number of darter species, the number of native cyprinid species, and the number of individuals or species of invertivores, predators, and omnivores (Linam and others, 2002). These five metrics commonly used in the calculation of an IBI will be discussed in this report to provide a detailed description of the structure and function of the fish community at each site, but not the IBI index values themselves.

The fish family Percidae includes darters and perches. Only darters, including the darter Bigscale logperch, and no true perches were collected during this study. Although the CPUE for darters and perches in fast runs was larger at Big Cypress 02 (fig. 11), the number of darter species (6) was larger in runs in general (slow and fast runs combined) at Little Cypress compared to the number of darter species (5) in runs in Big Cypress 02. An increase in the number of fish but a reduction in the number of native fish species, including darters, is common downstream from reservoirs (Neves and Angermeier, 2006).

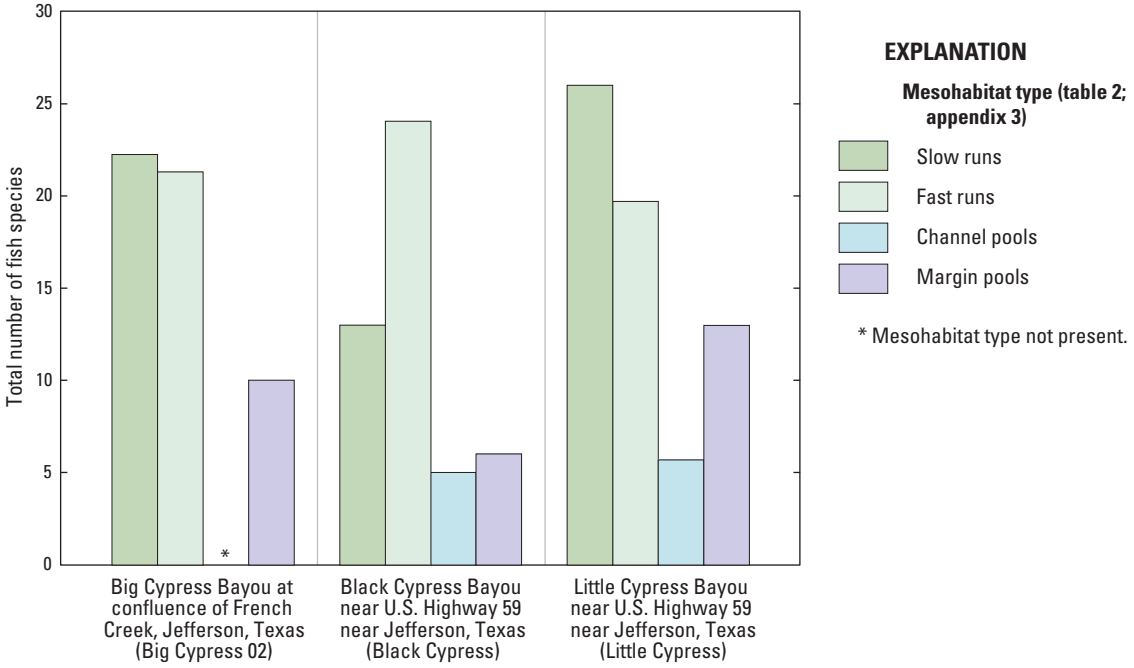

Figure 10. Number of fish species collected by mesohabitat type from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

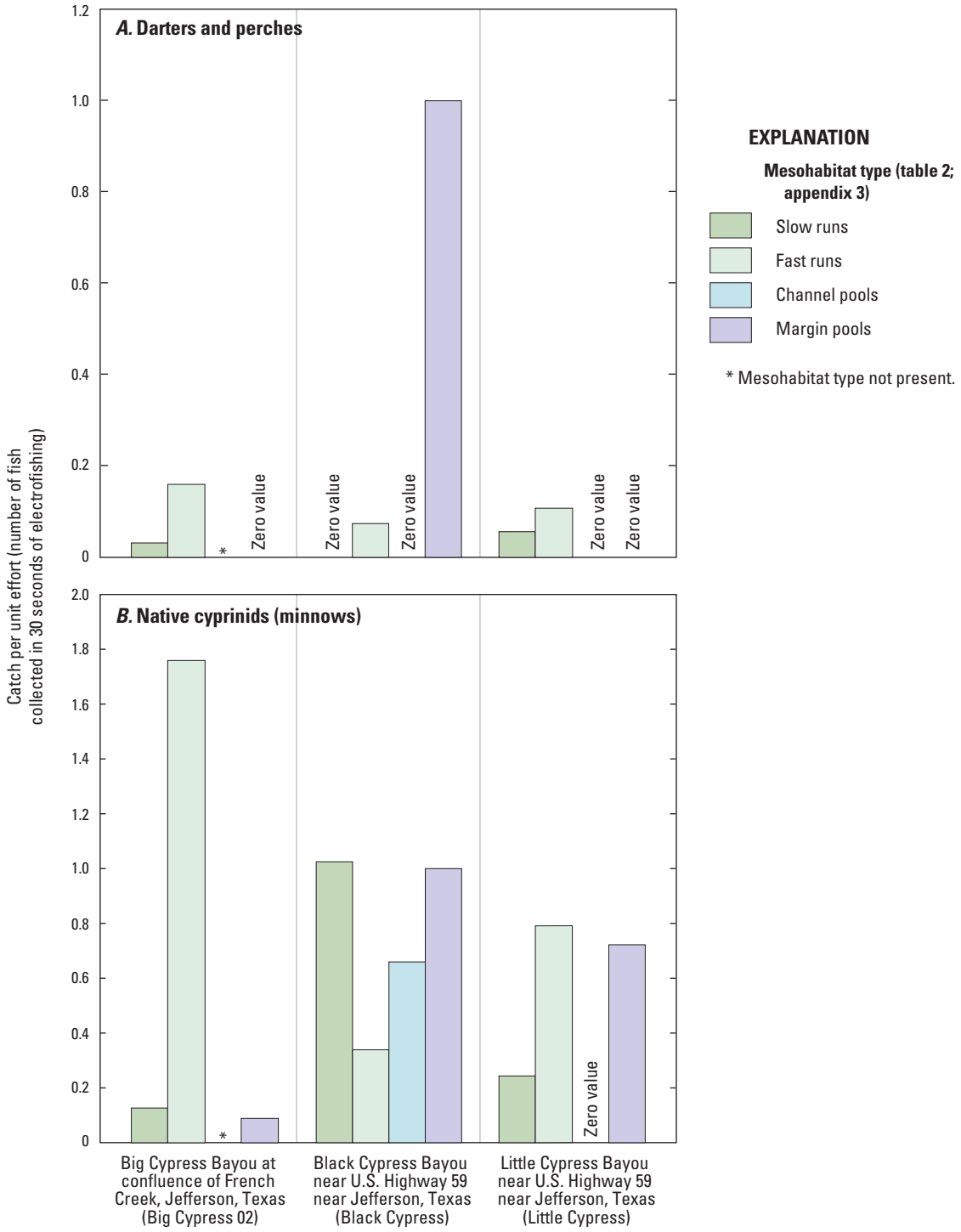

Figure 11. Catch per unit effort for *A*, darters and *B*, cyprinids collected by mesohabitat type from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

Cyprinids, as a group, are responsive to habitat degradation (Hughes and Gammon, 1987), and because native cyprinid species are so widespread in Texas, the number of native cyprinid species is a common metric used to evaluate fish communities (Linam and others, 2002). The CPUE for native cyprinids in fast runs at Big Cypress 02 in 2010 (1.76; appendix 3) was larger than the CPUE of native cyprinids in all other mesohabitat types at all sites. The larger CPUE in fast runs at Big Cypress 02 was influenced by the large number of one native cyprinid in particular, the blacktail shiner. The CPUE values for native cyprinids were more equally distributed among mesohabitat types in Black Cypress and Little Cypress (fig. 11). Four native cyprinids— pallid shiner, emerald shiner, ironcolor shiner, and weed shiner— were only collected in mesohabitats in Little Cypress (table 6; appendix 3).

Fish trophic metrics represented by the number of individuals or number of species of invertivorous, predaceous, and omnivorous fishes have been used as indicators of shifts in fish assemblage structure as influenced by degradation of river habitat, changes in water quality, and the presence of invasive fish species (Junwirth and others, 2000). In this study, fish classified as predators consume fish in addition to invertebrates and other animals.

The CPUE for invertivores was largest in fast runs in Big Cypress 02 (5.56).The number of invertivores was also influenced by the number of native cyprinids because the majority of the native cyprinids are invertivorous fish (appendix 3). The only native cyprinids collected from all three sites were red shiners, blacktail shiners, and ribbon shiners. In slow runs, the CPUE (0.91) for predators at Big Cypress 02 was more than four times larger than the CPUE (0.20) for predators at Black Cypress, and almost twice as large as the CPUE (0.49) for predators at Little Cypress (fig. 12; appendix 3). As with native cyprinids and invertivores, predatory fish were fewer in number but more evenly distributed among mesohabitats at Black Cypress and Little Cypress (fig. 12; appendix 3).

The larger CPUE for predators in slow runs at Big Cypress 02 was influenced by the collection of more individuals of species like largemouth bass and warmouth that were found at all three sites (appendix 3). The relatively small CPUE values for omnivores in slow runs were similar between Big Cypress 02 (0.31) and Little Cypress (0.32), and about three times smaller (0.10) in slow runs in Black Cypress (fig. 12).

Changes in the natural flow regime of a river can alter the composition of fish reproductive guilds by altering flow and temperature related spawning cues and river habitat (Penczak and others, 1998; Perkin and others, 2010). A recent comparison of the change in the relative abundance of nest spawners compared to broadcast spawners in Big Cypress Bayou between the 1950s and 2006 indicates that the relative abundance of nest spawners has increased by about 50 percent while the relative abundance of broadcast spawners has decreased by about 20 percent (Caddo Lake Institute, 2010). Nest spawners are fish that deposit eggs in a nest structure constructed and often guarded by one or both sexes of the species. Broadcast spawners release eggs into the water, and males and females of these species do not protect or nurture the eggs or develop juvenile fish in any way (Thomas and others, 2007). In this study, to compare reproductive guilds among sites and mesohabitat types, nest and substrate spawners were combined to form one reproductive guild because both types of spawners deposit eggs directly on some type of substrate. In contrast to nest spawners, substrate spawners simply deposit the eggs on a substrate without constructing a nest. Broadcast spawners formed the other reproductive guild (appendix 3), and live bearers were not evaluated as a category because only one live-bearing species, the non-native western mosquitofish, was collected. The CPUE of nest and substrate spawners was largest in slow and fast runs at Big Cypress 02 relative to the same mesohabitats at Black Cypress and Little Cypress (fig. 13). The larger CPUE values at Big Cypress 02 for nest and substrate spawners of 4.96 and 5.72 in slow and fast runs, respectively, reflect the large number of longear sunfish collected in these mesohabitats compared to the number of longear sunfish collected in the same types of mesohabitats at the other sites (appendix 3). In contrast, the combined broadcast spawner CPUE for all meoshabitats at Black Cypress and Little Cypress was 6.1 (Black Cypress) to 3.0 times (Little Cypress) the total CPUE for this reproductive guild at Big Cypress 02 (fig. 13). Two broadcast spawners, the ribbon shiner and the emerald shiner, were more abundant in the mesohabitats in Black Cypress and Little Cypress; only six ribbon shiners were collected in one slow run at Big Cypress 02 (appendix 3).

Mussel Surveys in Big Cypress Bayou and Black Cypress Bayou

A quantitative survey of freshwater mussels was completed in the summer of 2010 at Big Cypress 01, Big Cypress 02, and at Black Cypress. Mussel surveys were done to provide baseline data on the occurrence, abundance, and relative density of native mussel species in support of an evaluation of candidate biological environmental flow indicators for the purpose of long-term monitoring.

A total of 182 individual freshwater mussels were collected, and 15 species of mussels were identified (table 7). Of the mussels collected, 69.8 percent (127 individuals) were collected from Big Cypress 02, 23.6 percent (43 individuals) were collected from Big Cypress 01, and 6.6 percent (12 individuals) were collected from Black Cypress. Washboards (*Megalonaias nervosa*) were the most abundant species overall, with the majority of individuals of this species found at Big Cypress 02. Bleufers (*Potamilus purpuratus*), western pimplebacks (*Quadrula mortoni*), and pistolgrips (*Tritogonia verrucosa*) were the only species that occurred at all three sites. Big Cypress 02 was the most species rich with 13 species of mussels, followed by Big Cypress 01 with 8 species, and Black Cypress with 6 species.

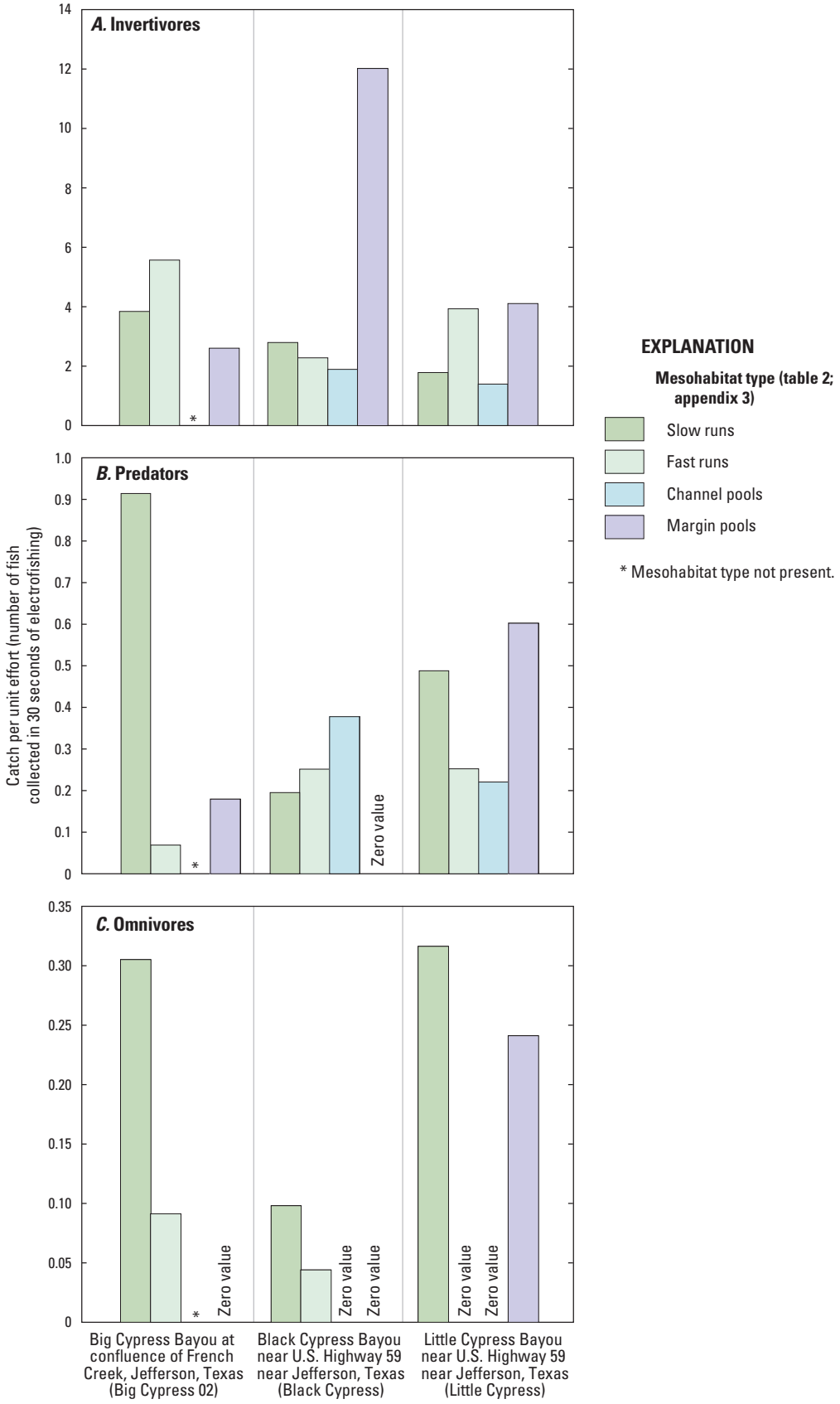

Figure 12. Catch per unit effort for *A*, invertivores, *B*, predators, and *C*, omnivores collected by mesohabitat type from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

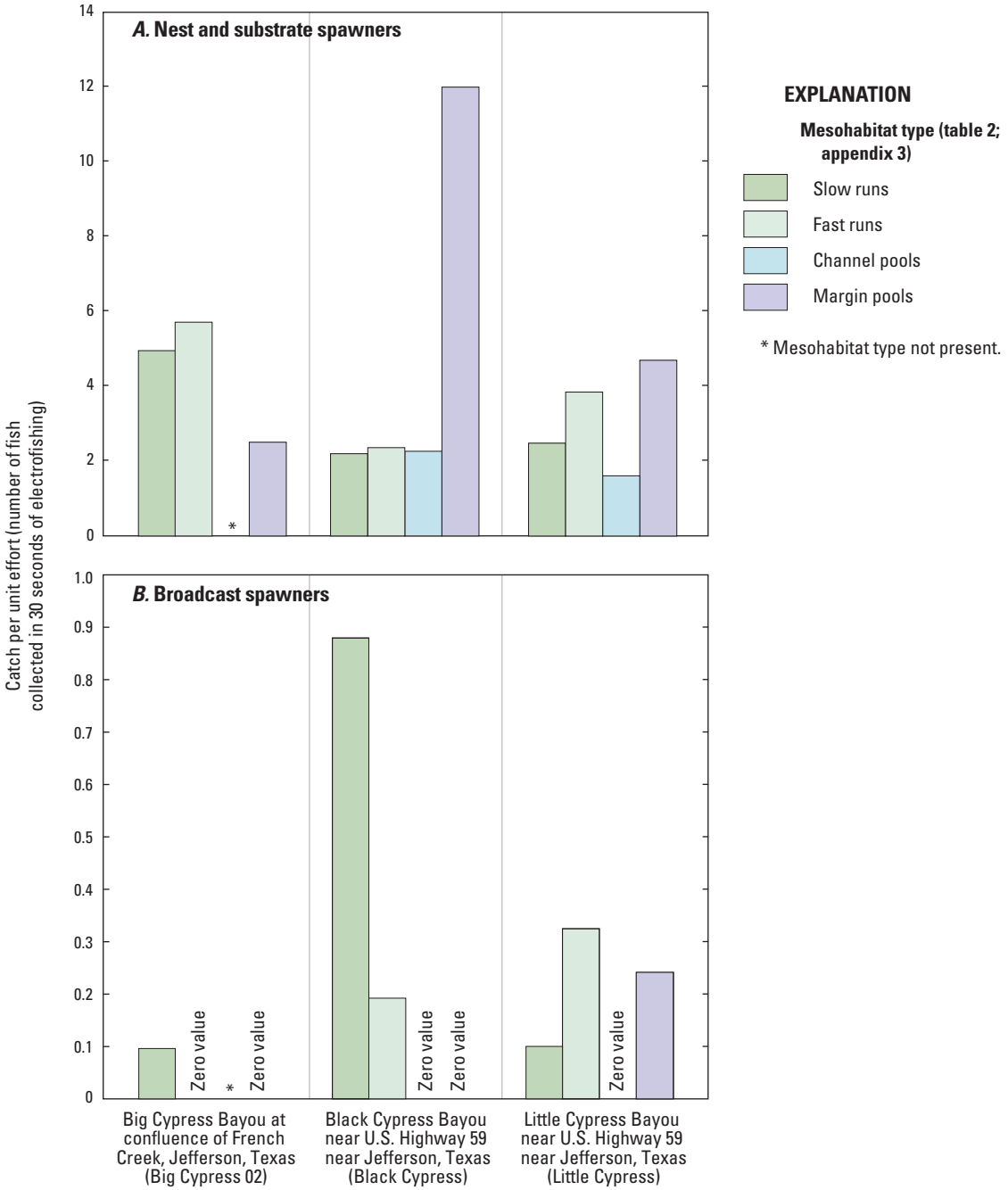

Figure 13. Catch per unit effort for *A*, nest and substrate spawners and *B*, broadcast spawners collected by mesohabitat type from U.S. Geological Survey stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

Table 7. Total abundance and relative density of mussel species collected from U.S. Geological Survey stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010

[relative density, number of quadrats with one or more individuals of a species collected relative to the total number of quadrats sampled; --, no data]

Species	Species common name	Status	Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Big Cypress 01)			Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02)			Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Black Cypress)		
			Number of individuals	Number of quadrats with one or more individuals	Relative density	Number of individuals	Number of quadrats with one or more individuals	Relative density	Number of individuals	Number of quadrats with one or more individuals	Relative density
Amblema plicata	Threeridge	Native	--	--	--	3	3	3.9	--	--	--
Lampsilis hydiana	Louisiana fatmucket	Native	--	--	--	2	2	2.6	--	--	--
Lampsilis teres	Yellow sandshell	Native	1	1	1.6	6	6	7.8	--	--	--
Leptodea fragilis	Fragile papershell	Native	--	--	--	4	4	5.2	--	--	--
Megalonaias nervosa	Washboard	Native	--	--	--	72	32	41.6	2	2	2.5
Obliquaria reflexa	Threehorn wartyback	Native	1	1	1.6	--	--	--	--	--	--
Plectomerus dombevanus	Bankclimber	Native	2	2	3.1	15	14	18.2	--	--	--
Potamilus purpuratus	Bleufer	Native	1	1	1.6	8	8	10.4	1	1	1.2
Quadrula apiculata	Southern mapleleaf	Native	2	2	3.1	--	--	--	--	--	--
Quadrula mortoni	Western pimpleback	Native	8	8	12.5	2	2	2.6	1	1	1.2
Quadrula pustulosa	Pimpleback	Native	--	--	--	6	5	6.5	2	2	2.5
Toxolasma texasienses	Texas lilliput[1]	Native	--	--	--	--	--	--	2	2	2.5
Tritogonia verrucosa	Pistolgrip	Native	11	8	12.5	5	5	6.5	3	3	3.7
Truncilla truncata	Deertoe	Native	16	11	17.2	1	1	1.3	--	--	--
Utterbackia imbecillis	Paper pondshell	Native	--	--	--	1	1	1.3	--	--	--
		Total	[2]43			[4]127			[2]12		
		Number of species	[3]8			[5]13			6		
		Total number of quadrats sampled	64			77			81		

[1]Preliminary identification.

[2]Total includes one unidentified mussel species.

[3]Total does not include unidentified mussel species.

[4]Total includes a pigtoe of unidentified species and a mussel that could not be differentiated between a yellow sandshell and a fragile papershell.

[5]Total includes a pigtoe of unidentified species.

Relative density was calculated by dividing the number of quadrats where one or more individuals of a species were collected by the total number of quadrats sampled and multiplying by 100 (table 7). Relative density was used as an indirect measure of how evenly distributed or clustered a mussel species is at a site, with the larger relative densities indicating a less clustered distribution for species because the more quadrats occupied by a species, the more broadly distributed the species is over the area sampled. Freshwater mussels typically occur in what are discrete isolated patches or subpopulations that are referred to as metapopulations in rivers and streams (Strayer, 2008), and these discrete subpopulations are patchy even at the reach scale because of variable meso- and microhabitat conditions related to depths, velocities, bed materials, and other factors that influence mussel occurrence and distribution at this spatial scale. At Big Cypress 01, relative density was largest overall for deertoes (17.2), pistolgrips (12.5), and western pimplebacks (12.5); all of which were larger than the values observed for these species at Big Cypress 02. At Big Cypress 02, relative density was largest overall for washboards (41.6), then bankclimbers (18.2), and bleufers (10.4). All relative densities for mussels at Black Cypress were comparatively low (less than 4.0) (table 7).

Because they are relatively immobile, freshwater mussels are sensitive to changes in microhabitat conditions related to boundary (near bed) current velocities, water depth, and the composition and physical characteristics of bed materials (Strayer, 2008). Developing adult freshwater mussels that inhabit rivers and streams typically are found in finer bed materials such as small gravels, sand, and fine sediments such as silts and clays. The effects of reservoirs and controlled releases from their dams on the downstream mussel community have been well documented (Benke, 1990; Yeager 1993; Vaughn and Taylor, 1999) and include altered flow and temperature regimes, differences in sediment deposition, and changes in the transport of particulate organic matter, which is the food base for mussels (Vaughn and Taylor, 1999). In this study, velocity and water depth were collected in all quadrats, and a shallow sediment core of the streambed was collected in a subset of quadrats where at least one mussel was collected that represented the different shallow bed materials present at the site (appendix 4). Only the water depths, velocities, and bed sediment bulk densities obtained from quadrats where mussels were actually collected were used to compute summary statistics for the different sampling sites (figs. 14–17; appendix 4).

Mussels occurred at water depths ranging from 0.6 ft at Big Cypress 01 to 5.6 ft at Black Cypress (fig. 14; appendix 4). Mean depth for those species that occurred at all sites generally was shallowest at Big Cypress 01, and deepest at Black Cypress, with intermediate depths found at Big Cypress 02. Velocities from quadrats where mussels were collected ranged from -0.04 ft/s for a quadrat in Big Cypress 02 to 1.58 ft/s in Big Cypress 01 (a small negative velocity such as -0.04 ft/s is likely caused by wind blowing upstream over stagnant water). Mean velocities in quadrats where mussels were collected were highest in Big Cypress 01 (0.93 ft/s), intermediate in Big Cypress 02 (0.41 ft/s), and lowest in Black Cypress (0.23 ft/s) (fig. 15; appendix 4). The mean velocities measured during the collection of mussels were different from mean velocities measured during the assessment of physical habitat properties (combined for all mesohabitats), which were higher in Black Cypress relative to Big Cypress 02 (appendix 1). Velocities from mussel quadrats were collected from as near to the streambed as possible. This method of measuring velocity was different from the method used for measuring velocities in the mesohabitats, where velocity was measured in accordance with standard USGS procedures (Rantz and others, 1982) at either 60 percent of the water depth or 20 percent and 80 percent of the water depth to compute an average velocity through the water column. Bankclimbers and washboards occurred over a larger range of velocities but at a lower mean velocity in Big Cypress 02 than several of the smaller species, including deertoes and pimblebacks. At Big Cypress 02, several of the more abundant mussel species, such as washboards and bankclimbers, were collected adjacent to or just downstream from woody snags or stumps, which might account for the lower velocities associated with these species. Mussels may adapt to higher seasonal low flows below reservoirs compared to lower seasonal (for example, summer) flows in nonregulated streams by associating with snags and stumps where velocities may be moderated and the streambed may be more stable (Hardison and Layzer, 2001).

Bed sediment bulk density is an indirect measure of the compactness of bed materials, which is influenced by grain-size distribution, the suspended load of sediment, flow conditions, and the hydraulic gradient of seepage flow in the hyporheic zone (Schalchli, 1992) among others factors. Bed compactness can influence mussel occurrence and distribution because mussel species vary in their ability to inhabit beds of varying composition and compactness (Strayer, 2008), and because most species spent part or all of their life cycle partially embedded in the streambed for stability. Higher mean velocities and homogenization of bed materials in rivers and streams below reservoirs can create more compacted beds, which limit mussel occurrence and distribution. Mean bed sediment bulk density was highest at Big Cypress 01, slightly lower at Big Cypress 02, and lowest at Black Cypress (fig. 16). Bed sediment bulk density preference was similar among species between Big Cypress 01 and Big Cypress 02 (fig. 17). No pattern in bulk density preference by species was evident, but this could be an artifact of the small sample size for each species.

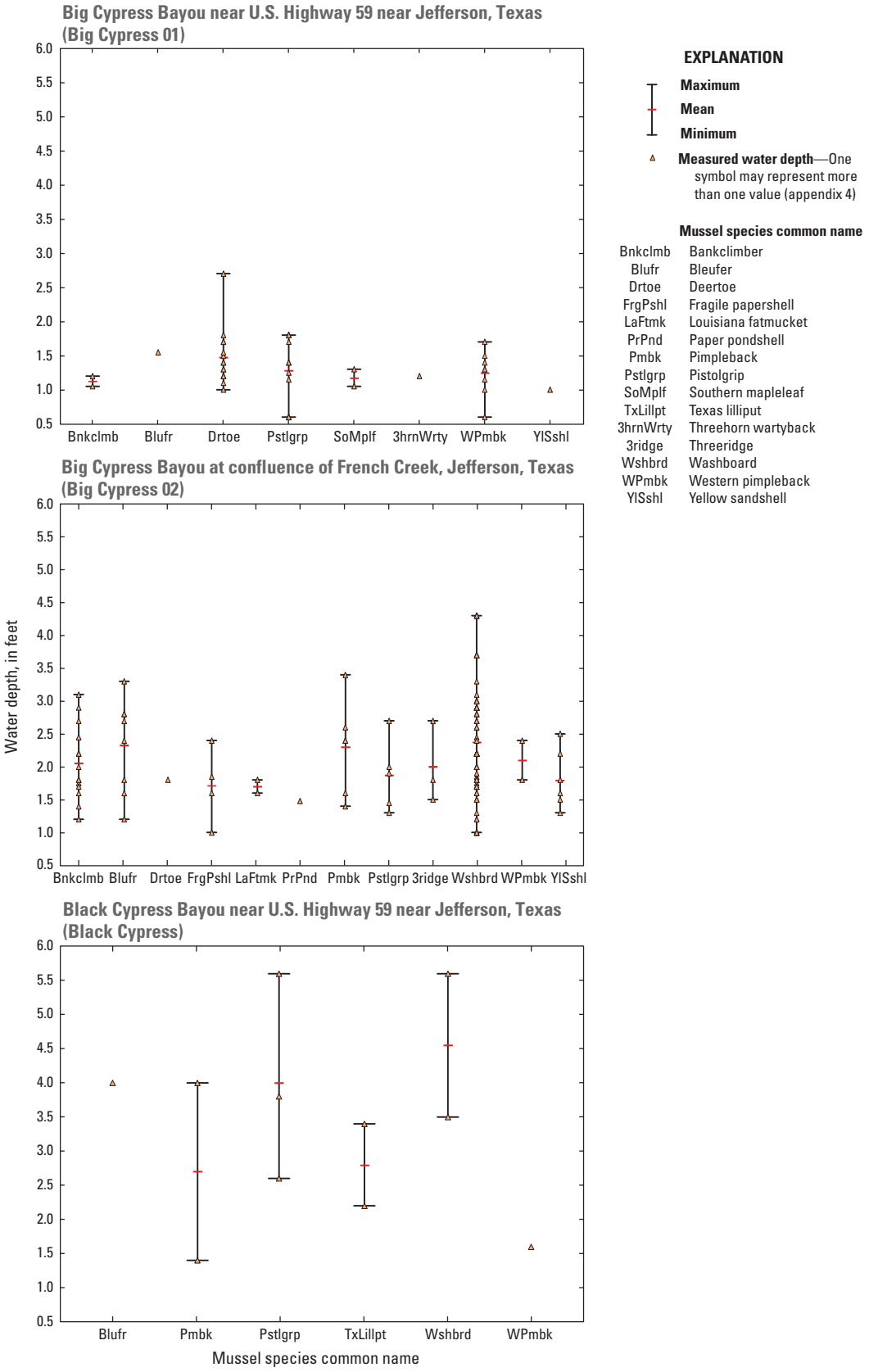

Figure 14. Water depths associated with different mussel species collected from U.S. Geological Survey stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

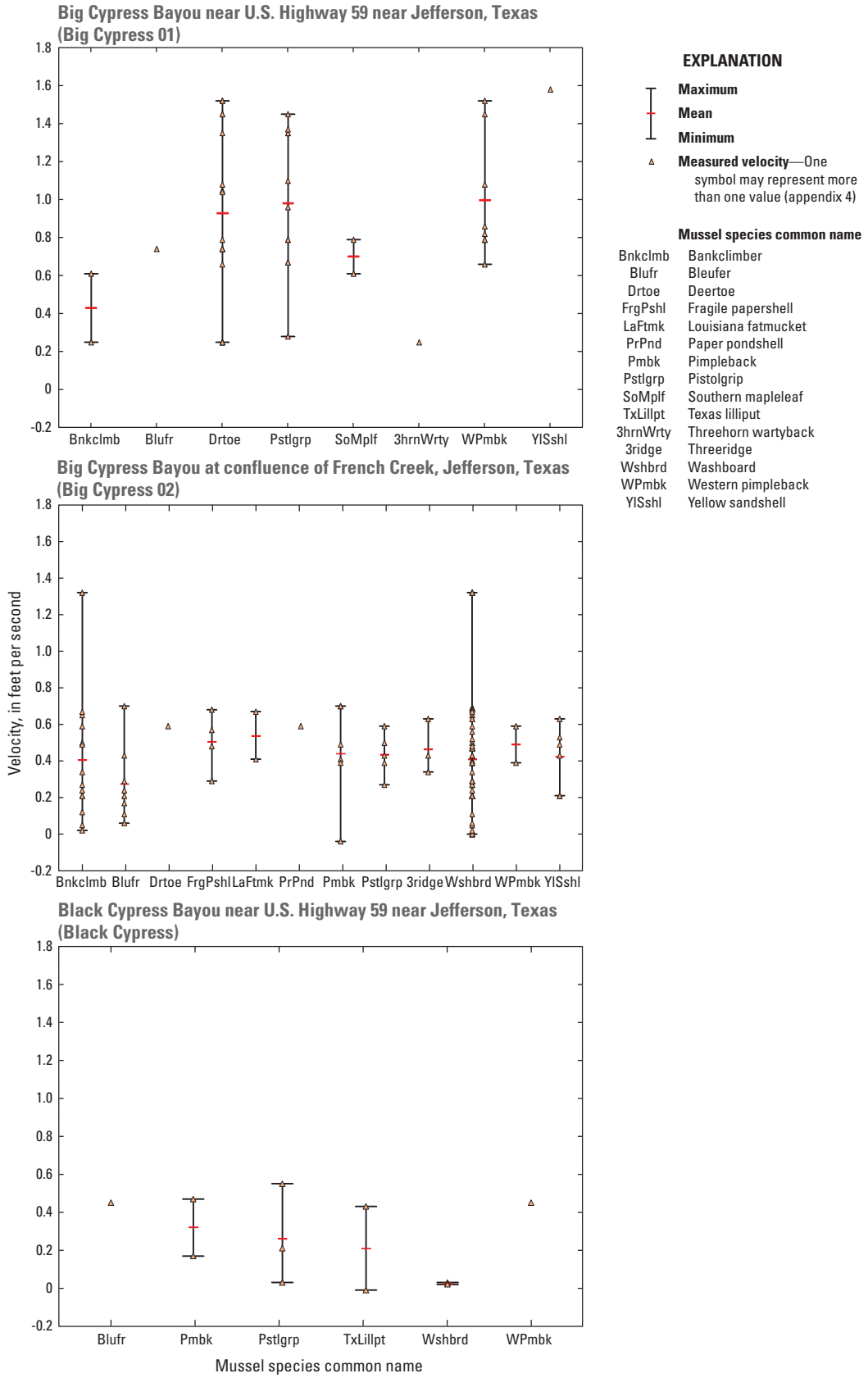

Figure 15. Velocities associated with different mussel species collected from U.S. Geological Survey stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

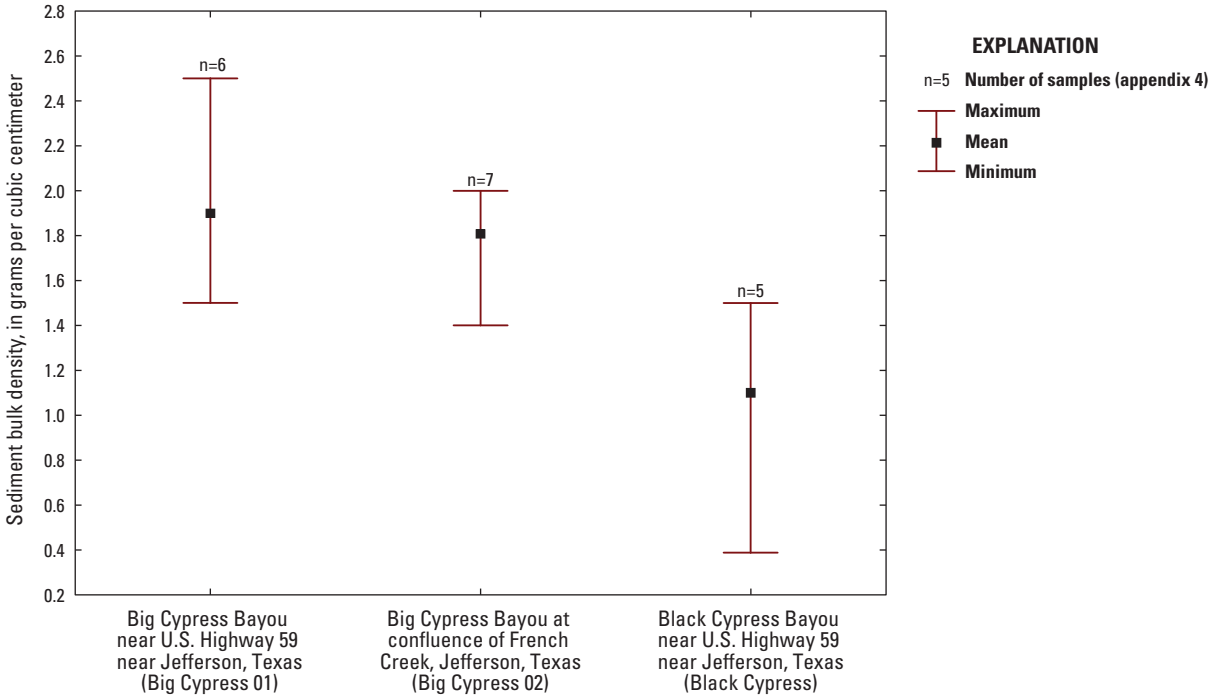

Figure 16. Bed sediment bulk densities at locations where mussels were collected from U.S. Geological Survey stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

Physical Characteristics and Aquatic Biota at the Reach and Mesohabitat Scale for Big Cypress Bayou During Summer 2010 and Summer 2011

Physical Characteristics

During July 30, 2010, the daily mean discharge at the USGS streamflow-gaging station (07346000 Big Cypress Bayou near Jefferson, Tex.) nearest to Big Cypress 02 was 62 ft^3/s (table 4), and the mean width across all mesohabitat types Big Cypress 02 was of 46.3 ft, and the median width was 59.1 ft. The mean and median widths on July 30, 2010, were 62.2 and 62.3 ft, respectively, when mesohabitats adjacent to the main channel and isolated from flowing water during low flow (margin pools) were excluded. During July 26–27, 2011, the daily mean discharge at USGS station 07346000 was 32 ft^3/s (table 4). On July 27, 2011, Big Cypress 02 had a mean width across all mesohabitat types of 35.1 ft and a median width of 48.2 ft (appendix 1). The mean and median widths in 2011 were 49.6 and 46.6, respectively, if only the main channel mesohabitats were considered. Depths in Big Cypress 02 also tended to decrease between the sampling events of 2010 and 2011. On July 30, 2010, Big Cypress 02 had mean and median depths of 4.2 ft and 3.6 ft, respectively, across all mesohabitat types and mean and median depths of 5.5 ft and 4.8 ft, respectively, when accounting for only main-channel mesohabitats; on July 27, 2011, mean and median depths dropped to 2.3 ft and 2.5 ft, respectively, across all mesohabitat types and 3.1 ft and 4.8 ft, respectively, when accounting for only main-channel mesohabitats. Four mesohabitats were mapped during each of the two sampling events (fig. 6), and each mesohabitat type remained the same between the two events.

Mean and median velocities in 2010 (0.22 ft/s and 0.14 ft/s, respectively, across all mesohabitat types and 0.31 ft/s and 0.21 ft/s, respectively, for main-channel mesohabitats exclusively) were approximately twice as high as the velocities observed in 2011 (mean and medians of 0.11 ft/s across all mesohabitat types and 0.17 ft/s and 0.11 ft/s, respectively, for main-channel mesohabitats exclusively). Mean velocities in slow runs decreased from 0.17 ft/s to 0.08 ft/s between 2010 and 2011, while mean velocities in fast runs decreased from 0.58 ft/s to 0.34 ft/s during that same period.

Fish Surveys

About 14 percent more fish were collected from Big Cypress 02 in 2010 (596) relative to 2011 (525; table 5; appendix 3). The total number of fish species decreased by

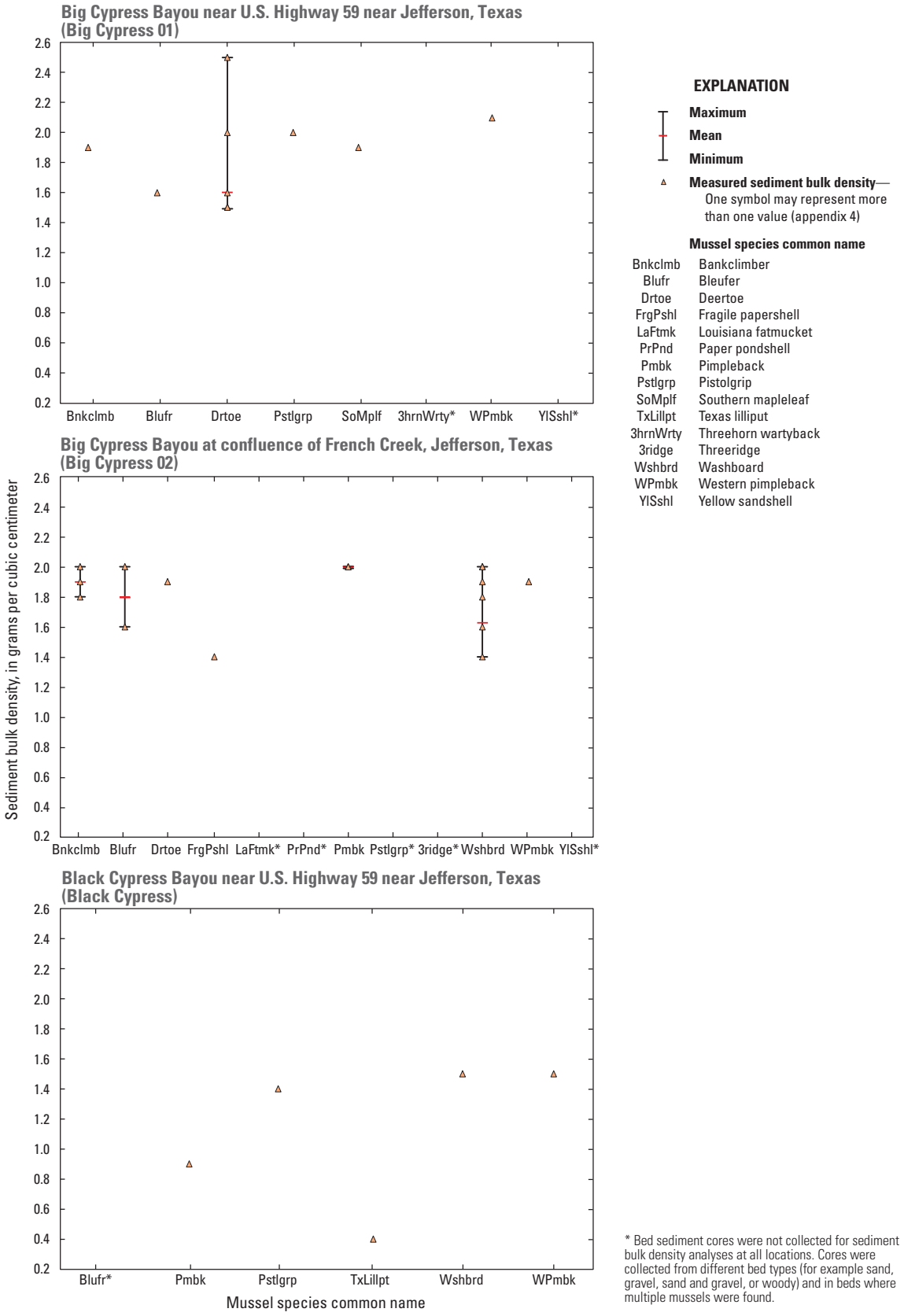

Figure 17. Bed sediment bulk densities associated with different mussels collected from U.S. Geological Survey stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

approximately 18 percent between the two sampling events (34 species in 2010 compared to 28 in 2011). The Menhinick index was larger in 2010 (1.39) than 2011 (1.22); the smaller Menhinick index in 2011 may be caused by lower streamflow in 2011 compared to 2010.

Two introduced species (common carp and redbreast sunfish) were collected only in 2010. Longear sunfish, which was the most abundant fish species collected in 2010, was second to western mosquitofish in 2011 (table 6).The relative abundance of western mosquitofish in 2011 was based on a single seine haul from a shallow embayment mesohabitat (appendix 3). Species of the sunfish family Centrarchidae tended to have higher relative abundance ranks compared to other fish families during both sampling events. Blacktail shiners were the second most abundant fish collected in 2010 and third most abundant in 2011. The lowest rank abundance for each date (six occurrences in 2010 and seven occurrences in 2011) corresponds to the collection of a single individual of several species. Low rank relative abundance was common in 2010 and 2011 for several darter species.

Physical Characteristics and Water-Quality Properties in the Absence of Flow in Isolated Pools at the Reach and Mesohabitat Scale on Black Cypress and Little Cypress Bayous During Fall 2011

In the absence of flow during fall 2011, the reach at Black Cypress was reduced to four isolated pools (fig. 7), and the reach at Little Cypress was reduced to three isolated pools (fig. 8). The farthest downstream pool in each of the reaches was bisected at the previously established downstream boundary, and only the upper parts were analyzed in this study.

Water depths were not measured at the same locations during both sampling events at Little Cypress and Black Cypress, so direct water-depth comparisons are not possible. Bathymetric maps depicting the depths of the isolated pools at Black Cypress and Little Cypress were generated from elevation data along surveyed transect lines (figs. 18–19). Elevation data were hand-contoured using linear interpolation between surveyed data points within each pool and extrapolation outside of these values to the surveyed pool perimeter. The perimeter of each pool was assigned a depth of zero. By overlaying the bathymetric maps from 2011 for both of the stream reaches on top of their respective mesohabitat maps from 2010 (after plotting measured water depths associated with the physical mesohabitat measurements), it was possible to estimate a difference in water depths between the two events. Water depths decreased by approximately 4.0 ft at Little Cypress and approximately 2.4 ft at Black Cypress between 2010 and 2011.

Dissolved oxygen, temperature, pH, and specific conductance data were collected from pools in Little Cypress and Black Cypress in the absence of flow because it was hypothesized that these conditions would be the most limiting with respect to aquatic life. Dissolved oxygen and specific conductance did not exhibit consistent readings in the isolated pools at Black Cypress. Specific conductance ranged from 98 µs/cm to 252 µs/cm and did not exhibit any consistent patterns with regards to depth or lateral position (appendix 2). However, aside from a few outliers (at transect *B–B'* at the bottom of mid-channel and in the only reading obtained from transect *D–D'*), specific conductance was stable on a transect-specific as well as a pool-specific basis. Dissolved oxygen concentrations at Black Cypress ranged from 0.58 mg/L to 4.79 mg/L and exhibited a more subtle inverse relation to depth compared to Little Cypress at the four transects where dissolved oxygen was measured at different depth intervals (*A–A'*, *B–B'*, *E–E'*, and *F–F'*). The stratification of dissolved oxygen concentrations at Black Cypress along the different transects is less pronounced than the stratification observed at Little Cypress (appendix 2), which might indicate more mixing at Black Cypress. Anoxic conditions (dissolved oxygen concentrations less than 0.5 mg/L) were not observed in any of the six transects at Black Cypress, but all three readings collected near the bottom of the water column along transect *B–B'* were less than 1.0 mg/L. Temperature ranged from 18.73°C to 20.43°C and in most cases, tended to be inversely related to water depth but did not exhibit any consistent patterns with regards to lateral position. The pH ranged from 6.27 to 6.98 and tended to be relatively stable on a transect-specific basis (aside from what appears to be an anomalous reading of 6.98 that was collected just below the water surface on transect *F–F'*).

Other than dissolved oxygen, the other water-quality properties measured at Little Cypress were relatively consistent at all locations, particularly the measurements made within each individual transect (appendix 2). Specific conductance ranged from 217 µs/cm to 235 µs/cm and did not exhibit any consistent patterns with regards to water depth or lateral position. Temperature ranged from 19.33°C to 22.12°C and tended to be inversely related to water depth. Temperatures also tended to be lower at mid-channel relative to temperatures observed closer to the banks, although this phenomenon is likely attributable to differences in water depths between the locations. The pH ranged from 6.05 to 6.91, but the range narrowed to 6.42 to 6.91 if data collected along *A–A'* were excluded. *A–A'* spans a shallow part of the most upstream pool that may be more heavily influenced by atmospheric conditions. Dissolved oxygen concentrations ranged from 0.24 mg/L to 5.33 mg/L and exhibited a consistent inverse relation to water depth, resulting in a stratified pattern in all five transects. The stratification of dissolved oxygen concentrations along the different transects on Little Cypress is shown in figure 19. Anoxic conditions were observed in two of the five transects (*C–C' and E–E'*).

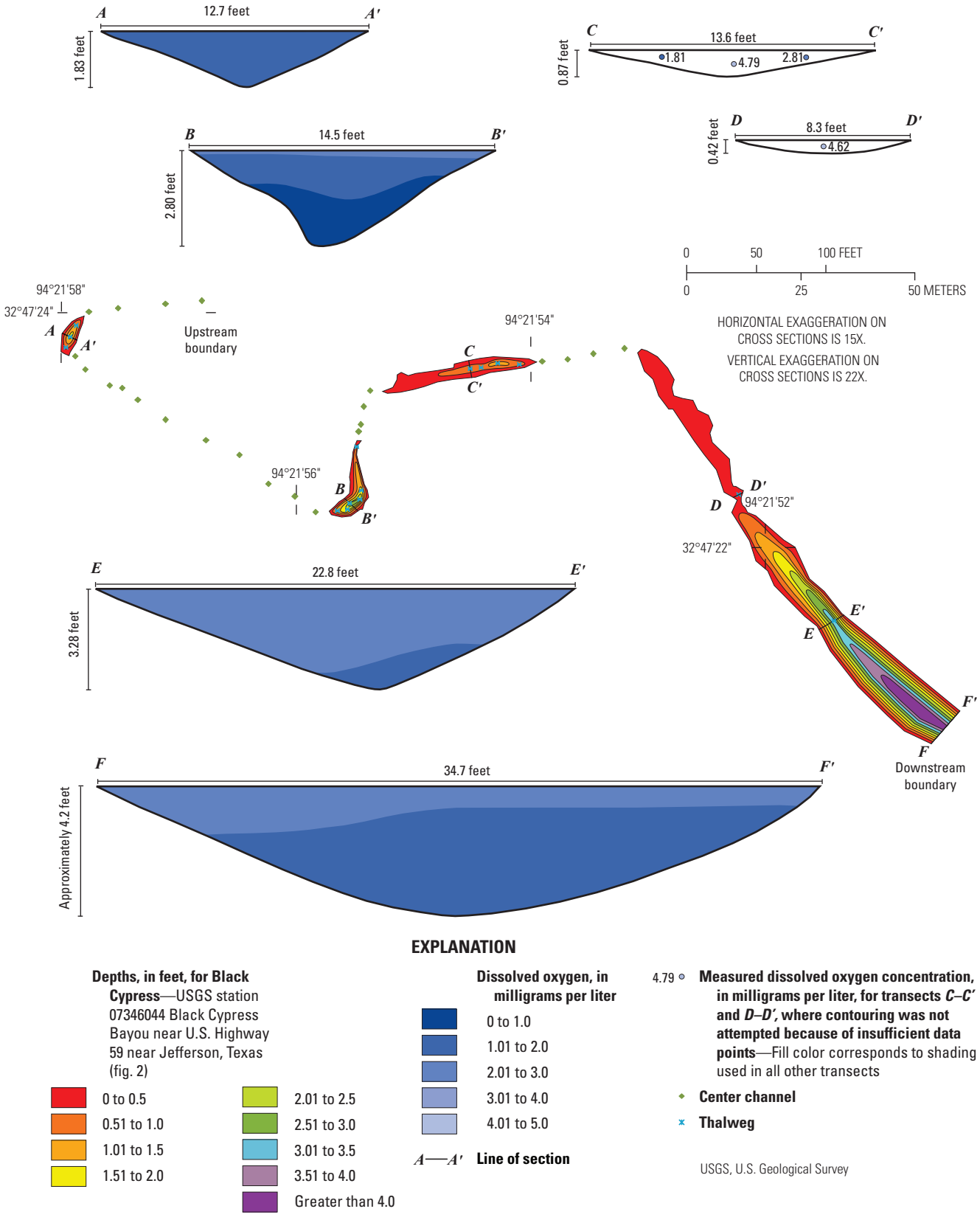

Figure 18. Diagram showing pool depths and cross-sectional representation of dissolved oxygen concentrations along surveyed transect lines on Black Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, on October 12, 2011.

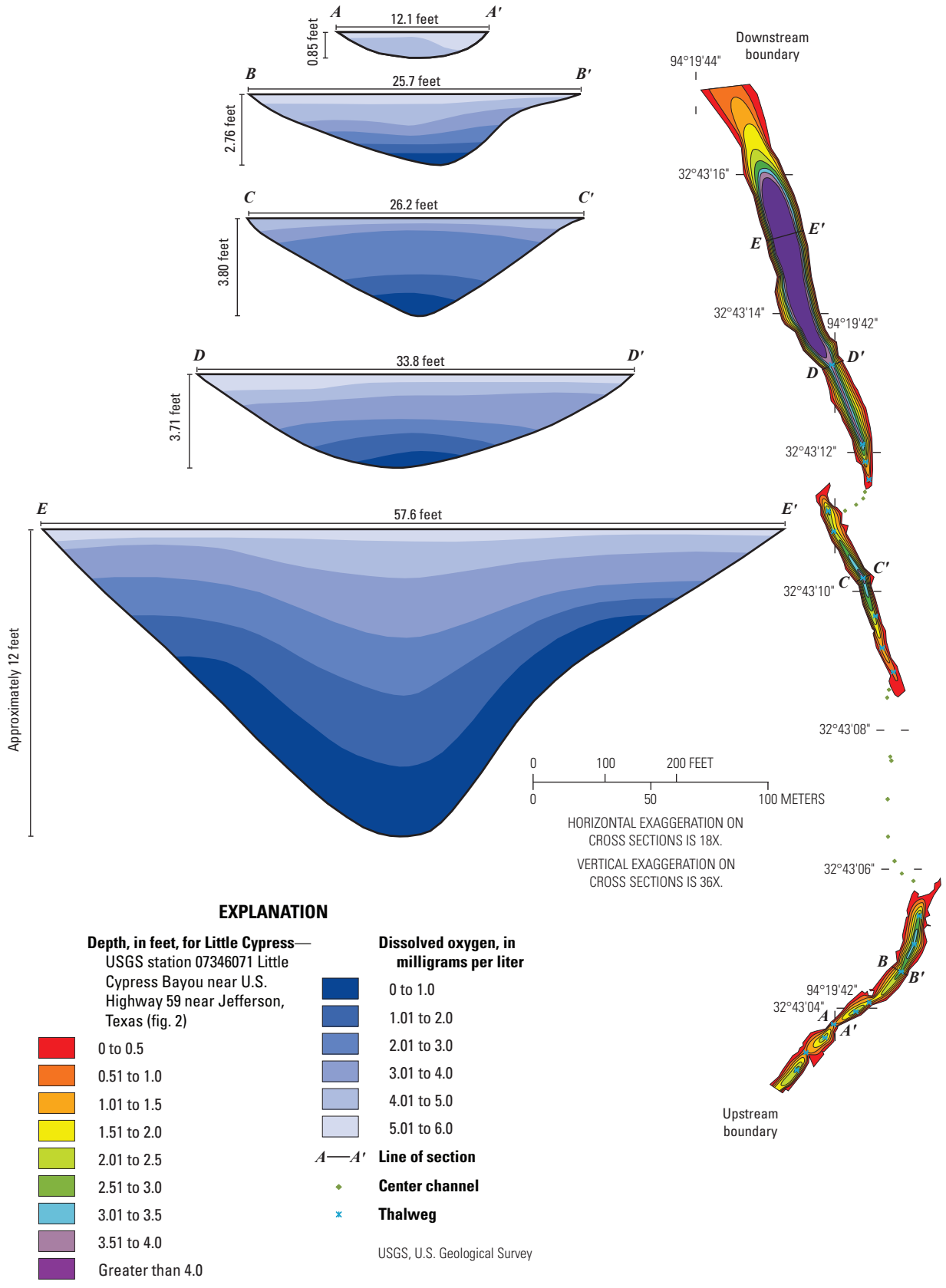

Figure 19. Diagram showing pool depths and cross-sectional representation of dissolved oxygen concentrations along surveyed transect lines on Little Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, on October 12, 2011.

Summary

In 2010 and 2011, the U.S. Geological Survey (USGS), in cooperation with the Northeast Texas Municipal Water District and the Texas Commission on Environmental Quality, did a baseline assessment of physical characteristics, aquatic biota (fish and mussels) collected at the mesohabitat scale for reaches of Big Cypress, Black Cypress, and Little Cypress Bayous in the Big Cypress Basin in northeastern Texas, and measured selected water-quality properties in isolated pools in Black Cypress and Little Cypress. All of the data were collected in the context of prescribed environmental flows. The information acquired during the course of the study will support the long-term monitoring of biota in relation to environmental flow prescriptions for Big Cypress Bayou, Black Cypress Bayou, and Little Cypress Bayou. Data collection and analysis were done at mesohabitat- and reach-specific scales, where a mesohabitat is defined as a discrete area within a stream that exhibits unique depth, velocity, slope, substrate, and cover.

Biological and physical characteristic data were collected from two sites on Big Cypress Bayou, and one site on both Black Cypress Bayou and Little Cypress Bayou. The upstream reach of Big Cypress Bayou (USGS station 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas) is hereinafter referred to as the Big Cypress 02 site. The downstream site on Big Cypress Bayou (USGS station 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) is hereinafter referred to as the Big Cypress 01 site and was sampled exclusively for mussels. The sites on Black Cypress Bayou (USGS station 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) and Little Cypress Bayou (USGS station 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex.) are hereinafter referred to as the Black Cypress and Little Cypress sites, respectively.

A small range of streamflows was targeted for data collection, including a period of low flow during July and August 2010 and a period of very low flow during July 2011. This approach accounted for variability in the abundance and distribution of fish and mussels and in the physical characteristics of mesohabitats present during different flow conditions. Mussels were not collected from Little Cypress. However, a quantitative survey of freshwater mussels was completed at Big Cypress 01, Big Cypress 02, and Black Cypress.

Of the three reaches where physical habitat data were measured in 2010, Big Cypress 02 was both the widest and deepest, with a mean width of 62.2 ft and a mean depth of 5.5 ft in main-channel mesohabitats. Little Cypress was the second widest and deepest, with a mean width of 49.9 ft and a mean depth of 4.5 ft in main-channel mesohabitats. Black Cypress was by far the narrowest of the three reaches, with a mean width of 29.1 ft and a mean depth of 3.3 ft in main-channel mesohabitats, but it had the highest mean velocity of 0.42 feet per second (ft/s).

Appreciably more fish were collected from Big Cypress 02 (596) in summer 2010 compared to Black Cypress (273) or Little Cypress (359), but the total number of fish species collected among the three sites was similar. Thirty-four fish species were collected from Big Cypress 02 in summer 2010 compared to 26 species from Black Cypress and 33 species from Little Cypress. Longear sunfish was the most abundant fish species collected from all three sites in 2010, and only 3 of the 48 fish species (common carp, western mosquitofish, and redbreast sunfish) collected were nonnative or introduced species; both occurred exclusively at Big Cypress 02. Fish data from the various mesohabitat types were combined into four mesohabitat categories for analysis: fast run, slow run, channel pool and margin pool (data from Forewaters, backwaters, and embayments were combined to form margin pool category for analysis). The larger number of fish collected from Big Cypress 02 was influenced by the larger abundance of sunfish (Centrarchidae) species, especially longear sunfish (*Lepomis megalotis*). Menhinick index values were greater for Black Cypress (1.57) and Little Cypress (1.74) than for Big Cypress 02 (1.39). Fish species richness was largest in slow run mesohabitats from Big Cypress 02 and Little Cypress and largest in fast runs from Black Cypress.

Fifteen species and 182 individuals of freshwater mussels were collected, with 69.8 percent of the individual mussels collected from Big Cypress 02, 23.6 percent collected from Big Cypress 01, and 6.6 percent collected from Black Cypress. Washboards were the most abundant species overall with the majority of individuals found at Big Cypress 02. Big Cypress 02 was the most species rich with 13 species, followed by Big Cypress 01 with 8 species, and Black Cypress with 6 species. At Big Cypress 01, the relative density was largest overall for deertoes (17.2), pistolgrips (12.5), and western pimplebacks (12.5); all of which were higher than the values observed for these species at Big Cypress 02. At Big Cypress 02, relative density was largest overall for washboards (41.6), then bankclimbers (18.2), and bleufers (10.4). All relative densities for mussels at Black Cypress were low (less than 4.0). Mussels occurred at water depths ranging from a minimum of 0.6 ft at Big Cypress 01 to a maximum of 5.6 ft at Black Cypress. Mean depth for those species that occurred at all sites generally was shallowest at Big Cypress 01, and deepest at Black Cypress, with intermediate depths found at Big Cypress 02.

About 14 percent more fish were collected from Big Cypress 02 in 2010 relative to 2011 (596 fish in 2010 compared to 525 in 2011), and about 18 percent more fish species were identified in 2010 compared to 2011 (34 species in 2010 compared to 28 in 2011). The Menhinick index was larger in 2010 (1.39) than 2011 (1.22); the smaller Menhinick index in 2011 may be caused by lower streamflow in 2011 compared to 2010. Longear sunfish, which was the most abundant fish species collected in 2010, was second to western mosquitofish in 2011.

In the absence of flow during fall 2011, the reach at Black Cypress was reduced to four isolated pools, and the reach at

Little Cypress was reduced to three isolated pools. Dissolved oxygen, temperature, pH, and specific conductance data were collected from the pools because it was hypothesized that these conditions would be the most limiting with respect to aquatic life. Dissolved oxygen concentrations ranged from 0.58 mg/L to 4.79 milligrams per liter (mg/L) at Black Cypress and from 0.24 mg/L to 5.33 mg/L at Little Cypress; both sites exhibited a stratified pattern in dissolved oxygen concentrations along transect lines, but the pattern was less pronounced at Black Cypress.

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Appendix 1—Physical Habitat Measurements

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Mesohabitat identifier	Mesohabitat type[1]	Measurement location along transect	Transect number	Physical measurements				
					Transect width (ft)	Depth (ft)	Velocity (ft/s)	Dominant substrate	Embeddedness (percent)
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02)									
7/30/2010	1	Slow run	right	1	59.1	4.8	0.12	SA/W	100
7/30/2010	1	Slow run	left	2	62.3	5.3	0.03	SA/W	100
7/30/2010	1	Slow run	center	3	62.3	6.3	0.10	SA/W	100
7/30/2010	1	Slow run	right	4	72.2	9.7	0.14	SA/W	100
7/30/2010	1	Slow run	left	5	68.9	3.9	0.17	SA/W	100
7/30/2010	2	Fast run	right	1	65.6	3.6	0.34	SA/W	100
7/30/2010	2	Fast run	left	2	68.9	2.7	0.90	SA/W	100
7/30/2010	2	Fast run	center	3	41.0	1.7	0.69	SA/W	100
7/30/2010	2	Fast run	right	4	62.3	2.2	0.24	SA/W	100
7/30/2010	2	Fast run	left	5	62.3	1.5	0.74	SA/W	100
7/30/2010	3	Embayment	left	1	7.9	0.6	0.02	SA/W	100
7/30/2010	3	Embayment	center	2	11.5	2.5	-0.04	SA/W	100
7/30/2010	3	Embayment	right	3	10.5	0.6	0.06	SA/W	100
7/30/2010	4	Backwater	left	1	2.3	0.2	0.00	SA	100
7/30/2010	4	Backwater	center	2	3.6	0.1	0.00	SA	100
7/30/2010	4	Backwater	right	3	3.9	0.6	0.00	SA	100
7/30/2010	5	Slow run	left	1	65.6	6.2	0.21	SA/W	100
7/30/2010	5	Slow run	center	2	68.9	11.4	0.12	SA/W	100
7/30/2010	5	Slow run	right	3	59.1	6.8	0.26	SA/W	100
7/30/2010	5	Slow run	left	4	59.1	12.1	0.39	SA/W	100
7/30/2010	5	Slow run	center	5	55.8	4.5	0.16	SA/W	100
				mean	46.3	4.2	0.22		
				median	59.1	3.6	0.14		
				mean (main-channel mesohabitats only)	62.2	5.5	0.31		
				median (main-channel mesohabitats only)	62.3	4.8	0.21		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identi-fier	Meso-habitat type[1]	Center transect measurements										
			Bank-full width (ft)	Bank-full height (ft)	Left bank angle (degrees)	Right bank angle (degrees)	Left bank buffer width (ft)	Right bank buffer width (ft)	Left bank canopy closure (degrees)	Right bank canopy closure (degrees)	Left bank densi-ometer reading (count from 0 to 17)	Right bank densi-ometer reading (count from 0 to 17)	Thalweg bearing (degrees)
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02)—Continued													
7/30/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	1	Slow run	75	16.3	42.5	15.3	>164	98	118	--	17	17	161
7/30/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	2	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	2	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	2	Fast run	72	7.3	20	10	>164	46	90	90	17	16	68
7/30/2010	2	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	2	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	3	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	3	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	3	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	4	Backwater	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	4	Backwater	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	4	Backwater	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	5	Slow run	69	10.8	32	35	>164	>164	90	90	17	17	80
7/30/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/30/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identifier	Mesohabitat type[1]	Fish cover measurements									Large woody debris (>1 ft in diameter)[3]	Small woody debris (<1 ft in diameter)[3]
			Filamentous algae[2]	Macrophytes	Live trees or roots	Overhanging vegetation	Undercut banks	Coarse gravel	Cobble	Artificial substrate	Snags or logs		
			Relative abundance from 0 to 4, 0 - absent (0 percent), 1 - sparse (<10 percent), 2 - moderate (10 to <40 percent), 3 - heavy (40–75 percent), 4 - very heavy (>75 percent)										
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02)—Continued													
7/30/2010	1	Slow run	0	0	2	0	0	0	0	0	0	6	13
7/30/2010	1	Slow run	0	0	2	0	0	0	0	0	0	4	7
7/30/2010	1	Slow run	0	0	2	0	0	0	0	0	0	4	12
7/30/2010	1	Slow run	0	0	2	0	0	0	0	0	0	6	6
7/30/2010	1	Slow run	0	0	2	0	0	0	0	0	0		
7/30/2010	2	Fast run	0	0	2	0	0	0	0	0	0	2	5
7/30/2010	2	Fast run	0	0	2	0	0	0	0	0	0	6	13
7/30/2010	2	Fast run	0	0	2	0	0	0	0	0	0	8	15
7/30/2010	2	Fast run	0	0	2	0	0	0	0	0	0	9	6
7/30/2010	2	Fast run	0	0	2	0	0	0	0	0	0		
7/30/2010	3	Embayment	0	0	3	0	0	0	0	0	0	0	tntc
7/30/2010	3	Embayment	0	0	3	0	0	0	0	0	0	0	tntc
7/30/2010	3	Embayment	0	0	3	0	0	0	0	0	0		
7/30/2010	4	Backwater	--	--	--	--	--	--	--	--	--	1	3
7/30/2010	4	Backwater	0	0	0	0	0	0	0	0	0	0	3
7/30/2010	4	Backwater	0	0	0	0	0	0	0	0	0		
7/30/2010	5	Slow run	0	0	2	0	0	0	0	0	0	5	4
7/30/2010	5	Slow run	0	0	2	0	0	0	0	0	0	5	4
7/30/2010	5	Slow run	0	0	2	0	0	0	0	0	0	tntc	tntc
7/30/2010	5	Slow run	0	0	2	0	0	0	0	0	0	11	5
7/30/2010	5	Slow run	0	0	2	0	0	0	0	0	0		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Mesohabitat identifier	Mesohabitat type[1]	Measurement location along transect	Transect number	Physical measurements				
					Transect width (ft)	Depth (ft)	Velocity (ft/s)	Dominant substrate	Embeddedness (percent)
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02)—Continued									
7/27/2011	6	Slow run	center	1	27.2	1.3	0.37	SA	100
7/27/2011	6	Slow run	right	2	37.7	4.5	-0.03	SA	100
7/27/2011	6	Slow run	left	3	46.6	2.1	0.11	SA	100
7/27/2011	6	Slow run	center	4	50.9	4.4	0.02	SA	100
7/27/2011	6	Slow run	right	5	55.4	4.8	0.10	SA	100
7/27/2011	7	Embayment	center	1	21.7	1.2	0.09	SI	100
7/27/2011	7	Embayment	right	2	16.4	0.6	-0.05	SI	100
7/27/2011	7	Embayment	left	3	10.8	0.2	0.02	SI	100
7/27/2011	8	Fast run	center	1	46.3	0.9	0.42	W	--
7/27/2011	8	Fast run	right	2	45.3	1.1	0.27	W	--
7/27/2011	8	Fast run	left	3	36.1	1.0	0.23	SA	100
7/27/2011	8	Fast run	center	4	47.2	1.4	0.33	SA	100
7/27/2011	8	Fast run	right	5	62.0	2.7	0.45	SA	100
7/27/2011	9	Embayment	left	1	3.9	0.6	0.10	SA	100
7/27/2011	9	Embayment	center	2	6.6	1.4	0.03	SA	100
7/27/2011	9	Embayment	right	3	8.2	1.4	0.00	SA	100
7/27/2011	10	Embayment	center	1	7.9	0.9	0.04	SI	100
7/27/2011	10	Embayment	right	2	9.5	0.6	0.00	SI	100
7/27/2011	10	Embayment	left	3	12.5	0.6	-0.11	SI	100
7/27/2011	11	Slow run	right	1	53.1	3.3	0.11	SA	100
7/27/2011	11	Slow run	left	2	48.2	2.3	0.01	SA	100
7/27/2011	11	Slow run	center	3	56.8	8.0	0.04	SA	100
7/27/2011	11	Slow run	right	4	66.9	6.0	0.02	SA	100
7/27/2011	11	Slow run	left	5	64.3	3.4	0.05	SA	100
				mean	35.1	2.3	0.11		
				median	48.2	2.5	0.11		
				mean (main-channel mesohabitats only)	49.6	3.1	0.17		
				median (main-channel mesohabitats only)	46.6	4.8	0.11		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

			Center transect measurements										
Date	Meso-habitat identi-fier	Mesohabitat type[1]	Bank-full width (ft)	Bank-full height (ft)	Left bank angle (degrees)	Right bank angle (degrees)	Left bank buffer width (ft)	Right bank buffer width (ft)	Left bank canopy closure (degrees)	Right bank canopy closure (degrees)	Left bank densi-ometer reading (count from 0 to 17)	Right bank densi-ometer reading (count from 0 to 17)	Thalweg bearing (de-grees)
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02—Continued													
7/27/2011	6	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	6	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	6	Slow run	72	7.9	30	25	> 98	> 98	64	78	17	17	80
7/27/2011	6	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	6	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	7	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	7	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	7	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	8	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	8	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	8	Fast run	62	6.4	15	20	>98	>98	90	90	17	17	55
7/27/2011	8	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	8	Fast run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	9	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	9	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	9	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	10	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	10	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	10	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	11	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	11	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	11	Slow run	72	36.6	45	30	> 98	> 98	55	44	16	17	158
7/27/2011	11	Slow run	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	11	Slow run	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identifier	Mesohabitat type[1]	Fish cover measurements										
			Filamentous algae[2]	Macrophytes	Live trees or roots	Overhanging vegetation	Undercut banks	Coarse gravel	Cobble	Artificial substrate	Snags or logs	Large woody debris (>1 ft in diameter)[3]	Small woody debris (<1 ft in diameter)[3]
			Relative abundance from 0 to 4, 0 - absent (0 percent), 1 - sparse (<10 percent), 2 - moderate (10 to <40 percent), 3 - heavy (40–75 percent), 4 - very heavy (>75 percent)										
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02)—Continued													
7/27/2011	6	Slow run	0	0	0	0	0	0	0	0	1	12	19
7/27/2011	6	Slow run	0	0	0	0	0	0	0	0	2	10	18
7/27/2011	6	Slow run	0	0	0	0	0	0	0	0	1	3	8
7/27/2011	6	Slow run	0	0	1	0	0	0	0	0	1	6	14
7/27/2011	6	Slow run	0	0	0	0	0	0	0	0	2		
7/27/2011	7	Embayment	0	0	0	0	0	0	0	0	3	--	--
7/27/2011	7	Embayment	--	--	--	--	--	--	--	--	--	--	--
7/27/2011	7	Embayment	--	--	--	--	--	--	--	--	--		
7/27/2011	8	Fast run	0	0	1	0	0	0	0	0	3	4	18
7/27/2011	8	Fast run	0	0	0	0	0	0	0	0	2	4	32
7/27/2011	8	Fast run	0	0	0	0	0	0	0	0	2	6	18
7/27/2011	8	Fast run	0	0	0	0	0	0	0	0	3	4	17
7/27/2011	8	Fast run	--	--	--	--	--	--	--	--	--		
7/27/2011	9	Embayment	0	0	1	0	0	0	0	0	0	0	0
7/27/2011	9	Embayment	0	0	1	0	0	0	0	0	0	0	0
7/27/2011	9	Embayment	0	0	1	0	0	0	0	0	0		
7/27/2011	10	Embayment	0	0	0	0	0	0	0	0	0	1	2
7/27/2011	10	Embayment	0	0	0	0	0	0	0	0	0	0	0

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identifier	Mesohabitat type[1]	Fish cover measurements										
			Filamentous algae[2]	Macrophytes	Live trees or roots	Overhanging vegetation	Undercut banks	Coarse gravel	Cobble	Artificial substrate	Snags or logs	Large woody debris (>1 ft in diameter)[3]	Small woody debris (<1 ft in diameter)[3]
			Relative abundance from 0 to 4, 0 - absent (0 percent), 1 - sparse (<10 percent), 2 - moderate (10 to <40 percent), 3 - heavy (40–75 percent), 4 - very heavy (>75 percent)										
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (Big Cypress 02)—Continued													
7/27/2011	10	Embayment	0	0	0	0	0	0	0	0	0		
7/27/2011	11	Slow run	0	0	1	0	0	3	0	0	1		
												9	14
7/27/2011	11	Slow run	0	0	0	0	0	0	0	0	2		
												4	7
7/27/2011	11	Slow run	0	0	0	0	0	0	0	0	2		
												10	11
7/27/2011	11	Slow run	0	0	0	0	0	0	0	0	2		
												4	4
7/27/2011	11	Slow run	0	0	1	0	0	0	0	0	0		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Mesohabitat identifier	Mesohabitat type[1]	Measurement location along transect	Transect number	Physical measurements				
					Transect width (ft)	Depth (ft)	Velocity (ft/s)	Dominant substrate	Embeddedness (percent)
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Black Cypress)									
8/3/2010	1	Fast run	center	1	23.0	1.3	1.44	SA/W	100
8/3/2010	1	Fast run	right	2	27.9	1.4	0.11	SA/W	100
8/3/2010	1	Fast run	left	3	30.5	1.7	0.51	SA	100
8/3/2010	1	Fast run	center	4	25.4	1.9	0.80	SA/W	100
8/3/2010	1	Fast run	right	5	23.0	1.5	1.10	SA/W	100
8/3/2010	2	Backwater	center	1	3.3	0.4	0.00	SA/W	100
8/3/2010	2	Backwater	right	2	7.2	1.0	0.00	SA/W	100
8/3/2010	2	Backwater	left	3	11.5	2.0	0.00	SA/W	100
8/3/2010	3	Channel pool	NR	1	28.2	14.8	-0.18	SA	100
8/3/2010	3	Channel pool	NR	2	29.5	6.9	0.54	SA/W	100
8/3/2010	3	Channel pool	NR	3	23.6	3.8	0.37	SA/W	100
8/3/2010	4	Fast run	center	1	16.7	4.1	0.50	SA/W	100
8/3/2010	4	Fast run	right	2	24.6	3.4	0.26	SA/W	100
8/3/2010	4	Fast run	left	3	21.3	1.5	0.91	SA/W	100
8/3/2010	4	Fast run	center	4	28.5	1.3	0.72	SA/W	100
8/3/2010	4	Fast run	right	5	38.1	3.3	0.10	SA/W	100
8/3/2010	5	Slow run	right	1	33.8	4.0	0.20	SA/W	100
8/3/2010	5	Slow run	left	2	24.3	4.0	0.32	SA/W	100
8/3/2010	5	Slow run	center	3	26.9	4.9	0.31	SA/W	100
8/3/2010	5	Slow run	right	4	27.9	4.9	0.22	SA/W	100
8/3/2010	5	Slow run	left	5	--	--	--	--	--
8/3/2010	6	Fast run	center	1	31.8	2.1	0.42	SA/W	100
8/3/2010	6	Fast run	right	2	34.4	1.1	0.58	SA/W	100
8/3/2010	6	Fast run	left	3	32.2	2.1	0.45	SA/W	100
8/3/2010	6	Fast run	center	4	27.6	1.8	-0.06	SA/W	100
8/3/2010	6	Fast run	right	5	29.5	3.6	0.35	FG/CG	100
8/3/2010	7	Slow run	left	1	28.5	2.4	0.21	SA/W	100
8/3/2010	7	Slow run	center	2	34.4	3.0	0.42	SA/W	100
8/3/2010	7	Slow run	right	3	38.7	3.0	0.35	SA/W	100
8/3/2010	7	Slow run	left	4	34.4	4.2	0.25	SA/W	100
8/3/2010	7	Slow run	center	5	40.4	1.9	0.05	SA/W	100
				mean	26.9	3.1	0.37		
				median	28.1	2.3	0.33		
				mean (main-channel mesohabitats only)	29.1	3.3	0.42		
				median (main-channel mesohabitats only)	28.5	3.0	0.35		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

			Center transect measurements										
Date	Meso-habitat identi-fier	Mesohabitat type[1]	Bank-full width (ft)	Bank-full height (ft)	Left bank angle (degrees)	Right bank angle (degrees)	Left bank buffer width (ft)	Right bank buffer width (ft)	Left bank canopy closure (degrees)	Right bank canopy closure (degrees)	Left bank densi-ometer reading (count from 0 to 17)	Right bank densi-ometer reading (count from 0 to 17)	Thalweg bearing (degrees)
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. . (Black Cypress)—Continued													
8/3/2010	1	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	1	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	1	Fast run	43	4.5	25	23	33	>164	90	90	12	16	138
8/3/2010	1	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	1	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	2	Backwater	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	2	Backwater	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	2	Backwater	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	3	Channel pool	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	3	Channel pool	39	5.0	25	38	>164	>164	140	48	0	8	--
8/3/2010	3	Channel pool	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	4	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	4	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	4	Fast run	39	3.9	22	10	>164	>164	90	90	17	17	35
8/3/2010	4	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	4	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	5	Slow run	43	7.8	34	30	>164	>164	90	90	14	13	90
8/3/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	6	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	6	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	6	Fast run	59	4.0	25	15	>164	>164	54	71	10	12	116
8/3/2010	6	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	6	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	7	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	7	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	7	Slow run	56	10.0	35	35	>164	>164	90	90	10	13	139
8/3/2010	7	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	7	Slow run	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identifier	Mesohabitat type[1]	Fish cover measurements										
			Filamentous algae[2]	Macrophytes	Live trees or roots	Overhanging vegetation	Undercut banks	Coarse gravel	Cobble	Artificial substrate	Snags or logs	Large woody debris (>1 ft in diameter)[3]	Small woody debris (<1 ft in diameter)[3]
			Relative abundance from 0 to 4, 0 - absent (0 percent), 1 - sparse (<10 percent), 2 - moderate (10 to <40 percent), 3 - heavy (40–75 percent), 4 - very heavy (>75 percent)										
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Black Cypress)—Continued													
8/3/2010	1	Fast run	0	0	2	0	0	0	0	0	1	4	4
8/3/2010	1	Fast run	0	0	2	0	0	0	0	0	1	1	5
8/3/2010	1	Fast run	0	0	1	0	0	0	0	0	1	2	12
8/3/2010	1	Fast run	0	0	1	1	0	0	0	0	2	0	0
8/3/2010	1	Fast run	0	0	1	2	0	0	0	0	2		
8/3/2010	2	Backwater	0	0	2	1	0	0	0	0	0	0	tntc
8/3/2010	2	Backwater	--	--	--	--	--	--	--	--	--	--	--
8/3/2010	2	Backwater	--	--	--	--	--	--	--	--	--		
8/3/2010	3	Channel pool	0	0	0	0	0	0	0	0	2	1	1
8/3/2010	3	Channel pool	0	0	0	0	0	0	0	0	2	--	--
8/3/2010	3	Channel pool	0	0	0	0	0	0	0	0	0		
8/3/2010	4	Fast run	0	0	2	2	0	0	0	0	2	5	4
8/3/2010	4	Fast run	0	0	2	0	0	0	0	0	2	1	1
8/3/2010	4	Fast run	0	0	0	0	0	0	0	0	3	3	2
8/3/2010	4	Fast run	0	0	0	2	0	0	0	0	2	5	15
8/3/2010	4	Fast run	0	0	0	2	0	0	0	0	3		
8/3/2010	5	Slow run	0	0	0	0	0	0	0	0	1	1	1
8/3/2010	5	Slow run	0	0	0	1	0	0	0	0	1	1	1
8/3/2010	5	Slow run	0	0	0	0	0	0	0	0	1	1	1
8/3/2010	5	Slow run	0	0	0	0	0	0	0	0	2	--	--
8/3/2010	5	Slow run	0	0	0	0	0	0	0	0	2		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identifier	Mesohabitat type[1]	Fish cover measurements										
			Filamentous algae[2]	Macrophytes	Live trees or roots	Overhanging vegetation	Undercut banks	Coarse gravel	Cobble	Artificial substrate	Snags or logs	Large woody debris (>1 ft in diameter)[3]	Small woody debris (<1 ft in diameter)[3]
			Relative abundance from 0 to 4, 0 - absent (0 percent), 1 - sparse (<10 percent), 2 - moderate (10 to <40 percent), 3 - heavy (40–75 percent), 4 - very heavy (>75 percent)										
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Black Cypress)—Continued													
8/3/2010	6	Fast run	1	0	0	0	0	0	0	0	1		
												4	1
8/3/2010	6	Fast run	0	0	0	1	0	0	0	0	1		
												1	tntc
8/3/2010	6	Fast run	0	0	0	0	0	0	0	0	3		
												0	tntc
8/3/2010	6	Fast run	0	0	0	0	0	3	1	0	2		
												0	tntc
8/3/2010	6	Fast run	2	0	0	0	0	2	1	0	2		
8/3/2010	7	Slow run	0	0	0	0	0	0	0	0	2		
												8	5
8/3/2010	7	Slow run	0	0	0	0	0	0	0	0	2		
												5	8
8/3/2010	7	Slow run	0	0	0	0	0	0	0	0	2		
												7	9
8/3/2010	7	Slow run	0	0	0	0	0	0	0	0	2		
												1	1
8/3/2010	7	Slow run	0	0	0	1	0	0	0	0	1		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Mesohabitat identifier	Mesohabitat type[1]	Measurement location along transect	Transect number	Physical measurements				
					Transect width (ft)	Depth (ft)	Velocity (ft/s)	Dominant substrate	Embeddedness (percent)
Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Little Cypress)									
8/18/2010	1	Slow run	center	1	45.9	6.6	0.14	SA/W	100
8/18/2010	1	Slow run	right	2	42.7	3.8	0.03	SA/W	100
8/18/2010	1	Slow run	left	3	52.5	3.1	0.22	SA/W	100
8/18/2010	1	Slow run	center	4	42.7	4.3	0.15	SA/W	100
8/18/2010	1	Slow run	right	5	52.5	5.4	0.08	SA/W	100
8/19/2010	2	Forewater	right	1	19.7	2.3	0.03	SA/W	100
8/19/2010	2	Forewater	left	2	23.0	2.5	0.02	SA/W	100
8/19/2010	2	Forewater	center	3	16.4	2.4	0.02	SA/W	100
8/19/2010	3	Fast run	right	1	26.2	1.2	0.17	SA/W	100
8/19/2010	3	Fast run	left	2	19.7	1.8	0.85	SA/W	100
8/19/2010	3	Fast run	center	3	29.5	1.5	0.44	SA/W	100
8/19/2010	3	Fast run	right	4	36.1	2.9	0.09	SA/W	100
8/19/2010	3	Fast run	left	5	26.2	2.7	0.10	SA/W	100
8/19/2010	4	Forewater	left	1	29.5	2.1	0.03	SA/W	100
8/19/2010	4	Forewater	center	2	29.5	1.4	0.09	SA/W	100
8/19/2010	4	Forewater	right	3	32.8	1.4	0.08	SA/W	100
8/19/2010	5	Slow run	center	1	42.7	6.4	0.00	SA/W	100
8/19/2010	5	Slow run	right	2	62.3	5.6	0.11	SA/W	100
8/19/2010	5	Slow run	left	3	65.6	11.5	0.04	SA/W	100
8/19/2010	5	Slow run	center	4	62.3	6.4	0.10	SA/W	100
8/19/2010	5	Slow run	right	5	65.6	7.2	0.13	SA/W	100
8/19/2010	6	Channel pool	center	1	65.6	3.3	0.07	SA/W	100
8/19/2010	6	Channel pool	right	2	75.5	4.1	0.06	SA/W	100
8/19/2010	6	Channel pool	left	3	85.3	3.5	-0.01	SA/W	100
				mean	43.7	3.9	0.13		
				median	42.7	3.2	0.09		
			mean (main-channel mesohabitats only)		49.9	4.5	0.15		
			median (main-channel mesohabitats only)		49.2	4.0	0.10		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

			Center transect measurements										
Date	Meso-habitat identi-fier	Meso-habitat type[1]	Bank-full width (ft)	Bank-full height (ft)	Left bank angle (degrees)	Right bank angle (degrees)	Left bank buffer width (ft)	Right bank buffer width (ft)	Left bank canopy closure (degrees)	Right bank canopy closure (degrees)	Left bank densi-ometer reading (count from 0 to 17)	Right bank densi-ometer reading (count from 0 to 17)	Thalweg bearing (degrees)
Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Little Cypress)—Continued													
8/18/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/18/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/18/2010	1	Slow run	69	--	27	25	164	164	82	60	7	17	47
8/18/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/18/2010	1	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	2	Forewater	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	2	Forewater	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	2	Forewater	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	3	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	3	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	3	Fast run	131	8.2	22	15	>164	>164	100	65	15	12	346
8/19/2010	3	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	3	Fast run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	4	Forewater	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	4	Forewater	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	4	Forewater	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	5	Slow run	102	15.2	20	20	>164	>164	54	81	17	17	342
8/19/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	5	Slow run	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	6	Channel pool	--	--	--	--	--	--	--	--	--	--	--
8/19/2010	6	Channel pool	102	3.5	15	30	>164	>164	59	31	6	16	0
8/19/2010	6	Channel pool	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identifier	Mesohabitat type[1]	Fish cover measurements									Large woody debris (>1 ft in diameter)[3]	Small woody debris (<1 ft in diameter)[3]
			Filamentous algae[2]	Macrophytes	Live trees or roots	Overhanging vegetation	Undercut banks	Coarse gravel	Cobble	Artificial substrate	Snags or logs		
			Relative abundance from 0 to 4, 0 - absent (0 percent), 1 - sparse (<10 percent), 2 - moderate (10 to <40 percent), 3 - heavy (40–75 percent), 4 - very heavy (>75 percent)										
Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Little Cypress)—Continued													
8/18/2010	1	Slow run	0	0	1	0	0	0	0	0	0		
												1	3
8/18/2010	1	Slow run	0	0	1	0	0	0	0	0	0		
												3	6
8/18/2010	1	Slow run	0	0	1	0	0	0	0	0	0		
												2	0
8/18/2010	1	Slow run	0	0	1	0	0	0	0	0	0		
												2	6
8/18/2010	1	Slow run	0	0	1	0	0	0	0	0	0		
8/19/2010	2	Forewater	0	0	1	1	0	0	0	0	1		
												2	4
8/19/2010	2	Forewater	0	0	1	0	0	0	0	0	1		
												1	2
8/19/2010	2	Forewater	0	0	1	1	0	0	0	0	1		
8/19/2010	3	Fast run	0	0	1	1	0	0	0	0	3		
												10	20
8/19/2010	3	Fast run	0	0	1	1	0	0	0	0	3		
												9	25
8/19/2010	3	Fast run	0	0	1	1	0	0	0	0	3		
												5	17
8/19/2010	3	Fast run	0	0	1	0	0	0	0	0	2		
												8	12
8/19/2010	3	Fast run	0	0	1	1	0	0	0	0	1		
8/19/2010	4	Forewater	0	0	1	2	0	0	0	0	2		
												--	--
8/19/2010	4	Forewater	0	0	1	1	0	0	0	0	2		
												--	--
8/19/2010	4	Forewater	0	0	0	0	0	0	0	0	1		

Appendix 1. Physical habitat measurements for USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010–11.—Continued

[ft, feet; ft/s, feet per second; >, greater than; <, less than; --, not measured; W, small woody debris and organic matter, regardless of size; SI, silt, <0.06 mm; SA, sand, >0.06 to 2 millimeters (mm); FG, fine gravel, >2 to 16 mm; CG, coarse gravel, >16 to 64 mm; NR, not recorded; tntc, too numerous to count]

Date	Meso-habitat identifier	Mesohabitat type[1]	Fish cover measurements									Large woody debris (>1 ft in diameter)[3]	Small woody debris (<1 ft in diameter)[3]
			Filamentous algae[2]	Macrophytes	Live trees or roots	Overhanging vegetation	Undercut banks	Coarse gravel	Cobble	Artificial substrate	Snags or logs		
			Relative abundance from 0 to 4, 0 - absent (0 percent), 1 - sparse (<10 percent), 2 - moderate (10 to <40 percent), 3 - heavy (40–75 percent), 4 - very heavy (>75 percent)										
Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (Little Cypress)—Continued													
8/19/2010	5	Slow run	0	0	1	2	0	0	0	0	1		
												6	7
8/19/2010	5	Slow run	0	0	1	2	0	0	0	0	2		
												9	11
8/19/2010	5	Slow run	0	0	1	0	0	0	0	0	1		
												2	2
8/19/2010	5	Slow run	0	0	1	2	0	0	0	0	1		
												0	0
8/19/2010	5	Slow run	0	0	1	1	0	0	0	0	1		
8/19/2010	6	Channel pool	1	0	1	0	0	0	0	0	1		
												4	3
8/19/2010	6	Channel pool	1	0	1	1	0	0	0	0	2		
												3	5
8/19/2010	6	Channel pool	1	0	1	1	0	0	0	0	2		

[1]Forewaters, backwaters, and embayments are together referred to as margin pools.

[2]Filamentous algae present on bedrock surface.

[3]Woody debris counts were made between transects within a mesohabitat; the position of the count indicates the inverval between transects where the count was made.

Appendix 2—Water-Quality Properties Measured in Samples Collected from Isolated Pools along Discrete Transect Lines

Appendix 2. Water-quality properties measured in samples collected from isolated pools along discrete transect lines at USGS stations 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Texas and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2011.

[mg/L, milligrams per liter; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, not measured]

Mesohabitat identifier	Transect identifier	Water quality	Measurement location in water column[1]	Left[2]	Center[3]	Right[4]
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. - October 12, 2011						
8	*A–A'*	dissolved oxygen (mg/L)	top	1.60	1.60	1.71
8	*A–A'*	dissolved oxygen (mg/L)	middle	1.45	1.41	1.45
8	*A–A'*	dissolved oxygen (mg/L)	bottom	1.43	1.45	1.40
8	*A–A'*	temperature (°C)	top	20.07	19.88	20.21
8	*A–A'*	temperature (°C)	middle	19.89	19.72	19.81
8	*A–A'*	temperature (°C)	bottom	19.92	19.64	19.83
8	*A–A'*	pH (standard units)	top	6.78	6.80	6.86
8	*A–A'*	pH (standard units)	middle	6.79	6.82	6.89
8	*A–A'*	pH (standard units)	bottom	6.78	6.83	6.91
8	*A–A'*	specific conductance (µS/cm)	top	185	185	185
8	*A–A'*	specific conductance (µS/cm)	middle	186	185	185
8	*A–A'*	specific conductance (µS/cm)	bottom	186	188	185
9	*B–B'*	dissolved oxygen (mg/L)	top	1.69	1.81	1.89
9	*B–B'*	dissolved oxygen (mg/L)	middle	1.11	1.10	1.28
9	*B–B'*	dissolved oxygen (mg/L)	bottom	0.96	0.58	0.70
9	*B–B'*	temperature (°C)	top	19.39	19.33	19.25
9	*B–B'*	temperature (°C)	middle	19.01	19.00	19.00
9	*B–B'*	temperature (°C)	bottom	18.96	18.73	18.82
9	*B–B'*	pH (standard units)	top	6.68	6.67	6.61
9	*B–B'*	pH (standard units)	middle	6.66	6.68	6.65
9	*B–B'*	pH (standard units)	bottom	6.63	6.50	6.52
9	*B–B'*	specific conductance (µS/cm)	top	191	190	191
9	*B–B'*	specific conductance (µS/cm)	middle	196	193	192
9	*B–B'*	specific conductance (µS/cm)	bottom	205	252	218
10	*C–C'*	dissolved oxygen (mg/L)	top	--	--	--
10	*C–C'*	dissolved oxygen (mg/L)	middle	1.81	4.79	2.81
10	*C–C'*	dissolved oxygen (mg/L)	bottom	--	--	--
10	*C–C'*	temperature (°C)	top	--	--	--
10	*C–C'*	temperature (°C)	middle	20.14	20.22	20.16
10	*C–C'*	temperature (°C)	bottom	--	--	--
10	*C–C'*	pH (standard units)	top	--	--	--
10	*C–C'*	pH (standard units)	middle	6.66	6.63	6.72
10	*C–C'*	pH (standard units)	bottom	--	--	--
10	*C–C'*	specific conductance (µS/cm)	top	--	--	--
10	*C–C'*	specific conductance (µS/cm)	middle	195	193	195
10	*C–C'*	specific conductance (µS/cm)	bottom	--	--	--

Appendix 2. Water-quality properties measured in samples collected from isolated pools along discrete transect lines at USGS stations 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Texas and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2011.—Continued

[mg/L, milligrams per liter; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, not measured]

Mesohabitat identifier	Transect identifier	Water quality	Measurement location in water column[1]	Left[2]	Center[3]	Right[4]
11	*D–D'*	dissolved oxygen (mg/L)	top	--	--	--
11	*D–D'*	dissolved oxygen (mg/L)	middle	--	4.62	--
11	*D–D'*	dissolved oxygen (mg/L)	bottom	--	--	--
11	*D–D'*	temperature (°C)	top	--	--	--
11	*D–D'*	temperature (°C)	middle	--	20.43	--
11	*D–D'*	temperature (°C)	bottom	--	--	--
11	*D–D'*	pH (standard units)	top	--	--	--
11	*D–D'*	pH (standard units)	middle	--	6.72	--
11	*D–D'*	pH (standard units)	bottom	--	--	--
11	*D–D'*	specific conductance (µS/cm)	top	--	--	--
11	*D–D'*	specific conductance (µS/cm)	middle	--	98	--
11	*D–D'*	specific conductance (µS/cm)	bottom	--	--	--
11	*E–E'*	dissolved oxygen (mg/L)	top	2.34	2.43	2.39
11	*E–E'*	dissolved oxygen (mg/L)	middle	2.20	2.35	2.23
11	*E–E'*	dissolved oxygen (mg/L)	bottom	1.97	2.09	2.16
11	*E–E'*	temperature (°C)	top	19.54	19.61	19.61
11	*E–E'*	temperature (°C)	middle	19.54	19.55	19.52
11	*E–E'*	temperature (°C)	bottom	19.62	19.51	19.48
11	*E–E'*	pH (standard units)	top	6.58	6.57	6.54
11	*E–E'*	pH (standard units)	middle	6.57	6.56	6.52
11	*E–E'*	pH (standard units)	bottom	6.54	6.54	6.50
11	*E–E'*	specific conductance (µS/cm)	top	142	141	141
11	*E–E'*	specific conductance (µS/cm)	middle	142	142	141
11	*E–E'*	specific conductance (µS/cm)	bottom	144	142	142
11	*F–F'*	dissolved oxygen (mg/L)	top	2.14	1.91	2.75
11	*F–F'*	dissolved oxygen (mg/L)	middle	1.54	1.02	2.18
11	*F–F'*	dissolved oxygen (mg/L)	bottom	1.17	1.30	1.67
11	*F–F'*	temperature (°C)	top	19.54	19.46	19.60
11	*F–F'*	temperature (°C)	middle	19.34	19.30	19.48
11	*F–F'*	temperature (°C)	bottom	19.34	19.29	19.39
11	*F–F'*	pH (standard units)	top	6.98	6.39	6.33
11	*F–F'*	pH (standard units)	middle	6.45	6.37	6.30
11	*F–F'*	pH (standard units)	bottom	6.43	6.35	6.27
11	*F–F'*	specific conductance (µS/cm)	top	146	146	146
11	*F–F'*	specific conductance (µS/cm)	middle	147	147	147
11	*F–F'*	specific conductance (µS/cm)	bottom	148	150	147

Appendix 2. Water-quality properties measured in samples collected from isolated pools along discrete transect lines at USGS stations 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Texas and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2011.—Continued

[mg/L, milligrams per liter; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, not measured]

Mesohabitat identifier	Transect identifier	Water quality	Measurement location in water column[1]	Left[2]	Center[3]	Right[4]
Little Cypress Creek near U.S. Highway 59 near Jefferson, Tex. - October 13, 2011						
7	*A–A'*	dissolved oxygen (mg/L)	top	4.53	4.68	5.33
7	*A–A'*	dissolved oxygen (mg/L)	middle	--	4.75	--
7	*A–A'*	dissolved oxygen (mg/L)	bottom	--	--	--
7	*A–A'*	temperature (°C)	top	20.81	20.52	20.78
7	*A–A'*	temperature (°C)	middle	--	20.60	--
7	*A–A'*	temperature (°C)	bottom	--	--	--
7	*A–A'*	pH (standard units)	top	6.45	6.27	6.05
7	*A–A'*	pH (standard units)	middle	--	6.38	--
7	*A–A'*	pH (standard units)	bottom	--	--	--
7	*A–A'*	specific conductance (µS/cm)	top	233	233	233
7	*A–A'*	specific conductance (µS/cm)	middle	--	232	--
7	*A–A'*	specific conductance (µS/cm)	bottom	--	--	--
7	*B–B'*	dissolved oxygen (mg/L)	top	4.84	4.65	4.93
7	*B–B'*	dissolved oxygen (mg/L)	middle	4.37	3.95	3.96
7	*B–B'*	dissolved oxygen (mg/L)	bottom	2.23	0.72	3.74
7	*B–B'*	temperature (°C)	top	20.75	20.52	20.60
7	*B–B'*	temperature (°C)	middle	20.18	20.02	19.90
7	*B–B'*	temperature (°C)	bottom	20.06	20.01	19.94
7	*B–B'*	pH (standard units)	top	6.73	6.66	6.58
7	*B–B'*	pH (standard units)	middle	6.68	6.59	6.50
7	*B–B'*	pH (standard units)	bottom	6.61	6.52	6.42
7	*B–B'*	specific conductance (µS/cm)	top	234	234	234
7	*B–B'*	specific conductance (µS/cm)	middle	233	234	233
7	*B–B'*	specific conductance (µS/cm)	bottom	234	235	234
8	*C–C'*	dissolved oxygen (mg/L)	top	3.33	2.94	3.25
8	*C–C'*	dissolved oxygen (mg/L)	middle	2.58	2.30	2.65
8	*C–C'*	dissolved oxygen (mg/L)	bottom	2.32	0.35	2.10
8	*C–C'*	temperature (°C)	top	21.04	20.60	20.94
8	*C–C'*	temperature (°C)	middle	20.20	19.83	20.63
8	*C–C'*	temperature (°C)	bottom	20.07	20.09	20.35
8	*C–C'*	pH (standard units)	top	6.76	6.75	6.76
8	*C–C'*	pH (standard units)	middle	6.74	6.74	6.75
8	*C–C'*	pH (standard units)	bottom	6.73	6.64	6.73
8	*C–C'*	specific conductance (µS/cm)	top	220	220	219
8	*C–C'*	specific conductance (µS/cm)	middle	220	219	220
8	*C–C'*	specific conductance (µS/cm)	bottom	220	223	225

Appendix 2. Water-quality properties measured in samples collected from isolated pools along discrete transect lines at USGS stations 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Texas and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2011.—Continued

[mg/L, milligrams per liter; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, not measured]

Mesohabitat identifier	Transect identifier	Water quality	Measurement location in water column[1]	Left[2]	Center[3]	Right[4]
9	*D–D'*	dissolved oxygen (mg/L)	top	4.91	3.78	4.03
9	*D–D'*	dissolved oxygen (mg/L)	middle	3.48	2.99	3.52
9	*D–D'*	dissolved oxygen (mg/L)	bottom	2.27	1.28	3.12
9	*D–D'*	temperature (°C)	top	22.12	21.32	21.82
9	*D–D'*	temperature (°C)	middle	20.54	20.00	20.68
9	*D–D'*	temperature (°C)	bottom	19.93	19.87	20.58
9	*D–D'*	pH (standard units)	top	6.87	6.78	6.86
9	*D–D'*	pH (standard units)	middle	6.78	6.74	6.85
9	*D–D'*	pH (standard units)	bottom	6.76	6.73	6.91
9	*D–D'*	specific conductance (µS/cm)	top	219	219	217
9	*D–D'*	specific conductance (µS/cm)	middle	218	217	217
9	*D–D'*	specific conductance (µS/cm)	bottom	217	217	218
9	*E–E'*	dissolved oxygen (mg/L)	top	4.03	4.81	4.54
9	*E–E'*	dissolved oxygen (mg/L)	middle	2.13	2.21	3.03
9	*E–E'*	dissolved oxygen (mg/L)	bottom	0.24	0.64	0.28
9	*E–E'*	temperature (°C)	top	20.90	20.91	20.97
9	*E–E'*	temperature (°C)	middle	19.50	19.53	19.97
9	*E–E'*	temperature (°C)	bottom	19.34	19.33	19.59
9	*E–E'*	pH (standard units)	top	6.80	6.74	6.72
9	*E–E'*	pH (standard units)	middle	6.75	6.66	6.68
9	*E–E'*	pH (standard units)	bottom	6.69	6.62	6.72
9	*E–E'*	specific conductance (µS/cm)	top	217	217	217
9	*E–E'*	specific conductance (µS/cm)	middle	217	217	217
9	*E–E'*	specific conductance (µS/cm)	bottom	224	223	217

[1]Measurement locations within the water column were collected a few inches below the water surface (top), the midpoint of the water column (middle), or a few inches above the stream bed (bottom).

[2]Refers to a location halfway between the midpoint of the channel and the left edge of water on the transect line.

[3]Refers to a location halfway between the left edge of water and the right edge of water on the transect line.

[4]Refers to a location halfway between the midpoint of the channel and the right edge of water on the transect line.

Appendix 3—Number of Fish, Relative Abundance, and Catch Per Unit Effort

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Family	Family common name	Species	Species common name	Status	Trophic group[1]	General spawning guild	Collection method
Lepisosteidae	Gars	*Lepisosteus oculatus*	Spotted gar	Native	Predator	Nest and substrate	Electrofishing
		Lepisosteus osseus	Longnose gar	Native	Predator	Nest and substrate	Electrofishing
Amiidae	Bowfin	*Amia calva*	Bowfin	Native	Predator	Nest and substrate	Electrofishing
Clupeidae	Herrings	*Dorosoma cepedianum*	Gizzard shad	Native	Omnivore	Nest and substrate	Electrofishing
		Dorosoma petenense	Threadfin shad	Native	Omnivore	Nest and substrate	Electrofishing
Cyprinidae	Carps and minnows	*Cyprinella lutrensis*	Red shiner	Native	Invertivore	Nest and substrate	Electrofishing
		Cyprinella venustus	Blacktail shiner	Native	Invertivore	Nest and substrate	Electrofishing
		Cyprinella venustus	Blacktail shiner	Native	Invertivore	Nest and substrate	Seining
		Cyprinus carpio	Common carp	Introduced	Omnivore	Nest and substrate	Electrofishing
		Hybopsis amnis	Pallid shiner	Native	Invertivore	NA	Electrofishing
		Lythrurus fumeus	Ribbon shiner	Native	Invertivore	Broadcast	Electrofishing
		Notropis atherinoides	Emerald shiner	Native	Invertivore	Broadcast	Electrofishing
		Notropis chalybaeus	Ironcolor shiner	Native	Invertivore	Nest and substrate	Electrofishing
		Notropis maculatus	Taillight shiner	Native	Invertivore	Nest and substrate	Electrofishing
		Notropis shumardi	Silverband shiner	Native	Invertivore	Broadcast	Electrofishing
		Notropis texanus	Weed shiner	Native	Invertivore	NA	Electrofishing
		Pimphales vigilax	Bullhead minnow	Native	Invertivore	Nest and substrate	Electrofishing
Atherinopsidae	Silversides	*Labidesthes sicculus*	Brook silverside	Native	Invertivore	Nest and substrate	Electrofishing
		Labidesthes sicculus	Brook silverside	Native	Invertivore	Nest and substrate	Seining
Fundulidae	Topminnows and killifishes	*Fundulus notatus*	Blackstripe topminnow	Native	Invertivore	Nest and substrate	Electrofishing
		Fundulus notatus	Blackstripe topminnow	Native	Invertivore	Nest and substrate	Seining
Catostomidae	Suckers	*Minytrema melanops*	Spotted sucker	Native	Omnivore	Nest and substrate	Electrofishing
Ictaluridae	Catfishes	*Ameiurus natalis*	Yellow bullhead	Native	Omnivore	Nest and substrate	Electrofishing
		Ictalurus punctatus	Channel catfish	Native	Omnivore	Nest and substrate	Electrofishing
		Noturus gyrinus	Tadpole madtom	Native	Invertivore	Nest and substrate	Electrofishing
		Noturus nocturnus	Freckled madtom	Native	Invertivore	Nest and substrate	Electrofishing
		Pylodictis olivaris	Flathead catfish	Native	Predator	Nest and substrate	Electrofishing
Esocidae	Pickerels	*Esox americanus*	Redfin pickerel	Native	Predator	Broadcast	Electrofishing
Aphredoderidae	Pirate perch	*Aphredoderus sayanus*	Pirate perch	Native	Invertivore	Nest and substrate	Electrofishing
Poecilidae	Mosquitofishes	*Gambusia affinis*	Western mosquitofish	Introduced	Invertivore	Live bearing	Electrofishing
		Gambusia affinis	Western mosquitofish	Introduced	Invertivore	Live bearing	Seining
Percidae	Darters and perches	*Percina macrolepida*	Bigscale logperch	Native	Invertivore	Nest and substrate	Electrofishing
		Percina sciera	Dusky darter	Native	Invertivore	Nest and substrate	Electrofishing
		Etheostoma asprigene	Mud darter	Native	Invertivore	Nest and substrate	Electrofishing

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Family	Family common name	Species	Species common name	Status	Trophic group[1]	General spawning guild	Collection method
		Etheostoma chlorosoma	Bluntnose darter	Native	Invertivore	Nest and substrate	Electrofishing
		Etheostoma gracile	Slough darter	Native	Invertivore	Nest and substrate	Electrofishing
		Etheostoma histrio	Harlequin darter	Native	Invertivore	Nest and substrate	Electrofishing
		Percina maculata	Blackside darter	Native	Invertivore	Nest and substrate	Electrofishing
		Etheostoma proeliare	Cypress darter	Native	Invertivore	Nest and substrate	Electrofishing
Centrarchidae	Sunfishes	*Lepomis macrochirus*	Bluegill	Native	Invertivore	Nest and substrate	Electrofishing
		Lepomis macrochirus	Bluegill	Native	Invertivore	Nest and substrate	Seining
		Lepomis cyanellus	Green sunfish	Native	Predator	Nest and substrate	Electrofishing
		Micropterus salmoides	Largemouth bass	Native	Predator	Nest and substrate	Electrofishing
		Lepomis megalotis	Longear sunfish	Native	Invertivore	Nest and substrate	Electrofishing
		Lepomis megalotis	Longear sunfish	Native	Invertivore	Nest and substrate	Seining
		Lepomis auritus	Redbreast sunfish	Introduced	Invertivore	Nest and substrate	Electrofishing
		Lepomis marginatus	Dollar sunfish	Native	Invertivore	Nest and substrate	Electrofishing
		Lepomis microlophus	Redear sunfish	Native	Invertivore	Nest and substrate	Electrofishing
		Lepomis microlophus	Redear sunfish	Native	Invertivore	Nest and substrate	Seining
		Lepomis miniatus	Redspotted sunfish	Native	Invertivore	Nest and substrate	Electrofishing
		Lepomis symmetricus	Bantam sunfish	Native	Invertivore	Nest and substrate	Electrofishing
		Micropterus punctulatus	Spotted bass	Native	Predator	Nest and substrate	Electrofishing
		Lepomis gulosus	Warmouth	Native	Predator	Nest and substrate	Electrofishing
		Pomoxis annularis	White crappie	Native	Predator	Nest and substrate	Electrofishing
Scianidae	Drums	*Aplodinotus grunniens*	Freshwater drum	Native	Invertivore	Nest and substrate	Electrofishing

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (July 31, 2010)									
	Slow run (e-time 1871)			Fast run (e-time 1312)			Embayment (Margin Pool) (e-time 335)			Total relative abundance
	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	
Spotted gar	8	0.025	0.128	--	--	--	--	--	--	0.013
Longnose gar	--	--	--	--	--	--	--	--	--	--
Bowfin	3	0.010	0.048	--	--	--	--	--	--	0.005
Gizzard shad	--	--	--	--	--	--	--	--	--	--
Threadfin shad	5	0.016	0.080	--	--	--	--	--	--	0.008
Red shiner	--	--	--	4	0.016	0.091	1	0.032	0.090	0.008
Blacktail shiner	2	0.006	0.032	61	0.244	1.395	--	--	--	0.106
Blacktail shiner	--	--	--	4	0.016	0.091	--	--	--	0.007
Common carp	2	0.006	0.032	--	--	--	--	--	--	0.003
Pallid shiner	--	--	--	--	--	--	--	--	--	--
Ribbon shiner	6	0.019	0.096	--	--	--	--	--	--	0.010
Emerald shiner	--	--	--	--	--	--	--	--	--	--
Ironcolor shiner	--	--	--	--	--	--	--	--	--	--
Taillight shiner	--	--	--	5	0.020	0.114	--	--	--	0.008
Silverband shiner	--	--	--	--	--	--	--	--	--	--
Weed shiner	--	--	--	--	--	--	--	--	--	--
Bullhead minnow	--	--	--	3	0.012	0.069	--	--	--	0.005
Brook silverside	4	0.013	0.064	1	0.004	0.023	1	0.032	0.090	0.010
Brook silverside	--	--	--	--	--	--	--	--	--	--
Blackstripe topminnow	1	0.003	0.016	12	0.048	0.274	4	0.129	0.358	0.029
Blackstripe topminnow	--	--	--	--	--	--	--	--	--	--
Spotted sucker	3	0.010	0.048	--	--	--	--	--	--	0.005
Yellow bullhead	--	--	--	--	--	--	--	--	--	--
Channel catfish	9	0.029	0.144	4	0.016	0.091	--	--	--	0.022
Tadpole madtom	--	--	--	--	--	--	--	--	--	--
Freckled madtom	--	--	--	1	0.004	0.023	--	--	--	0.002
Flathead catfish	1	0.003	0.016	--	--	--	2	0.065	0.179	0.005
Redfin pickerel	--	--	--	--	--	--	--	--	--	--
Pirate perch	2	0.006	0.032	1	0.004	0.023	4	0.129	0.358	0.012
Western mosquitofish	--	--	--	--	--	--	3	0.097	0.269	0.005
Western mosquitofish	--	--	--	--	--	--	--	--	--	--
Bigscale logperch	2	0.006	0.032	--	--	--	--	--	--	0.003
Dusky darter	--	--	--	3	0.012	0.069	--	--	--	0.005
Mud darter	--	--	--	1	0.004	0.023	--	--	--	0.002
Bluntnose darter	--	--	--	--	--	--	--	--	--	--
Slough darter	--	--	--	--	--	--	--	--	--	--
Harlequin darter	--	--	--	2	0.008	0.046	--	--	--	0.003
Blackside darter	--	--	--	--	--	--	--	--	--	--
Cypress darter	--	--	--	1	0.004	0.023	--	--	--	0.002
Bluegill	53	0.168	0.850	10	0.040	0.229	--	--	--	0.106
Bluegill	--	--	--	--	--	--	--	--	--	--
Green sunfish	--	--	--	--	--	--	--	--	--	--

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (July 31, 2010)									
	Slow run (e-time 1871)			Fast run (e-time 1312)			Embayment (Margin Pool) (e-time 335)			Total relative abundance
	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	
Largemouth bass	12	0.038	0.192	2	0.008	0.046	--	--	--	0.023
Longear sunfish	119	0.378	1.908	108	0.432	2.470	8	0.258	0.716	0.394
Longear sunfish	--	--	--	--	--	--	--	--	--	--
Redbreast sunfish	--	--	--	1	0.004	0.023	--	--	--	0.002
Dollar sunfish	--	--	--	2	0.008	0.046	--	--	--	0.003
Redear sunfish	20	0.063	0.321	10	0.040	0.229	3	0.097	0.269	0.055
Redear sunfish	--	--	--	1	0.004	0.023	--	--	--	0.002
Redspotted sunfish	27	0.086	0.433	12	0.048	0.274	4	0.129	0.358	0.072
Bantam sunfish	--	--	--	--	--	--	1	0.032	0.090	0.002
Spotted bass	1	0.003	0.016	--	--	--	--	--	--	0.002
Warmouth	18	0.057	0.289	1	0.004	0.023	--	--	--	0.032
White crappie	14	0.044	0.224	--	--	--	--	--	--	0.023
Freshwater drum	3	0.010	0.048	--	--	--	--	--	--	0.005
Totals number of individuals and CPUE per mesohabitat type	315		5.051	250		5.716	31		2.776	
Total number of species per mesohabitat type			22			21			10	
Number of darter and perch species per mesohabitat type			1			4			0	
CPUE for darters and perches			0.032			0.160			0	
CPUE for native cyprinids (minnows)			0.128			1.761			0.090	
CPUE for invertivores			3.832			5.556			2.597	
CPUE for predators			0.914			0.069			0.179	
CPUE for omnivores			0.305			0.091			0	
CPUE for nest and subtrate spawners			4.955			5.716			2.507	
CPUE for broadcast spawners			0.096			0			0	
CPUE for live-bearing			0			0			0.269	
CPUE for broadcast spawners per site per sampling event										0.051
Total number of species per site per sampling event										34
Total fish per site per sampling event										596
Total CPUE per site per sampling event										5.082

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (July 27, 2011)						
	Slow run (e-time not recorded)		Fast run (e-time not recorded)		Embayment (Margin Pool) (e-time not recorded)		Total relative abundance
	Number of individuals	Relative abundance	Number of individuals	Relative abundance	Number of individuals	Relative abundance	
Spotted gar	1	0.006	--	--	--	--	0.002
Longnose gar	1	0.006	--	--	--	--	0.002
Bowfin	1	0.006	--	--	--	--	0.002
Gizzard shad	--	--	--	--	--	--	--
Threadfin shad	2	0.012	--	--	--	--	0.004
Red shiner	--	--	--	--	--	--	--
Blacktail shiner	14	0.087	48	0.310	6	0.029	0.130
Blacktail shiner	--	--	--	--	1	0.005	0.002
Common carp	--	--	--	--	--	--	--
Pallid shiner	--	--	--	--	--	--	--
Ribbon shiner	--	--	--	--	--	--	--
Emerald shiner	--	--	--	--	--	--	--
Ironcolor shiner	--	--	--	--	--	--	--
Taillight shiner	--	--	--	--	--	--	--
Silverband shiner	--	--	--	--	--	--	--
Weed shiner	--	--	--	--	--	--	--
Bullhead minnow	3	0.019	20	0.129	--	--	0.044
Brook silverside	5	0.031	--	--	1	0.005	0.011
Brook silverside	--	--	--	--	2	0.010	0.004
Blackstripe topminnow	2	0.012	7	0.045	1	0.005	0.019
Blackstripe topminnow	--	--	--	--	26	0.124	0.050
Spotted sucker	3	0.019	--	--	--	--	0.006
Yellow bullhead	--	--	1	0.006	--	--	0.002
Channel catfish	4	0.025	--	--	--	--	0.008
Tadpole madtom	--	--	--	--	--	--	--
Freckled madtom	--	--	--	--	--	--	--
Flathead catfish	2	0.012	1	0.006	--	--	0.006
Redfin pickerel	--	--	--	--	--	--	--
Pirate perch	6	0.037	1	0.006	3	0.014	0.019
Western mosquitofish	2	0.012	--	--	--	--	0.004
Western mosquitofish	--	--	--	--	158	0.756	0.301
Bigscale logperch	--	--	--	--	--	--	--
Dusky darter	1	0.006	--	--	--	--	0.002
Mud darter	--	--	2	0.013	--	--	0.004
Bluntnose darter	--	--	1	0.006	--	--	0.002
Slough darter	--	--	--	--	--	--	--
Harlequin darter	--	--	--	--	--	--	--

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (July 27, 2011)						
	Slow run (e-time not recorded)		Fast run (e-time not recorded)		Embayment (Margin Pool) (e-time not recorded)		Total relative abundance
	Number of individuals	Relative abundance	Number of individuals	Relative abundance	Number of individuals	Relative abundance	
Blackside darter	--	--	--	--	--	--	--
Cypress darter	--	--	--	--	1	0.005	0.002
Bluegill	18	0.112	1	0.006	1	0.005	0.038
Bluegill	--	--	2	0.013	--	--	0.004
Green sunfish	--	--	--	--	--	--	--
Largemouth bass	8	0.050	--	--	--	--	0.015
Longear sunfish	66	0.410	2	0.013	8	0.038	0.145
Longear sunfish	--	--	43	0.277	--	--	0.082
Redbreast sunfish	--	--	--	--	--	--	--
Dollar sunfish	--	--	6	0.039	--	--	0.011
Redear sunfish	7	0.043	9	0.058	--	--	0.030
Redear sunfish	--	--	--	--	--	--	--
Redspotted sunfish	8	0.050	9	0.058	1	0.005	0.034
Bantam sunfish	--	--	--	--	--	--	--
Spotted bass	1	0.006	2	0.013	--	--	0.006
Warmouth	2	0.012	--	--	--	--	0.004
White crappie	2	0.012	--	--	--	--	0.004
Freshwater drum	2	0.012	--	--	--	--	0.004
Totals number of individuals and CPUE per mesohabitat type	161		155		209		
Total number of species per mesohabitat type		23		14		9	
Number of darter and perch species per mesohabitat type		1		2		1	
CPUE for darters and perches							
CPUE for native cyprinids (minnows)							
CPUE for invertivores							
CPUE for predators							
CPUE for omnivores							
CPUE for nest and subtrate spawners							
CPUE for broadcast spawners							
CPUE for live-bearing							
CPUE for broadcast spawners per site per sampling event							
Total number of species per site per sampling event							28
Total fish per site per sampling event							525
Total CPUE per site per sampling event							

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (August 3–4, 2010)												
	Slow run (e-time 614)			Fast run (e-time 2033)			Pool (Channel) (e-time 318)			Backwater (Margin Pool) (e-time 30)			Total relative abundance
	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	
Spotted gar	--	--	--	--	--	--	--	--	--	--	--	--	--
Longnose gar	--	--	--	--	--	--	--	--	--	--	--	--	--
Bowfin	--	--	--	--	--	--	--	--	--	--	--	--	--
Gizzard shad	--	--	--	--	--	--	--	--	--	--	--	--	--
Threadfin shad	--	--	--	--	--	--	--	--	--	--	--	--	--
Red shiner	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Blacktail shiner	3	0.048	0.147	10	0.057	0.148	6	0.250	0.566	1	0.083	1.000	0.073
Blacktail shiner	--	--	--	1	0.006	0.015	1	0.042	0.094	--	--	--	0.007
Common carp	--	--	--	--	--	--	--	--	--	--	--	--	--
Pallid shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Ribbon shiner	18	0.286	0.879	10	0.057	0.148	--	--	--	--	--	--	0.103
Emerald shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Ironcolor shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Taillight shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Silverband shiner	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Weed shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Bullhead minnow	--	--	--	--	--	--	--	--	--	--	--	--	--
Brook silverside	9	0.143	0.440	2	0.011	0.030	--	--	--	--	--	--	0.040
Brook silverside	--	--	--	--	--	--	--	--	--	2	0.167	2.000	0.007
Blackstripe topminnow	1	0.016	0.049	17	0.098	0.251	--	--	--	1	0.083	1.000	0.070
Blackstripe topminnow	--	--	--	3	0.017	0.044	--	--	--	--	--	--	0.011
Spotted sucker	2	0.032	0.098	3	0.017	0.044	--	--	--	--	--	--	0.018
Yellow bullhead	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel catfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Tadpole madtom	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Freckled madtom	1	0.016	0.049	--	--	--	--	--	--	--	--	--	0.004
Flathead catfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Redfin pickerel	--	--	--	2	0.011	0.030	--	--	--	--	--	--	0.007
Pirate perch	--	--	--	7	0.040	0.103	--	--	--	--	--	--	0.026
Western mosquitofish	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Western mosquitofish	--	--	--	--	--	--	--	--	--	--	--	--	--
Bigscale logperch	--	--	--	1	0.006	0.015	--	--	--	1	0.083	1.000	0.007
Dusky darter	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Mud darter	--	--	--	--	--	--	--	--	--	--	--	--	--
Bluntnose darter	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Slough darter	--	--	--	--	--	--	--	--	--	--	--	--	--
Harlequin darter	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Blackside darter	--	--	--	--	--	--	--	--	--	--	--	--	--
Cypress darter	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Bluegill	--	--	--	26	0.149	0.384	--	--	--	1	0.083	1.000	0.099
Bluegill	4	0.063	0.195	1	0.006	0.015	--	--	--	--	--	--	0.018
Green sunfish	--	--	--	5	0.029	0.074	--	--	--	--	--	--	0.018

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (August 3–4, 2010)												
	Slow run (e-time 614)			Fast run (e-time 2033)			Pool (Channel) (e-time 318)			Backwater (Margin Pool) (e-time 30)			Total relative abundance
	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	
Largemouth bass	2	0.032	0.098	7	0.040	0.103	1	0.042	0.094	--	--	--	0.037
Longear sunfish	12	0.190	0.586	58	0.333	0.856	12	0.500	1.132	5	0.417	5.000	0.319
Longear sunfish	--	--	--	--	--	--	--	--	--	1	0.083	1.000	0.004
Redbreast sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Dollar sunfish	--	--	--	2	0.011	0.030	--	--	--	--	--	--	0.007
Redear sunfish	7	0.111	0.342	1	0.006	0.015	--	--	--	--	--	--	0.029
Redear sunfish	--	--	--	1	0.006	0.015	--	--	--	--	--	--	0.004
Redspotted sunfish	2	0.032	0.098	6	0.034	0.089	1	0.042	0.094	--	--	--	0.033
Bantam sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted bass	1	0.016	0.049	--	--	--	--	--	--	--	--	--	0.004
Warmouth	1	0.016	0.049	3	0.017	0.044	3	0.125	0.283	--	--	--	0.026
White crappie	--	--	--	--	--	--	--	--	--	--	--	--	--
Freshwater drum	--	--	--	--	--	--	--	--	--	--	--	--	--
Totals number of individuals and CPUE per mesohabitat type	63		3.078	174		2.568	24		2.264	12		12.000	
Total number of species per mesohabitat type			13			24			5			6	
Number of darter and perch species per mesohabitat type			0			5			0			1	
CPUE for darters and perches			0			0.074			0			1.000	
CPUE for native cyprinids (minnows)			1.026			0.339			0.660			1.000	
CPUE for invertivores			2.785			2.273			1.887			12.000	
CPUE for predators			0.195			0.251			0.377			0	
CPUE for omnivores			0.098			0.044			0			0	
CPUE for nest and subtrate spawners			2.199			2.361			2.264			12.000	
CPUE for broadcast spawners			0.879			0.192			0			0	
CPUE for live-bearing			0			0.015			0			0	
CPUE for broadcast spawners per site per sampling event													0.311
Total number of species per site per sampling event													26
Total fish per site per sampling event													273
Total CPUE per site per sampling event													2.735

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (August 19, 2010)												
	Slow Run (e-time 2090)			Fast Run (e-time 834)			Pool (Channel) (e-time 410)			Forewater (Margin Pool) (e-time 249)			Total relative abundance
	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	
Spotted gar	4	0.022	0.057	--	--	--	--	--	--	--	--	--	0.011
Longnose gar	--	--	--	--	--	--	--	--	--	--	--	--	--
Bowfin	1	0.006	0.014	--	--	--	--	--	--	--	--	--	0.003
Gizzard shad	9	0.050	0.129	--	--	--	--	--	--	--	--	--	0.025
Threadfin shad	--	--	--	--	--	--	--	--	--	--	--	--	--
Red shiner	6	0.033	0.086	3	0.026	0.108	--	--	--	--	--	--	0.025
Blacktail shiner	1	0.006	0.014	6	0.052	0.216	--	--	--	--	--	--	0.019
Blacktail shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Common carp	--	--	--	--	--	--	--	--	--	--	--	--	--
Pallid shiner	1	0.006	0.014	--	--	--	--	--	--	--	--	--	0.003
Ribbon shiner	6	0.033	0.086	--	--	--	--	--	--	2	0.049	0.241	0.022
Emerald shiner	--	--	--	8	0.069	0.288	--	--	--	--	--	--	0.022
Ironcolor shiner	3	0.017	0.043	4	0.034	0.144	--	--	--	--	--	--	0.019
Taillight shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Silverband shiner	--	--	--	--	--	--	--	--	--	--	--	--	--
Weed shiner	--	--	--	--	--	--	--	--	--	4	0.098	0.482	0.011
Bullhead minnow	--	--	--	1	0.009	0.036	--	--	--	--	--	--	0.003
Brook silverside	3	0.017	0.043	1	0.009	0.036	--	--	--	2	0.049	0.241	0.017
Brook silverside	--	--	--	--	--	--	--	--	--	--	--	--	--
Blackstripe topminnow	7	0.039	0.100	10	0.086	0.360	--	--	--	3	0.073	0.361	0.056
Blackstripe topminnow	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted sucker	11	0.061	0.158	--	--	--	--	--	--	1	0.024	0.120	0.033
Yellow bullhead	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel catfish	2	0.011	0.029	--	--	--	--	--	--	1	0.024	0.120	0.008
Tadpole madtom	--	--	--	--	--	--	--	--	--	--	--	--	--
Freckled madtom	--	--	--	--	--	--	--	--	--	--	--	--	--
Flathead catfish	--	--	--	1	0.009	0.036	1	0.045	0.073	1	0.024	0.120	0.008
Redfin pickerel	1	0.006	0.014	1	0.009	0.036	--	--	--	--	--	--	0.006
Pirate perch	2	0.011	0.029	1	0.009	0.036	--	--	--	--	--	--	0.008
Western mosquitofish	--	--	--	--	--	--	--	--	--	--	--	--	--
Western mosquitofish	--	--	--	--	--	--	--	--	--	--	--	--	--
Bigscale logperch	--	--	--	--	--	--	--	--	--	--	--	--	--
Dusky darter	1	0.006	0.014	--	--	--	--	--	--	--	--	--	0.003
Mud darter	1	0.006	0.014	--	--	--	--	--	--	--	--	--	0.003
Bluntnose darter	--	--	--	--	--	--	--	--	--	--	--	--	--
Slough darter	1	0.006	0.014	--	--	--	--	--	--	--	--	--	0.003
Harlequin darter	--	--	--	2	0.017	0.072	--	--	--	--	--	--	0.006
Blackside darter	--	--	--	1	0.009	0.036	--	--	--	--	--	--	0.003
Cypress darter	1	0.006	0.014	--	--	--	--	--	--	--	--	--	0.003
Bluegill	17	0.094	0.244	4	0.034	0.144	4	0.182	0.293	3	0.073	0.361	0.078
Bluegill	--	--	--	--	--	--	--	--	--	--	--	--	--
Green sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Largemouth bass	11	0.061	0.158	2	0.017	0.072	1	0.045	0.073	2	0.049	0.241	0.045
Longear sunfish	66	0.367	0.947	65	0.560	2.338	9	0.409	0.659	17	0.415	2.048	0.437

Appendix 3. Number of fish, relative abundance, and catch per unit effort by species, mesohabitat type, and collection method from USGS stations 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Texas, 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., and 07346071 Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[e-time, time in seconds that electrofishing was the collection method used in the mesohabitat; CPUE, catch per unit of electrofishing effort (number of individuals caught in 30 seconds); --, no data]

Species common name	Little Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (August 19, 2010)												
	Slow Run (e-time 2090)			Fast Run (e-time 834)			Pool (Channel) (e-time 410)			Forewater (Margin Pool) (e-time 249)			Total relative abundance
	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	Number of individuals	Relative abundance	CPUE	
Longear sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Redbreast sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Dollar sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Redear sunfish	7	0.039	0.100	1	0.009	0.036	6	0.273	0.439	3	0.073	0.361	0.047
Redear sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Redspotted sunfish	--	--	--	2	0.017	0.072	--	--	--	--	--	--	0.006
Bantam sunfish	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted bass	4	0.022	0.057	1	0.009	0.036	1	0.045	0.073	1	0.024	0.120	0.019
Warmouth	9	0.050	0.129	2	0.017	0.072	--	--	--	1	0.024	0.120	0.033
White crappie	4	0.022	0.057	--	--	--	--	--	--	--	--	--	0.011
Freshwater drum	1	0.006	0.014	--	--	--	--	--	--	--	--	--	0.003
Totals number of individuals and CPUE per mesohabitat type	180		2.584	116		4.173	22		1.610	41		4.940	
Total number of species per mesohabitat type			26			19			6			13	
Number of darter and perch species per mesohabitat type			4			2			0			0	
CPUE for darters and perches			0.057			0.108			0			0	
CPUE for native cyprinids (minnows)			0.244			0.791			0			0.723	
CPUE for invertivores			1.780			3.921			1.390			4.096	
CPUE for predators			0.488			0.252			0.220			0.602	
CPUE for omnivores			0.316			0			0			0.241	
CPUE for nest and subtrate spawners			2.483			3.849			1.610			4.699	
CPUE for broadcast spawners			0.100			0.324			0			0.241	
CPUE for live-bearing			0			0			0			0	
CPUE for broadcast spawners per site per sampling event													0.151
Total number of species per site per sampling event													33
Total fish per site per sampling event													359
Total CPUE per site per sampling event													3.006

[1] Taxon (refers to a genetically related group or groups of one or more organisms with common characteristics that differentiated them as a unit. From International Commission on Zoological Nomenclature.

[1]Fish species classified as predators consume other fish more than other organisms.

Appendix 4—Mussel Data and Habitat Descriptions

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (random starting point no. 1) - 7/30/2010														
1	1	NF	NA	NA	2.5	0.82	SA	--	8.0	2.35	138.8	278.1	262.9	1.9
1	2	NF	NA	NA	0.7	0.02	SA	--	--	--	--	--	--	--
2	3	NF	NA	NA	1.3	1.45	CG	--	--	--	--	--	--	--
3	4	Pistolgrip	L	50	1.4	0.67	SA	--	--	--	--	--	--	--
3	4	Pistolgrip	L	84	1.4	0.67	SA	--	--	--	--	--	--	--
3	5	NF	NA	NA	1.1	0.98	CG	--	3.0	2.35	52.0	112.8	93.0	1.8
4	6	NF	NA	NA	1.4	0.84	SA	--	--	--	--	--	--	--
4	7	Deertoe	L	48	1.5	0.74	SA	--	4.0	2.35	69.4	129.6	105.5	1.5
4	7	Deertoe	L	47	1.5	0.74	SA	--	4.0	2.35	69.4	129.6	105.5	1.5
4	8	NF	NA	NA	1.3	0.00	H	--	--	--	--	--	--	--
4	9	NF	NA	NA	1.1	1.00	SA	--	--	--	--	--	--	--
5	10	NF	NA	NA	1.3	0.45	SA/G	--	--	--	--	--	--	--
5	11	Bankclimber	L	73	1.1	0.61	CG	--	2.5	2.35	43.4	94.8	83.8	1.9
5	11	Southern mapleleaf	L	40	1.1	0.61	CG	--	2.5	2.35	43.4	94.8	83.8	1.9
5	12	NF	NA	NA	0.9	0.86	FG	--	--	--	--	--	--	--
5	13	NF	NA	NA	0.7	0.63	SA	--	4.0	2.35	69.4	135.9	110.9	1.6
5	14	NF	NA	NA	1.2	0.74	SA/FG	--	--	--	--	--	--	--
6	15	NF	NA	NA	2.2	0.14	SA	--	--	--	--	--	--	--
6	16	NF	NA	NA	1.5	0.67	SA	--	--	--	--	--	--	--
6	17	NF	NA	NA	1.5	0.67	H	--	--	--	--	--	--	--
6	18	NF	NA	NA	2.0	0.01	SA/O	--	--	--	--	--	--	--
6	19	NF	NA	NA	1.9	0.62	SA/CG	--	--	--	--	--	--	--
6	20	NF	NA	NA	2.3	0.94	CG	--	4.0	2.35	69.4	157.0	139.3	2.0
6	21	NF	NA	NA	1.0	0.25	SA/W	--	--	--	--	--	--	--
Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (random starting point no. 2) - 7/30/2010														
1	22	NF	NA	NA	2.1	0.00	SA/O	--	--	--	--	--	--	--
1	23	NF	NA	NA	2.8	0.28	SA	--	8.0	2.35	139	394.3	338.3	2.4
1	24	NF	NA	NA	1.9	0.39	VCG	--	--	--	--	--	--	--
2	25	Threehorn wartyback	L	39	1.2	0.25	SA/CG	--	--	--	--	--	--	--
2	25	Bankclimber	D	65	1.2	0.25	SA/CG	--	--	--	--	--	--	--
2	25	Deertoe	D	50	1.2	0.25	SA/CG	--	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
2	25	Deertoe	D	45	1.2	0.25	SA/CG	--	--	--	--	--	--	--
2	25	Deertoe	D	46	1.2	0.25	SA/CG	--	--	--	--	--	--	--
2	26	NF	NA	NA	1.4	1.47	CG	--	--	--	--	--	--	--
3	27	Western pimpleback	L	35	1.5	0.82	SA/G	--	8.0	2.35	139	332.1	288.8	2.1
3	28	Deertoe	L	35	1.4	1.52	SA	--	--	--	--	--	--	--
3	28	Western pimpleback	L	34	1.4	1.52	SA	--	--	--	--	--	--	--
3	28	Deertoe	L	36	1.4	1.52	SA	--	--	--	--	--	--	--
4	29	Western pimpleback	L	38	1.3	1.08	SA/G	--	--	--	--	--	--	--
4	29	Deertoe	L	47	1.3	1.08	SA/G	--	--	--	--	--	--	--
4	30	Pistolgrip	D	80	1.2	1.1	SA/CO	--	--	--	--	--	--	--
4	31	NF	NA	NA	1.3	0.94	B Covered by SA	--	--	--	--	--	--	--
4	32	NF	NA	NA	1.0	0	B Covered by SA	--	--	--	--	--	--	--
5	33	NF	NA	NA	1.3	0.67	SA	--	--	--	--	--	--	--
5	34	Deertoe	L	49	1.1	1.05	SA/CG	--	5.0	2.35	86.7	229.9	218.5	2.5
5	35	Western pimpleback	L	23	1.2	0.86	SA/CG	--	--	--	--	--	--	--
5	36	Pistolgrip	L	43	0.6	0.96	SA/FG	--	--	--	--	--	--	--
6	37	NF	NA	NA	2.1	0.38	CG	--	--	--	--	--	--	--
6	38	NF	NA	NA	1.5	0.74	SA	--	--	--	--	--	--	--
6	39	NF	NA	NA	1.2	0.86	B	--	--	--	--	--	--	--
6	40	NF	NA	NA	1.1	0.06	CG	--	--	--	--	--	--	--
7	41	NF	NA	NA	2.5	0.31	SA/W	--	--	--	--	--	--	--
7	42	NF	NA	NA	1.7	0.27	SA/O	--	--	--	--	--	--	--
7	43	NF	NA	NA	1.4	0.68	B	--	--	--	--	--	--	--
7	44	NF	NA	NA	2.1	0.66	SA/FG	--	--	--	--	--	--	--
Big Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (random starting point no. 3) - 7/30/2010														
1	45	NF	NA	NA	2.3	0.18	SA	--	--	--	--	--	--	--
1	46	Deertoe	L	53	2.7	1.04	SA	--	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
2	47	Pistolgrip	L	60	1.8	1.35	SA/FG	--	6.0	2.35	104	246.4	211.7	2.0
2	47	Deertoe	L	44	1.8	1.35	SA/FG	--	6.0	2.35	104	246.4	211.7	2.0
2	47	Pistolgrip	L	72	1.8	1.35	SA/FG	--	6.0	2.35	104	246.4	211.7	2.0
2	47	Unknown	L	49	1.8	1.35	SA/FG	--	6.0	2.35	104	246.4	211.7	2.0
2	48	NF	NA	NA	1.0	1.05	CG	--	--	--	--	--	--	--
3	49	Western pimpleback	L	34	1.7	1.45	CG	--	--	--	--	--	--	--
3	49	Pistolgrip	L	75	1.7	1.45	CG	--	--	--	--	--	--	--
3	49	Deertoe	L	46	1.7	1.45	CG	--	--	--	--	--	--	--
3	49	Deertoe	L	28	1.7	1.45	CG	--	--	--	--	--	--	--
3	50	Yellow sandshell	L	74	1.0	1.58	CG	--	--	--	--	--	--	--
4	51	Pistolgrip	L	70	1.3	1.37	SA/CG	--	--	--	--	--	--	--
4	52	NF	NA	NA	1.1	1.24	SA/ CG	--	--	--	--	--	--	--
4	53	NF	NA	NA	1.2	0.85	CG	--	--	--	--	--	--	--
5	54	NF	NA	NA	1.1	0.79	SA	--	6.0	2.35	104	260.9	218.6	2.1
5	55	Western pimpleback	L	37	1.3	0.79	SA	--	--	--	--	--	--	--
5	55	Southern mapleleaf	L	25	1.3	0.79	SA	--	--	--	--	--	--	--
5	55	Deertoe	L	27	1.3	0.79	SA	--	--	--	--	--	--	--
5	56	Bleufer	L	116	1.6	0.74	SA	--	5.0	2.35	86.7	164.3	136.2	1.6
5	56	Deertoe	L	39	1.6	0.74	SA	--	5.0	2.35	86.7	164.3	136.2	1.6
5	57	Pistolgrip	L	71	0.6	0.79	SA/CG	--	--	--	--	--	--	--
5	57	Pistolgrip	L	45	0.6	0.79	SA/CG	--	--	--	--	--	--	--
5	57	Western pimpleback	L	33	0.6	0.79	SA/CG	--	--	--	--	--	--	--
6	58	NF	NA	NA	1.9	0.7	SA/CO	--	--	--	--	--	--	--
6	59	NF	NA	NA	1.2	0.81	SA	--	--	--	--	--	--	--
6	60	NF	NA	NA	1.1	0.94	CG	--	--	--	--	--	--	--
6	61	Deertoe	D	27	1.0	0.66	CG	--	--	--	--	--	--	--
6	61	Western pimpleback	L	52	1.0	0.66	CG	--	--	--	--	--	--	--
7	62	Pistolgrip	D	61	1.8	0.28	SA	--	--	--	--	--	--	--
7	63	NF	NA	NA	1.7	0.85	B	--	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
7	64	NF	NA	NA	1.8	0.94	CG	--	--	--	--	--	--	--
Mean depth and velocity in quadrats where mussels were collected					1.4	0.93								
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (random starting point no. 1) - 7/31/2010														
1	1	Bankclimber	D	113	3.1	0.05	SA	0	7.5	2.35	1301	283.9	231.9	1.8
1	1	Washboard	L	155	3.1	0.05	SA	1.0	7.5	2.35	130	283.9	231.9	1.8
1	2	Washboard	L	160	4.3	0.00	SA	0	--	--	--	--	--	--
1	2	Washboard	L	145	4.3	0.00	SA	1.0	--	--	--	--	--	--
1	2	Washboard	L	167	4.3	0.00	SA	2.0	--	--	--	--	--	--
1	2	Washboard	L	167	4.3	0.00	SA	3.0	--	--	--	--	--	--
1	3	Pimpleback	L	30	3.4	-0.04	SA/O	0.3	--	--	--	--	--	--
2	4	Bankclimber	L	113	2.9	0.50	SA	--	--	--	--	--	--	--
2	4	Washboard	L	174	2.9	0.50	SA	--	--	--	--	--	--	--
2	4	Washboard	L	160	2.9	0.50	SA	--	--	--	--	--	--	--
2	5	Bankclimber	L	117	2.5	0.02	SA	0.3	--	--	--	--	--	--
2	5	Washboard	L	166	2.5	0.02	SA	1.3	--	--	--	--	--	--
3	6	Washboard	L	148	1.8	0.65	SA	--	10.0	2.35	174	421.2	345.5	2.0
3	6	Bankclimber	L	113	1.8	0.65	SA	--	10.0	2.35	174	421.2	345.5	2.0
3	7	NF	NA	NA	1.6	0.13	SA/O	>5	--	--	--	--	--	--
4	8	Washboard	L	172	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	163	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	155	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	172	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Yellow sandshell or fragile papershell	L	83	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Bankclimber	L	112	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	174	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	175	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	157	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	155	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Bankclimber	L	111	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	174	2.2	0.21	SA	0	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
4	8	Washboard	L	166	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	167	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Washboard	L	168	2.2	0.21	SA	0	--	--	--	--	--	--
4	8	Yellow sandshell	L	98	2.2	0.21	SA	0	--	--	--	--	--	--
4	9	NF	NA	NA	0.8	0.58	SA	--	--	--	--	--	--	--
5	10	Washboard	L	167	1.5	0.52	SA	--	--	--	--	--	--	--
5	11	NF	NA	NA	2.1	0.43	SA/O	--	3.0	2.35	52.0	76.2	57.0	1.1
6	12	NF	NA	NA	1.2	0.44	SA	--	--	--	--	--	--	--
6	13	Bleufer	L	141	2.7	0.43	SA/O	0.5	--	--	--	--	--	--
6	13	Washboard	L	184	2.7	0.43	SA/O	0.5	--	--	--	--	--	--
6	13	Washboard	L	165	2.7	0.43	SA/O	0.5	--	--	--	--	--	--
6	13	Threeridge	D	114	2.7	0.43	SA/O	0.5	--	--	--	--	--	--
6	13	Pistolgrip	L	110	2.7	0.43	SA/O	0.5	--	--	--	--	--	--
6	14	NF	NA	NA	1.2	0.30	SA/O	--	--	--	--	--	--	--
7	15	Fragile papershell	L	81	1.9	0.68	SA/O	>5	--	--	--	--	--	--
7	15	Washboard	D	151	1.9	0.68	SA/O	>5	--	--	--	--	--	--
7	16	Washboard	L	167	3.3	0.21	SA/O	>5	--	--	--	--	--	--
7	16	Bleufer	L	148	3.3	0.21	SA/O	>5	--	--	--	--	--	--
7	17	NF	NA	NA	1.1	0.00	O	--	--	--	--	--	--	--
8	18	NF	NA	NA	1.9	0.90	SA	--	--	--	--	--	--	--
8	19	Washboard	L	153	1.8	0.40	SA/O	--	--	--	--	--	--	--
8	19	Washboard	L	158	1.8	0.40	SA/O	--	--	--	--	--	--	--
9	20	Washboard	L	146	1.9	0.47	SA/O	--	--	--	--	--	--	--
9	21	Washboard	L	157	2.0	0.27	SA/O	0.5	--	--	--	--	--	--
9	21	Pistolgrip	D	114	2.0	0.27	SA/O	0.5	--	--	--	--	--	--
9	21	Bankclimber	D	112	2.0	0.27	SA/O	0.5	--	--	--	--	--	--
9	21	Washboard	D	178	2.0	0.27	SA/O	0.5	--	--	--	--	--	--
9	21	Washboard	D	165	2.0	0.27	SA/O	0.5	--	--	--	--	--	--
9	22	NF	NA	NA	1.0	0.00	SA/CL/O	--	--	--	--	--	--	--
10	23	Bankclimber	L	118	1.7	1.32	SA/O	--	--	--	--	--	--	--
10	23	Washboard	L	168	1.7	1.32	SA/O	--	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
10	23	Washboard	L	156	1.7	1.32	SA/O	--	--	--	--	--	--	--
10	23	Washboard	D	159	1.7	1.32	SA/O	--	--	--	--	--	--	--
10	23	Washboard	D	157	1.7	1.32	SA/O	--	--	--	--	--	--	--
10	24	Yellow sandshell	L	105	2.5	0.49	--	0	--	--	--	--	--	--
10	25	NF	NA	NA	1.5	0.37	SA/O	--	--	--	--	--	--	--
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (random starting point no. 2) - 7/31/2010														
1	26	Washboard	L	163	1.0	0.29	SA/O	0	5.0	2.35	86.7	160.4	121.5	1.4
1	26	Washboard	L	173	1.0	0.29	SA/O	0	5.0	2.35	86.7	160.4	121.5	1.4
1	26	Washboard	L	156	1.0	0.29	SA/O	0	5.0	2.35	86.7	160.4	121.5	1.4
1	26	Washboard	L	161	1.0	0.29	SA/O	0	5.0	2.35	86.7	160.4	121.5	1.4
1	26	Washboard	L	175	1.0	0.29	SA/O	0	5.0	2.35	86.7	160.4	121.5	1.4
1	26	Fragile papershell	L	82	1.0	0.29	SA/O	0	5.0	2.35	86.7	160.4	121.5	1.4
1	27	NF	NA	NA	1.0	0.29	SA/O	0	--	--	--	--	--	--
1	28	Washboard	L	157	3.7	0.69	SA	2.5	--	--	--	--	--	--
1	28	Washboard	L	152	3.7	0.69	SA	2.5	--	--	--	--	--	--
1	28	Washboard	L	154	3.7	0.69	SA	2.5	--	--	--	--	--	--
1	28	Washboard	L	161	3.7	0.69	SA	2.5	--	--	--	--	--	--
2	29	Louisiana fatmucket	NA	108	1.8	0.67	SA	4.4	--	--	--	--	--	--
2	30	NF	NA	NA	1.1	0.24	SA/O	--	--	--	--	--	--	--
2	31	Washboard	L	162	1.8	0.59	SA	2.2	6.0	2.35	104	247.9	201.4	1.9
2	31	Bankclimber	L	114	1.8	0.59	SA	2.2	6.0	2.35	104	247.9	201.4	1.9
2	31	Deertoe	L	47	1.8	0.59	SA	2.2	6.0	2.35	104	247.9	201.4	1.9
2	31	Western pimpleback	D	63	1.8	0.59	SA	2.2	6.0	2.35	104	247.9	201.4	1.9
3	32	NF	NA	NA	1.3	0.52	SA/O	--	--	--	--	--	--	--
3	33	Washboard	L	178	2.4	0.39	SA	--	--	--	--	--	--	--
3	33	Western pimpleback	L	35	2.4	0.39	SA	1.0	--	--	--	--	--	--
3	33	Fragile papershell	D	90	2.4	0.57	SA	--	--	--	--	--	--	--
3	34	NF	NA	NA	0.8	0.57	SA	--	--	--	--	--	--	--
4	35	NF	NA	NA	0.6	0.37	SA	--	--	--	--	--	--	--
4	36	Washboard	L	154	2.8	0.68	SA	2.5	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
5	37	NF	NA	NA	0.9	0.29	SA/O	--	--	--	--	--	--	--
5	38	Bleufer	L	140	2.8	0.11	SA/O	--	8.0	2.35	139	286.4	227.4	1.6
5	38	Washboard	L	153	2.8	0.11	SA/O	--	8.0	2.35	139	286.4	227.4	1.6
6	39	NF	NA	NA	1.3	0.52	SA	--	--	--	--	--	--	--
6	40	Washboard	L	162	2.9	0.47	SA/O	2.2	--	--	--	--	--	--
6	40	Washboard	L	171	2.9	0.47	SA/O	2.2	--	--	--	--	--	--
6	40	Washboard	L	151	2.9	0.47	SA/O	2.2	--	--	--	--	--	--
6	40	Washboard	L	149	2.9	0.47	SA/O	2.2	--	--	--	--	--	--
6	40	Washboard	L	156	2.9	0.47	SA/O	2.2	--	--	--	--	--	--
6	40	Washboard	L	147	2.9	0.47	SA/O	2.2	--	--	--	--	--	--
6	41	Bankclimber	L	106	2.7	0.24	SA/O	1.3	--	--	--	--	--	--
6	41	Washboard	L	161	2.7	0.24	SA/O	1.3	--	--	--	--	--	--
7	42	Yellow sandshell	L	46	1.6	0.53	SA	0	--	--	--	--	--	--
7	43	Washboard	L	175	2.8	0.06	SA/W	0	--	--	--	--	--	--
7	43	Bleufer	L	141	2.8	0.06	SA/W	0	--	--	--	--	--	--
7	44	NF	NA	NA	1.6	0.01	SA/W	--	--	--	--	--	--	--
8	45	Pistolgrip	D	133	1.9	0.50	SA/W	0	--	--	--	--	--	--
8	45	Pigtoe[1]	D	73	1.9	0.50	SA/W	0	--	--	--	--	--	--
8	46	NF	NA	NA	1.5	0.59	SA/W	--	--	--	--	--	--	--
8	46	Paper pondshell	L	44	1.5	0.59	SA/W	--	--	--	--	--	--	--
8	46	Pistolgrip	D	147	1.5	0.59	SA/W	--	--	--	--	--	--	--
8	47	Bleufer	L	52	1.8	0.24	SA/O	0.5	--	--	--	--	--	--
8	47	Yellow sandshell	--	107	1.8	0.24	SA/O	--	--	--	--	--	--	--
9	48	Washboard	L	160	1.2	0.65	SA	>5	10.0	2.35	1745	412.4	341.3	2.0
9	49	Bankclimber	L	101	1.6	0.12	SA/O	1.0	--	--	--	--	--	--
9	50	Bleufer	D	NA	1.2	0.17	SA	--	--	--	--	--	--	--
Big Cypress Bayou at confluence of French Creek, Jefferson, Tex. (random starting point no. 3) - 7/31/2010														
1	51	Washboard	L	155	1.8	0.34	--	3.0	--	--	--	--	--	--
1	51	Bankclimber	D	76	1.8	0.34	--	3.0	--	--	--	--	--	--
1	51	Threeridge	D	106	1.8	0.34	SA	3.0	--	--	--	--	--	--
1	52	NF	NA	NA	0.5	0.19	SA/O	0	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
1	53	NF	NA	NA	1.8	-0.01	SA/W/R	--	--	--	--	--	--	--
1	54	NF	NA	NA	1.2	0.02	SA/W/R	--	--	--	--	--	--	--
2	55	Yellow sandshell	L	102	1.3	0.43	SA/W	0	--	--	--	--	--	--
2	56	Bankclimber	L	117	1.4	0.49	SA	0	--	--	--	--	--	--
2	56	Pimpleback	L	67	1.4	0.49	SA	1	--	--	--	--	--	--
2	57	NF	NA	NA	2.2	-0.09	SA/O	--	--	--	--	--	--	--
3	58	NF	NA	NA	1.7	0.28	SA	--	--	--	--	--	--	--
4	59	Pimpleback	L	67	2.4	0.70	SA	2.0	7.5	2.35	130	313.4	257.4	2.0
4	59	Pimpleback	L	29	2.4	0.70	SA	2.0	7.5	2.35	130	313.4	257.4	2.0
4	59	Bleufer	L	143	2.4	0.70	SA	2.0	7.5	2.35	130	313.4	257.4	2.0
4	60	Louisiana fatmucket	L	102	1.6	0.41	SA	--	--	--	--	--	--	--
4	60	Pimpleback	L	32	1.6	0.41	SA	--	--	--	--	--	--	--
5	61	Pimpleback	L	34	2.6	0.39	SA	2.0	--	--	--	--	--	--
5	61	Washboard	L	169	2.6	0.39	SA	--	--	--	--	--	--	--
5	61	Washboard	L	158	2.6	0.39	SA	--	--	--	--	--	--	--
5	62	Washboard	L	149	1.5	0.63	SA	--	--	--	--	--	--	--
5	62	Washboard	L	150	1.5	0.63	SA	--	--	--	--	--	--	--
5	62	Threeridge	L	103	1.5	0.63	SA	--	--	--	--	--	--	--
5	62	Yellow sandshell	L	70	1.5	0.63	SA	--	--	--	--	--	--	--
6	63	NF	NA	NA	1.0	0.37	SA/O	--	5.0	2.35	86.7	145.8	109.4	1.3
6	64	NF	NA	NA	2.4	0.27	SA	--	--	--	--	--	--	--
6	65	Bleufer	L	142	1.6	0.29	SA/O	0	--	--	--	--	--	--
7	66	NF	NA	NA	1.5	1.80	SA/S/CL	--	--	--	--	--	--	--
7	67	Washboard	L	156	3.0	0.21	SA/W	>5	--	--	--	--	--	--
7	67	Washboard	L	154	3.0	0.21	SA/W	>5	--	--	--	--	--	--
7	67	Washboard	L	145	3.0	0.21	SA/W	>5	--	--	--	--	--	--
7	67	Washboard	L	143	3.0	0.21	SA/W	>5	--	--	--	--	--	--
7	67	Bankclimber	D	112	--	--	--	--	--	--	--	--	--	--
7	68	NF	NA	NA	1.9	0.15	SA/W	--	--	--	--	--	--	--
7	69	NF	NA	NA	1.0	0.40	SA/O	--	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
8	70	Washboard	--	152	1.6	0.48	SA/O	1.7	--	--	--	--	--	--
8	70	Washboard	--	153	1.6	0.48	SA/O	1.7	--	--	--	--	--	--
8	70	Fragile papershell	D	106	1.6	0.48	SA/O	1.7	--	--	--	--	--	--
8	71	NF	NA	NA	1.7	0.23	SA/W	--	--	--	--	--	--	--
9	72	Washboard	D	172	1.2	0.67	SA	--	--	--	--	--	--	--
9	72	Bankclimber	D	69	1.2	0.67	SA	--	--	--	--	--	--	--
9	73	NF	NA	NA	2.1	0.36	SA	--	--	--	--	--	--	--
9	74	NF	NA	NA	1.4	0.23	SA/W	--	--	--	--	--	--	--
10	75	NF	NA	NA	0.6	0.39	SA	--	--	--	--	--	--	--
10	76	Washboard	L	165	1.3	0.39	SA/W	0	--	--	--	--	--	--
10	76	Pistolgrip	L	150	1.3	0.39	SA/W	1	--	--	--	--	--	--
10	77	Washboard	L	146	2.2	0.56	SA/O	0.5	--	--	--	--	--	--
Mean depth and velocity in quadrats where mussels were collected					2.2	0.41								
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (random starting point no. 1) - 8/3/2010														
1	1	NF	NA	NA	1.9	0.04	RM	--	--	--	--	--	--	--
3	2	NF	NA	NA	--	--	SI/RM	--	--	--	--	--	--	--
4	1	NF	NA	NA	1.5	-0.03	SI/RM	--	--	--	--	--	--	--
4	2	NF	NA	NA	5.9	0.01	SI	--	--	--	--	--	--	--
4	3	NF	NA	NA	3.9	0.27	SA/O	--	--	--	--	--	--	--
5	4	NF	NA	NA	1.1	0.14	SA/W	--	--	--	--	--	--	--
5	5	NF	NA	NA	2.8	0.77	SA/W	--	--	--	--	--	--	--
5	6	NF	NA	NA	1.3	0.50	SA/RM	--	--	--	--	--	--	--
6	7	NF	NA	NA	2.0	-0.05	CG	--	--	--	--	--	--	--
6	8	NF	NA	NA	3.4	0.29	SA/W	--	--	--	--	--	--	--
6	9	NF	NA	NA	1.1	0.33	W/RM	--	--	--	--	--	--	--
7	10	NF	NA	NA	2.8	0.41	LCO	--	--	--	--	--	--	--
7	11	Pistolgrip	D	57	3.8	0.21	LCO	--	3.0	2.35	52.0	99.8	73.3	1.4
8	12	NF	NA	NA	2.1	0.22	SA/S	--	--	--	--	--	--	--
8	13	NF	NA	NA	2.3	0.27	SA/O	--	3.0	2.35	52.0	79.6	51.6	1.0
9	14	NF	NA	NA	2.1	0.07	SA	--	--	--	--	--	--	--
9	15	NF	NA	NA	4.6	0.04	SA/O	--	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

[L, alive; D, dead; mm, millimeters; ft, feet; ft/s, feet per second; m, meters; cm, centimeters; cm^3, cubic centimeters; g, grams; g/cm^3, grams per cubic centimeter; NF, no mussels were found in this quadrat; NA, not applicable; --, not measured or determined; SA, sand; CG, coarse gravel; H, hardpan; G, gravel; FG, fine gravel; O, organic matter; W, woody debris; VCG, very coarse gravel; B, bedrock; G, gravel; CO, cobble; CL, clay; R, root; RM, root mass; SI, silt; >, greater than; Starting points no. 1, 2, and 3 refer to the random starting points for each of the three quadrat surveys per site; no., number]

Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
10	16	NF	NA	NA	3.8	0.16	RM	--	--	--	--	--	--	--
10	17	Pistolgrip	L	63	5.6	0.03	SA/W	--	--	--	--	--	--	--
10	17	Washboard	L	91	5.6	0.03	SA/W	--	--	--	--	--	--	--
11	18	NF	NA	NA	1.5	0.52	SA/O	--	--	--	--	--	--	--
11	19	NF	NA	NA	3.8	0.64	SA/O	--	--	--	--	--	--	--
12	20	NF	NA	NA	2.2	0.16	O	--	--	--	--	--	--	--
13	21	NF	NA	NA	1.4	-0.05	O	--	--	--	--	--	--	--
13	22	NF	NA	NA	2.4	0.33	SA/W	--	--	--	--	--	--	--
14	23	NF	NA	NA	1.3	0.61	SA/W	--	--	--	--	--	--	--
14	24	NF	NA	NA	1.3	0.62	SA	--	11.0	2.35	191	334.3	229.8	1.2
15	25	NF	NA	NA	1.8	0.53	SA/O	--	--	--	--	--	--	--
15	26	NF	NA	NA	2.8	0.60	SA/W	--	--	--	--	--	--	--
16	27	NF	NA	NA	1.9	0.29	SA	--	--	--	--	--	--	--
16	28	Western pimpleback	L	23	1.6	0.45	SA/W	--	5.0	2.35	86.7	171.8	127.4	1.5
17	29	NF	NA	NA	1.2	0.39	O	--	--	--	--	--	--	--
17	30	Bleufer	L	49	4.0	0.45	SA	--	--	--	--	--	--	--
18	31	NF	NA	NA	1.2	0.28	SA/O	--	--	--	--	--	--	--
18	32	NF	NA	NA	1.9	1.14	SA/W	--	--	--	--	--	--	--
19	33	NF	NA	NA	2.0	0.00	SA/W	--	--	--	--	--	--	--
19	34	NF	NA	NA	2.3	1.02	SA/W	--	--	--	--	--	--	--
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (random starting point no. 2) - 8/3/2010														
4	35	NF	NA	NA	3.2	-0.12	SA/O	--	--	--	--	--	--	--
4	36	NF	NA	NA	5.6	0.25	SA/O	--	--	--	--	--	--	--
5	37	NF	NA	NA	1.3	0.12	SA/RM	--	--	--	--	--	--	--
5	38	Pimpleback	D	45	4.0	0.17	SA	--	4.0	2.35	69.4	102.5	64.7	0.9
6	39	NF	NA	NA	2.5	-0.02	RM	--	--	--	--	--	--	--
6	40	NF	NA	NA	3.0	0.54	SA/O	--	--	--	--	--	--	--
7	41	NF	NA	NA	1.2	0.57	B	--	--	--	--	--	--	--
7	42	NF	NA	NA	3.4	0.08	FG	--	5.0	2.35	86.7	169.7	118.8	1.4
8	43	Texas lilliput[2]	L	42	2.2	0.43	SA	--	--	--	--	--	--	--
8	44	NF	NA	NA	1.6	0.30	SA/W	--	--	--	--	--	--	--
9	45	NF	NA	NA	4.4	0.16	SA/W	--	--	--	--	--	--	--
9	46	NF	NA	NA	2.9	0.19	SA/O	--	--	--	--	--	--	--

Appendix 4. Mussel data and habitat descriptions, including bed sediment bulk densities from USGS stations 07346017 Big Cypress Bayou near U.S. Highway 59 near Jefferson, Texas, 07346015 Big Cypress Bayou at confluence of French Creek, Jefferson, Tex., and 07346044 Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex., 2010.—Continued

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Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
10	47	NF	NA	NA	3.5	0.19	SA/O	--	--	--	--	--	--	--
10	48	NF	NA	NA	4.1	0.02	O	--	--	--	--	--	--	--
11	49	Pimpleback	D	42	1.4	0.47	SA/O	--	--	--	--	--	--	--
11	50	Texas lilliput[2]	L	43	3.4	-0.01	SA/O	--	5.0	2.35	86.7	93.9	36.6	0.4
13	51	NF	NA	NA	1.2	0.57	SA/O	--	--	--	--	--	--	--
13	52	NF	NA	NA	3.2	0.41	SA	--	--	--	--	--	--	--
14	53	NF	NA	NA	1.5	0.62	SA/W	--	--	--	--	--	--	--
14	54	NF	NA	NA	0.9	0.57	SA	--	6.0	2.35	104	161.5	115.0	1.1
15	55	NF	NA	NA	1.6	0.71	SA/O	--	--	--	--	--	--	--
15	56	Unknown	--	62	1.0	-0.02	SA/O	--	--	--	--	--	--	--
16	57	NF	NA	NA	1.5	0.71	SA/W	--	--	--	--	--	--	--
16	58	NF	NA	NA	1.2	0.48	SA	--	--	--	--	--	--	--
17	59	NF	NA	NA	2.1	0.51	SA/O	--	--	--	--	--	--	--
17	60	NF	NA	NA	3.0	0.27	SA	--	9.0	2.35	156	313.3	246.4	1.6
18	61	NF	NA	NA	1.2	0.23	SA/W	--	--	--	--	--	--	--
18	62	NF	NA	NA	3.1	0.17	SA/W	--	--	--	--	--	--	--
19	63	NF	NA	NA	1.9	0.41	SA	--	--	--	--	--	--	--
Black Cypress Bayou near U.S. Highway 59 near Jefferson, Tex. (random starting point no. 3) - 8/3/2010														
1	64	NF	NA	NA	4.1	0.09	SA	--	--	--	--	--	--	--
1	65	NF	NA	NA	3.5	0.06	SA/RM	--	--	--	--	--	--	--
2	66	NF	NA	NA	3.9	-0.03	SA	--	--	--	--	--	--	--
2	67	NF	NA	NA	3.9	0.22	SA/W	--	--	--	--	--	--	--
3	68	NF	NA	NA	2.4	-0.04	SA/W	--	--	--	--	--	--	--
4	69	Washboard	L	127	3.5	0.02	CG	--	4.0	2.35	69.4	145.5	105.8	1.5
5	70	NF	NA	NA	2.9	0.12	W	--	--	--	--	--	--	--
6	71	NF	NA	NA	3.3	0.31	SA/W	--	5.0	2.35	86.7	186.7	133.7	1.5
7	72	NF	NA	NA	3.6	0.32	SA	--	--	--	--	--	--	--
8	73	NF	NA	NA	2.8	-0.15	SA/W	--	--	--	--	--	--	--
8	74	NF	NA	NA	1.0	0.12	O	--	--	--	--	--	--	--
9	75	NF	NA	NA	5.2	0.27	SA	--	--	--	--	--	--	--
11	76	NF	NA	NA	1.3	0.35	SA	--	9.0	2.35	156	307.6	238.6	1.5
12	77	NF	NA	NA	1.0	0.85	SA	--	--	--	--	--	--	--
13	78	NF	NA	NA	1.1	0.43	RM	--	--	--	--	--	--	--

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Transect	Quadrat	Common species name	Condition (L/D)	Length (mm)	Depth (ft)	Velocity (ft/s)	Substrate description	Distance to woody debris (m)	Properties of bed sediment bulk density cores					
									Length (cm)	Radius (cm)	Volume (cm^3)	Final wet weight (g)	Final dry weight (g)	Bulk density (g/cm^3)
14	79	Pistolgrip	L	89	2.6	0.55	SA/RM	--	--	--	--	--	--	--
15	80	NF	NA	NA	5.1	--	SA	--	--	--	--	--	--	--
16	81	NF	NA	NA	1.3	0.85	SA/W	--	--	--	--	--	--	--
Mean depth and velocity in quadrats where mussels were collected					3.2	0.23								

[1]Unidentified species.

[2]Preliminary identification.

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