Village Creek Watershed Bioassessment

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River Studies Report No. 25

Inland Fisheries Division
Texas Parks and Wildlife Department
Austin, Texas

November 2016

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ACKNOWLEDGMENTS

This study was a collaborative effort between the Texas Parks and Wildlife Department's Inland Fisheries, Wildlife, and Parks divisions and the University of Texas with aid from a few other partners. Without the collective effort of these individuals this study would not have been possible.

Texas Parks and Wildlife Department, Inland Fisheries Division: Karim Aziz, Preston Bean, John Botros, Kevin Kolodziejcyk, Stephan Magnelia, Kevin Mayes, and Rachel McDaniel

Texas Parks and Wildlife Department, State Parks Division: Jerry Rashall and Kathy Smith

Texas Parks and Wildlife Department, Wildlife Division: Cullen Hanks

University of Texas: Adam Cohen, Sebastian Espinoza, Dean Hendrickson, Ben Labay, and Chris Long

National Park Service: Ryan Desliu, Kenneth Hyde, and Herbert Young

University of Houston-Clear Lake: Stephen Curtis

Partial funding for this project was provided through the State Wildlife Grants Program in corporation with the U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program.

Village Creek Watershed Bioassessment

EXECUTIVE SUMMARY

One bioassessment study area and 26 supplemental fish collection sites were sampled in the Village Creek Watershed in Hardin, Polk, and Tyler counties, Texas during the summer of 2015. The bioassessment study area included one study reach on Village Creek, two study sites on adjacent sloughs, and one study site on an oxbow lake, all within Village Creek State Park. The study reach on Village Creek was selected to collect fish, freshwater mussel, riparian, and instream habitat data in an effort to support the aquatic science needs of Village Creek State Park, fill gaps in statewide fish and mussel data, and support recreational initiatives such as Texas Parks and Wildlife Department's Texas Paddling Trails Program. The 26 additional fish collections sites were spread throughout the watershed and were selected to supplement statewide fish data needs as determined by the University of Texas' Fishes of Texas Project.

Overall 57 species of fish, 18 species of mussels, 17 aquatic macroinvertebrate taxa, 5 species of crayfish, and 19 species of riparian plants were documented from the Village Creek Watershed, including two fish species of greatest conservation need and three state threatened mussel species. The overall fish community in the Village Creek study reach was given an exceptional aquatic life use rating and was characterized by high species richness, diversity among trophic positions, and a lack of non-native species. The only metrics that scored low for the fish community in that reach were related to low sampling catch-per-unit-effort. Of all fish collection sites, species richness ranged from 1 to 30 species with the least species-rich site being a roadside ditch, sampled to target Least Killifish, and the most species-rich site being the study reach on Village Creek at Village Creek State Park; however, it should be noted that this site also had the highest level of sampling effort. There were some notable differences between mainstem and tributary fish collections, with 18 species collected from tributaries and absent from the mainstem and seven species collected on the mainstem and absent in tributaries. Only one non-native fish species (Redbreast Sunfish) was collected from one site during this study.

Mussel species richness and catch-per-unit effort in the Village Creek study reach were high. Three state threatened species were collected, including Texas Pigtoe, which was the second most abundant species collected in the study reach comprising 22% of the total individuals collected.

Village Creek was not sampled for benthic macroinvertebrates during this study due to a lack of available shallow habitats. Sandy Slough, a tributary of Village Creek within the state park, was sampled instead and contained 17 taxa of benthic macroinvertebrates, including a high diversity of aquatic beetles.

The study reach on Village Creek was assessed for riparian community health and was found to have a well-functioning riparian area as indicated by a wide, contiguous riparian zone, diverse mixture of appropriate riparian species, high plant vigor, low herbivory, and high recruitment of young trees.

The Village Creek study reach was also evaluated for overall stream health using a modified stream visual assessment protocol and was rated as having good stream health.

This study found high fish, mussel, and riparian plant species richness for the Village Creek study reach adjacent to Village Creek State Park. High fish species richness was also found in sloughs at the state park and at many of the supplemental fish collection sites throughout the watershed. Overall the Village Creek Watershed aquatic and riparian ecosystems appear to be healthy and functioning.

INTRODUCTION

Study Area

Village Creek: Village Creek is located in the Piney Woods Ecoregion of East Texas and is part of the Neches River Basin. The Village Creek Watershed totals approximately 1,057 square miles. Village Creek arises from the joining of Big Sandy Creek and Kimball Creek and flows 54 miles, unimpounded, before it joins the Neches River in southeastern Hardin County. Most of the riparian corridor surrounding Village Creek is protected by the National Park Service (NPS: Big Thicket National Preserve), the Nature Conservancy (TNC: Roy E. Larsen Sandyland Sanctuary), and the Texas Parks and Wildlife Department (TPWD: Village Creek State Park). Village Creek was named as a Texas Natural Rivers System nominee and was recognized for its exceptional scenery, recreational value, fisheries, and wildlife (NPS 2010). Additionally, the River Recreationalist Survey named Village Creek the top scenic and recreational river in East Texas (NPS 2010). Due to its valuable biological functions, unique biological community, intact riparian areas, and high water quality TPWD has identified Village Creek as an ecologically significant stream segment (TPWD 2016a).

> Village Creek State Park: Village Creek State Park is comprised of 1,090 acres located outside of Lumberton, TX in Hardin County (TPWD 2016b). A recent land acquisition increased the total area of the park to 2,462 acres; however, the new property is not yet open to the public. The state park is bordered by a 1.8 mile stretch of Village Creek and contains several sloughs that branch off of the main creek into the park. Located within two hours of Houston and Beaumont, the park hosts approximately 30,000 visitors annually (TPWD 2013). The park offers many recreational activities including fishing, swimming, kayaking, hiking, bird watching, and camping. It is stop number UTC 018 on the Great Texas Coastal Birding Trail (TPWD 2016a). Village Creek State Park is also located on the Village Creek paddling trail, a 20.9 mile trail with five public access points (TPWD 2016c). In 2014 it was estimated that the Village Creek State Park had an economic impact of more than $525,000 on sales in Hardin County (Jeong and Crompton 2014). Village Creek plays a significant role in drawing people to the park and providing recreational opportunities for the community.

Survey and Management History

Biological Surveys: Big Thicket Preserve, which encompasses much of the Village Creek Watershed, has long been a site for biological research due to its high species richness. In 2006, an effort began, known as the Thicket of Diversity, to inventory aquatic and terrestrial taxa that occur in Big Thicket Preserve (NPS 2016). As of February 2014, 2,901 species had been identified from the preserve, including 62 species of fish, 32 species of freshwater mussels, and 106 species of aquatic macroinvertebrates (Big Thicket Association 2016).

Relevant biological research in the Village Creek Watershed includes a mussel survey (Bordelon and Harrel 2004) that identified 18 species across 22 sites, a benthic macroinvertebrate survey that found 143 taxa across six sites (Lewis and Harrel 1978), and a fish survey that found 44 species in Village Creek adjacent to the Roy E. Larsen Sandyland Sanctuary (Moriarty and Winemiller 1997).

No comprehensive aquatic surveys have taken place at Village Creek State Park; however, a 2005 study documented the presence of parasites in fish collected from Caney Slough in Village Creek State Park (Yoder and Crabtree 2005).

Imperiled Species: Historical fish collections from the Village Creek Watershed contain six species currently identified by TPWD (2012) as species of greatest conservation need (SGCN): American Eel *Anguilla rostrata*, Blackspot Shiner *Notropis atrocaudalis*, Ironcolor Shiner *Notropis chalybaeus*, Sabine Shiner *Notropis sabinae*, Creek Chubsucker *Erimyzon oblongus* (now known as Western Creek Chubsucker *Erimyzon claviformis* in Texas), and Western Sand Darter *Ammocrypta clara* (Hendrickson and Cohen 2015). Creek Chubsucker is concurrently listed as state threatened in Texas (TPWD 2012).

Bordelon and Harrel (2004) reported four state threatened mussel species during their surveys of Village Creek in 2001 and 2002. These species, concurrently listed by TPWD as SGCN, are Texas Pigtoe *Fusconaia askewi*, Sandbank Pocketbook *Lampsilis satura*, Southern Hickorynut *Obovaria jacksoniana*, and Louisiana Pigtoe *Pleurobema riddellii*. Of the Village Creek sites sampled, Texas Pigtoe was the second most abundant species collected (Bordelon and Harrel 2004).

Sport Fish Harvest Regulations: Sport fishes in Village Creek and its tributaries are managed under statewide freshwater fishing regulations (TPWD 2016d).

Sport Fish Surveys: TPWD has not conducted any sport fish surveys in Village Creek (Todd Driscoll, District Supervisor, TPWD Brookland Fisheries Management Office, personal communication).

Fish Stockings: TPWD has not stocked fish in Village Creek or any of its tributaries (TPWD 2016e).

Water Quality: Village Creek is listed by the Texas Commission on Environmental Quality (TCEQ) as Segment ID 0608 (TCEQ 2014a). The only water quality concern listed in TCEQ's 2014 Texas Integrated Report (2014a) for Village Creek is elevated levels of mercury in edible fish tissues. More specifically, there is a fish consumption advisory in place for crappie, gar, and Largemouth Bass in Village Creek in Hardin County due to elevated mercury levels (TPWD 2016f).

STUDY SITES

The Village Creek Watershed Bioassessment included comprehensive sampling at one bioassessment study area (Village Creek State Park) and supplemental fish assemblage sampling at 26 additional sites throughout the watershed (Figure 1; Table 1). The study area at Village Creek State Park included one comprehensive study reach on Village Creek and three supplemental study sites: Village Slough, Sandy Slough, and Mandy Lake (Figure 2; Table 1). In the study reach on Village Creek, data was collected on the fish community, freshwater mussel assemblage, riparian plant community, water quality, and overall stream health. In addition, supplemental fish assemblage (Figure 2: Sites A-C) and benthic macroinvertebrate (Figure 2: Site B) data were collected from sloughs and oxbows in the state park. Fish assemblage data was collected at 26 supplemental sites throughout the Village Creek Watershed (Figure 1; Table 2) where data was either lacking, or outdated based on historical data available in the Fishes of Texas database (Hendrickson and Cohen 2015).

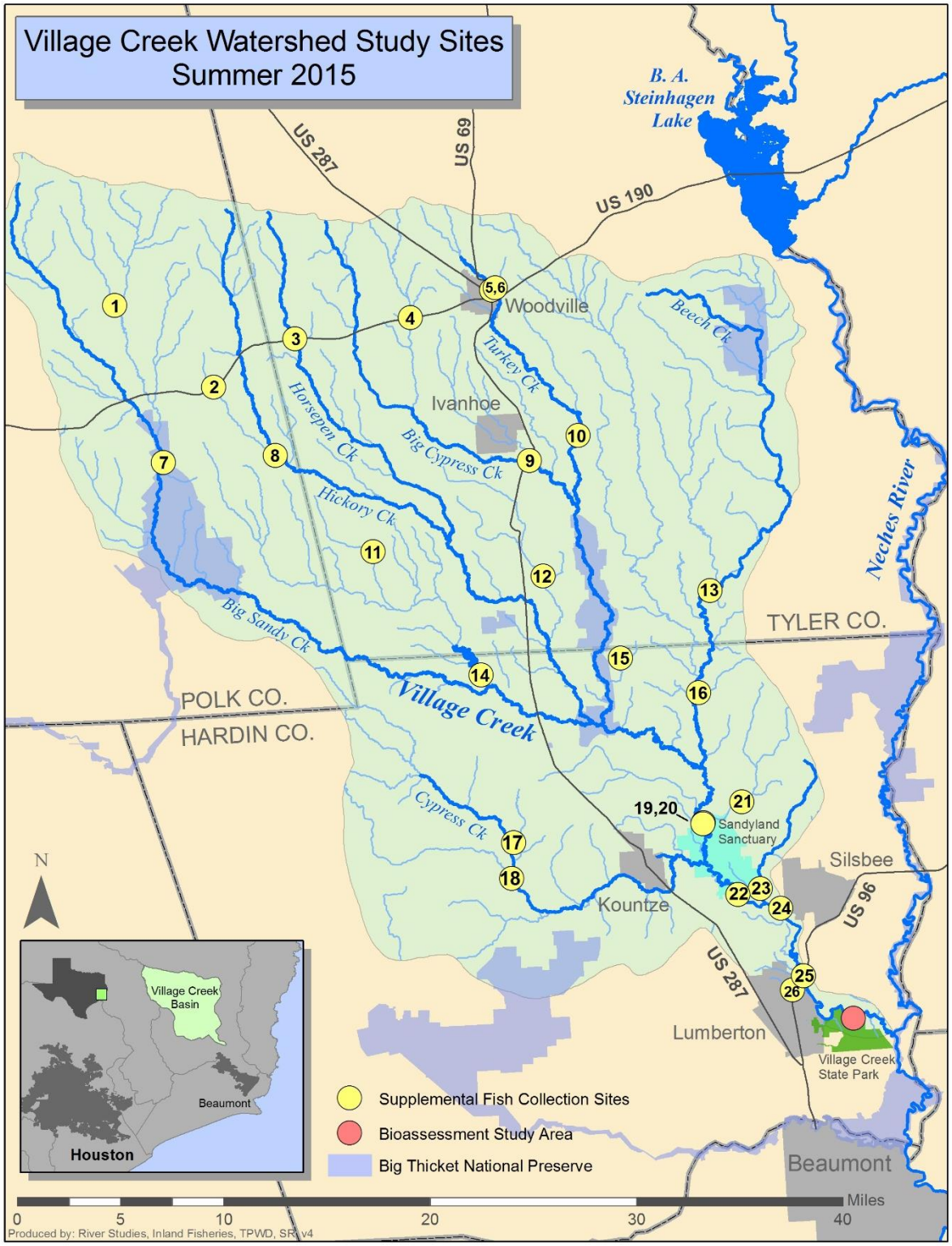

FIGURE 1.—Locations of Village Creek Watershed data collection sites in Hardin, Polk, and Tyler counties, TX. See Table 2 for site location information.

TABLE 1.—Village Creek Watershed study site locations and the type of data collected at each site during the summer of 2015 in Hardin, Polk, and Tyler counties, TX. Sites designated "Reach" or with letters fall within the bioassessment study area and sites designated with numbers represent supplemental fish collection sites.

				Survey Conducted				
Site	**Location**	**Coordinates**	**Sampling Date**	**Fish**	**Mussels**	**Stream Health**	**Riparian**	**Macro-Inverts**
Reach	Village Creek at Village Creek SP	30.25534, -94.17249	5/1/2015	x				
			7/13/2015	x				
			8/4/2015	x	x	x	x	
A	Village Slough at Village Creek SP	30.25244, -94.17571	8/4/2015	x				
B	Sandy Slough at Village Creek SP	30.25485, -94.16994	8/4/2015	x				x
C	Mandy Lake at Village Creek SP	30.23815, -94.12803	5/3/2015	x				
1	Unknown creek at 1688/Puckett Cutoff	30.78344, -94.72246	8/2/2015	x				
2	Little Hickory Creek at US 190	30.72259, -94.64514	8/2/2015	x				
3	Horsepen Creek at US 190	30.75390, -94.57671	8/2/2015	x				
4	Little Cypress Creek at US 190	30.76468, -94.48185	7/13/2015	x				
5	Unnamed ditch at CR 300/Carlow Rd.	30.78120, -94.41435	8/2/2015	x				
6	Turkey Creek at CR 300/Carlow Rd.	30.78283, -94.41148	8/2/2015	x				
7	Big Sandy Creek at FM 1276	30.67120, -94.68902	7/13/2015	x				
8	Little Hickory Creek at FM 1273	30.67248, -94.59765	7/13/2015	x				
9	Big Cypress Creek at US 287	30.65993, -94.39092	7/12/2015	x				
10	Turkey Creek at FM 1013	30.67583, -94.35000	7/12/2015	x				
11	Jacks Creek at FM 1943	30.60132, -94.52184	7/13/2015	x				
12	Black Creek at CR 4770	30.57812, -94.38448	8/2/2015	x				
13	Beech Creek at FM 1943	30.56192, -94.24915	7/12/2015	x				
14	Kimball Creek below Lake Kimball	30.51077, -94.43905	7/13/2015	x				
15	Unnamed slough at Gore Store Rd	30.51745, -94.32478	7/13/2015	x				
16	Beech Creek at Gore Store Rd	30.49032, -94.26268	7/13/2015	x				
17	Tributary of Cypress Creek at FM 1293	30.39161, -94.41936	7/14/2015	x				
18	Cypress Creek at Old Honey Island Rd.	30.36630, -94.42249	5/1/2015	x				
19	Village Creek at 418 near Dry Creek	30.39864, -94.26455	8/3/2015	x				
20	Village Creek downstream of CR 418	30.39784, -94.26498	8/3/2015	x				
21	Dry Creek at Fire Tower Rd.	30.41212, -94.23240	8/3/2015	x				
22	Village Creek at 327	30.34682, -94.2394	8/3/2015	x				
23	Mill Creek at 327	30.34935, -94.22108	5/2/2015	x				
			7/14/2015	x				
24	Village Creek at Baby Galvez	30.33559, -94.20518	8/3/2015	x				
25	Ponds near Village Creek at SH 96	30.28730, -94.18954	8/3/2015	x				
26	Walton Creek at Walton Creek Rd.	30.27759, -94.19936	5/2/2015	x				

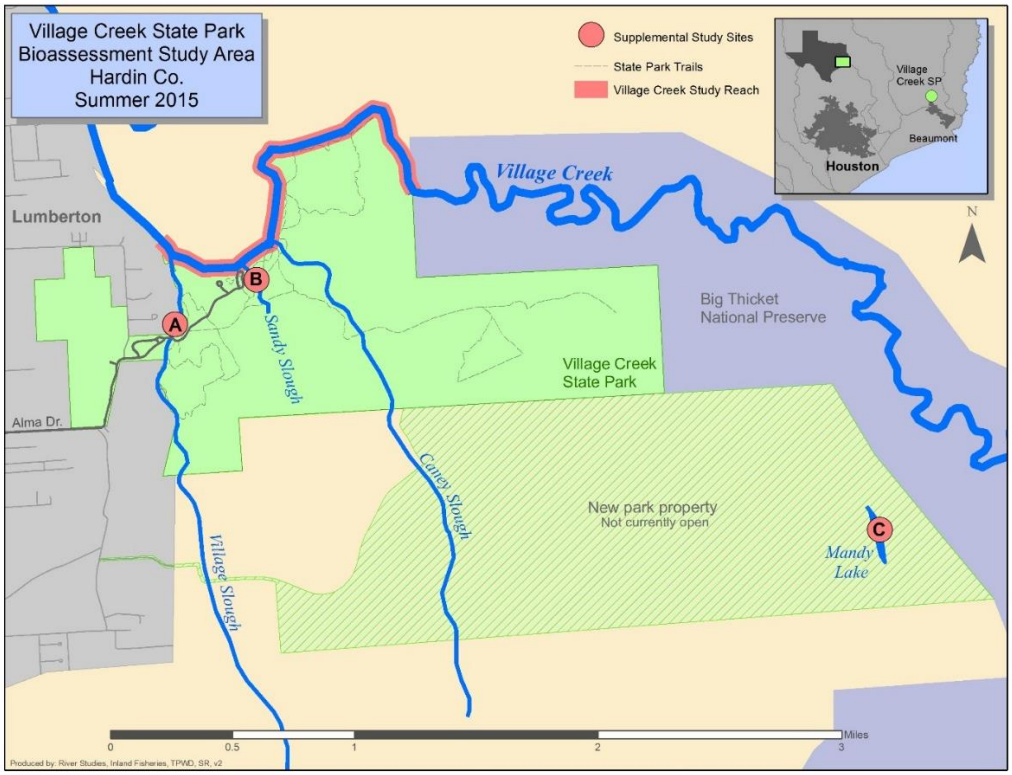

FIGURE 2.—Locations of study reach and supplemental sampling sites within the bioassessment study area at Village Creek State Park, Hardin County, TX. See Table 2 for site location information.

Village Creek

The 1.8 mile study reach on Village Creek was located adjacent to Village Creek State Park (Figure 2) in Hardin County, TX. This river reach was characterized by a wide, sandy channel (channel width of 30-60 meters), predominantly slow run and pool habitats, tannin-stained water, and overhanging riparian vegetation (Figure 3). Fish assemblage data was collected from four additional sites on Village Creek upstream of the park and is included with the supplemental fish collection data (Figure 1, Table 1).

FIGURE 3.—Habitats found within the study reach of Village Creek at Village Creek State Park. The left photo shows deep, slow run habitats and the right photo shows shallow habitats with inundated vegetation.

Village and Sandy Sloughs

Three major sloughs are connected to Village Creek and back up into Village Creek State Park: Village Slough, Sandy Slough, and Caney Slough (Figure 2). Village Slough (Site A) and Sandy Slough (Site B) were sampled for fish assemblages. Caney Slough was not accessible during the bioassessment due to standing water on park trails from recent flooding and was not sampled. Village and Sandy sloughs contained large amounts of leaf litter and woody debris, silty substrates, and little to no current (Figure 4).

FIGURE 4.—Habitats typical of Village Slough (Site A; left) and Sandy Slough (Site B; right) are slow moving and contain large amounts of woody debris.

Mandy Lake

Mandy Lake, an oxbow lake, is located in swampy lowlands near the confluence of Village Creek and the Neches River in Hardin County. The lake connects to Village Creek when flows are high, as was the case during the May sampling event at the state park. The site was characterized by submerged bottomland hardwood forest, sandy bottoms with high leaf litter accumulation, tannin stained water, and large woody debris (Figure 5).

FIGURE 5.—Mandy Lake (Site C) was connected to Village Creek during May 2015 and thus most habitats consisted of submerged bottomland hardwood forests with large amounts of leaf litter and woody debris.

Supplemental Fish Collection Sites

Twenty-six supplemental fish collection sites were sampled throughout the Village Creek Watershed in Hardin, Polk, and Tyler counties, TX (Sites 1-26; Figure 1; Table 1). These included four additional sites on Village Creek, 17 tributaries, and several roadside sloughs and ditches. These sites were sampled to fill gaps or update fish assemblage data in the statewide Fishes of Texas database (Hendrickson and Cohen 2015). Limited descriptive site information was recorded at the time of sampling; however, photos of each site are included to provide some reference to site conditions at the time of sampling (Figure 6).

FIGURE 6.—Supplemental fish collection sites 1-26 which were sampled in May, July, and August 2015. Photos are labeled with the corresponding site numbers found in Table 1.

FIGURE 6.—Continued.

FIGURE 6.—Continued.

FIGURE 6.—Continued.

WATER QUALITY AND QUANTITY

Methods: Water temperature (°C), specific conductivity (µS/cm), dissolved oxygen (mg/L), and pH were recorded for a 21.5 hour period in 15 min increments starting the afternoon of August 3, 2015 using a YSI multi-parameter water quality sonde. Total dissolved solids (TDS) concentrations were calculated by multiplying specific conductivity by 0.64 (Atekwana et al. 2004). Data were verified using TCEQ quality assurance procedures (TCEQ 2014b). Means were calculated for each verified parameter and evaluated in context of the surface water quality standards (TCEQ 2014a). Stream discharge (ft^3/sec) data were collected from United States Geological Survey (USGS) gage 08041500 on Village Creek near Kountze, TX – located about 33 river kilometers upstream from Village Creek State Park.

Results and Discussion: Water temperature and pH recorded during this study were within their designated water quality standards (Table 2). While the 24-hour period of data collection needed to evaluate dissolved oxygen against the TCEQ standard was not met, we report results here to give some reference to dissolved oxygen levels in Village Creek. Of the 21.5 hours of data recorded, one dissolved oxygen measurement (2.9 mg/L) fell below the 3 mg/L minimum standard. This measurement is potentially an anomaly as the concentrations recorded 15 min prior to and after this measurement were 3.47 and 3.35 mg/L respectively. While no standard exists for specific conductivity, it can be used as a means of indirectly measuring TDS. Based upon specific conductivity, TDS concentrations were also within established standards (Table 2). Village Creek is listed as impaired by TCEQ because of elevated mercury concentrations in edible tissue (TCEQ 2014a); however, fish tissue contaminants, bacteria, and metals were not evaluated during this study.

TABLE 2. —Water quality summary based upon data collected over a 21.5-hour period from Village Creek (Hardin County, TX) August 3-4, 2015. TCEQ water quality standards for Segment 0608: Village Creek - from the confluence with the Neches River in Hardin County to the confluence of Big Sandy Creek and Kimball Creek in Hardin County (TCEQ 2014a) are reported for comparison.

	Temperature (°C)	Specific Conductivity (µS/cm)	Total Dissolved Solids (mg/L)	Dissolved Oxygen (mg/L)	pH
Mean	30.4	106	68	5.1	6.6
Minimum	30.3	105	67	2.9	6.3
Maximum	30.5	113	72	6.1	6.8
TCEQ Standard	≤ 32.2	N/A	≤300	24 hr avg: ≥5 24 hr min: ≥3	6-8.5

Stream discharge at the time of sampling was considerably lower than what is typical of historical conditions during August. Median discharge during the two day sampling period was about 80 cfs. Daily median discharge for August 3rd, calculated from data reported from this USGS gage for the period of record (1938-2016), is 127 cfs.

FISH ASSEMBLAGE

Village Creek State Park Study Area (Study Reach and Supplemental Sites A-C)

Methods: Fish were collected from the study reach on Village Creek on three dates: May 1st, July 13th, and August 4th, 2015. The bulk of effort occurred in August utilizing boat electrofishers, seines, and hoop nets to assess fish community composition. Supplemental sampling occurred in May and July using gill nets and baited trot lines, eel traps, and minnow traps. Fish were also collected from three supplemental sites within Village Creek State Park. Village and Sandy sloughs (Sites A and B) were sampled on August 4, 2015 and Mandy Lake (Site C) was sampled on May 3, 2015. All three sites were sampled using seines and backpack electrofishers with the additional deployment of a 100 ft trammel net and two 50 ft gill nets at Mandy Lake.

Sampling techniques were selected based on effectiveness of capturing fish at each particular sampling area given the depth, velocity, substrate, and cover present. Expanding upon TCEQ sampling protocols (2014b), a minimum sampling effort of 10 seine hauls and 900 seconds of electrofishing effort was utilized in the study reach and at supplemental sites within the state park; however, additional sampling continued as needed until all habitat types had been effectively sampled and new species were not collected.

Once captured, large fish were identified to species, measured, photographed, and released. Smaller specimens were fixed in a 10% solution of formalin for identification and enumeration in the laboratory. All fish were examined for external deformities, disease, lesions, tumors, and skeletal abnormalities. Vouchered specimens will be permanently housed at the University of Texas' Biodiversity Collections (formerly the Texas Natural History Collections) in Austin, Texas. Data will be available online through the Fishes of Texas Project (Hendrickson and Cohen 2015).

Regionalized Index of Biotic Integrity (IBI) metrics developed for the South Central and Southern Humid, Mixed Land Use Region (Linam et al. 2002) were calculated for the study reach on Village Creek using seine, boat electrofishing, and hoop net data collected on the August 4, 2015 sampling date on which the bulk of the sampling effort occurred. The IBI provides a means of assessing fish assemblage health in relation to reference fish communities within the same ecoregion. Results are reported as an aquatic life use and possible rankings include exceptional, high, intermediate, and limited.

Results and Discussion: A total of 1,147 individuals comprising 39 fish species were collected throughout Village Creek State Park (Table 3). The study reach on Village Creek yielded the most species with 30 collected (Village Creek fish data from three sampling dates are combined in Table 3); however, the Village and Sandy sloughs had high species richness as well with 16 and 18 species collected, respectively. Collections from the sloughs added eight additional fish species that were not collected in the mainstem Village Creek reach. Collections at Mandy Lake yielded low numbers of individuals and species; however, these collections did add one new species to the overall species list for the park (Green Sunfish *Lepomis cyanellus*).

Six native cyprinid species were collected from the study reach on Village Creek (Table 3). Collections from the sloughs added one additional species, Golden Shiner *Notemigonus crysoleucas*. Weed Shiner *Notropis texanus* was the most numerous cyprinid collected within the park and was collected from the mainstem Village Creek and Sandy Slough (Table 3; Figure 7). Ribbon Shiner *Lythrurus fumeus* and Golden Shiner were the second and third most abundant cyprinids collected from the park respectively.

Ten centrarchid species were collected within the state park, with Bluegill *Lepomis machrochirus* being the most abundant (Figure 7). Sunfish species were the most evenly distributed taxa throughout the sites in the park, most likely due to their habitat generalist tendencies.

Four species of darters (*Percidae*) were collected in low numbers, primarily from the Village Creek study reach. Only one additional darter was collected from Sandy Slough. The low abundance of darters within the park is likely due to the low relative proportion of riffle habitats within this reach. Dusky Darter *Percina sciera* was the most abundant species with six individuals collected. Although darter numbers were low, Dusky Darter is classified as an intolerant species and is an indicator of good water quality (Linam and Kleinsasser 1998).

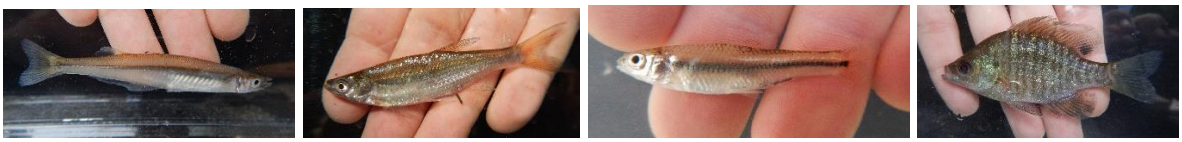

FIGURE 7.—The most abundant species collected from the study reach on Village Creek and the three supplemental study sites within Village Creek State Park shown from left to right are Brook Silverside (study reach), Golden Shiner (Village Slough), Weed Shiner (Sandy Slough), and Bluegill (Mandy Lake).

Five fish families were collected from Village Creek, but were absent in the sloughs: Lepisosteidae (gar), Clupeidae (shads), Catostomidae (suckers), Mugilidae (mullets), and Sciaenidae (drums). Species collected from these families are large-bodied and are often residents of moderate to large river systems.

TABLE 3.—Abundance of fish collected by species for all gear types combined by site from the Village Creek study reach, Village Slough, Sandy Slough, and Mandy Lake in Village Creek State Park from May-August 2015, Hardin County, Texas.

Family	**Scientific name**	**Common name**	**Reach** *Village Creek*	**Site A** *Village Slough*	**Site B** *Sandy Slough*	**Site C** *Mandy Lake*
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar	4			
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad	2			
Cyprinidae	*Cyprinella venusta*	Blacktail Shiner	70			
	Lythrurus fumeus	Ribbon Shiner	132			
	Notemigonus crysoleucas	Golden Shiner		16	82	
	Notropis sabinae	Sabine Shiner	3			
	Notropis texanus	Weed Shiner	69		96	
	Opsopoeodus emiliae	Pugnose Minnow	17			
	Pimephales vigilax	Bullhead Minnow	2			
Catostomidae	*Ictiobus bubalus*	Smallmouth Buffalo	1			
	Minytrema melanops	Spotted Sucker	4			
	Moxostoma poecilurum	Blacktail Redhorse	5			
Ictaluridae	*Ameiurus melas*	Black Bullhead		1		
	Ameiurus natalis	Yellow Bullhead		12	3	
	Ictalurus furcatus	Blue Catfish	1			
	Ictalurus punctatus	Channel Catfish	2			
Esocidae	*Esox americanus*	Redfin Pickerel		3	5	2
Aphredoderidae	*Aphredoderus sayanus*	Pirate Perch		6	35	1
Mugilidae	*Mugil cephalus*	Striped Mullet	11			
Atherinopsidae	*Labidesthes sicculus*	Brook Silverside	145		1	
Fundulidae	*Fundulus notatus*	Blackstripe Topminnow	41	10	21	
	Fundulus olivacious	Blackspotted Topminnow	12	7	4	
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	4	16	16	3
Centrarchidae	*Centrarchus macropterus*	Flier		10	2	1
	Lepomis cyanellus	Green Sunfish				1
	Lepomis gulosus	Warmouth	1	3	2	
	Lepomis macrochirus	Bluegill	89	3	5	4
	Lepomis megalotis	Longear Sunfish	72	1	7	
	Lepomis microlophus	Redear Sunfish	21	1		
	Lepomis miniatus	Redspotted Sunfish	4	4	1	1
	Lepomis sp. (hybrid)	Hybrid Sunfish sp.		9		
	Micropterus punctulatus	Spotted Bass	12			
	Micropterus salmoides	Largemouth Bass	8		2	
	Pomoxis nigromaculatus	Black Crappie			1	
Percidae	*Ammocrypta vivax*	Scaly Sand Darter	1			
	Etheostoma chlorosoma	Bluntnose Darter	1		1	
	Etheostoma histrio	Harlequin Darter	1			
	Percina sciera	Dusky Darter	6			
Sciaenidae	*Aplodinotus grunniens*	Freshwater Drum	2			
Elassomatidae	*Elassoma zonatum*	Banded Pygmy Sunfish		2	3	
	Number of species collected		**30**	**16**	**18**	**7**
	Number of individuals collected		**743**	**104**	**287**	**13**

Conversely, several families of fish were only collected in the sloughs and Mandy Lake: Esocidae (pikes), Aphredoderidae (pirate perch), and Elassomatidae (pygmy sunfishes). Pirate Perch *Aphredoderus sayanus* and Redfin Pickerel *Esox americanus* are two of the species in these families and were collected at Sites A, B, and C. Likewise Banded Pygmy Sunfish *Elassoma zonatum* were collected at Sites A and B, but absent from Site C and the study reach on Village Creek. All three of these species often associate with habitats with little to no streamflow such as oxbows, sloughs, and backwaters (Thomas et al. 2007).

Village Creek received an exceptional aquatic life use score based upon data collected during the August 4, 2015 sampling event using the regionalized Index of Biotic Integrity (IBI) (Table 4). This reach of river received the highest possible metric score of five for species richness, number of native cyprinid species, number and percent relative abundance of benthic invertivore species, number of sunfish species, number and percent relative abundance of intolerant species, and percent relative abundance of omnivores. Village Creek also scored high due to the lack of non-native species or individuals with disease or anomalies collected during this sampling. The only metrics in which the fish community received less than perfect scores were those metrics relating to abundance and catch-per-unit-effort (CPUE). In particular, this reach received the lowest score for number of individuals collected per seine haul. The study reach was comprised of primarily deep run and pool habitats and no riffles. The lack of shallow water habitats reduced effectiveness of seining and contributed to the low seine haul CPUE.

TABLE 4.—Index of Biotic Integrity results for fish collected from the Village Creek study reach at Village Creek State Park on August 4, 2015 (Hardin County, Texas).

Village Creek at Village Creek State Park @ , Hardin Co.					
Collector: Linam, Kolodziejcyk, Magnelia, et al.			August-15	Ecoregion 34	
Metric Category	**Intermediate Totals for Metrics**		**Metric Name**	**Raw Value**	**IBI Score**
	Drainage Basin Size (km^2)	2738.7			
Species Richness and Composition	Number of Fish Species	29	Number of Fish Species	29	5
	Number of Native Cyprinid Species	5	Number of Native Cyprinid Species	5	5
	Number of Benthic Invertivore Species	6	Number of Benthic Invertivore Species	6	5
	Number of Sunfish Species	5	Number of Sunfish Species	5	5
	Number of Intolerant Species	3	Number of Intolerant Species	3	5
	Number of Individuals as Tolerants[a]	95	% of Individuals as Tolerant Species[a]	13.1	5
Trophic Composition	Number of Individuals as Omnivores	15	% of Individuals as Omnivores	2.1	5
	Number of Individuals as Invertivores	686	% of Individuals as Invertivores	94.6	5
Fish Abundance and Condition	Number of Individuals (Seine)	471	Number of Individuals in Sample		2
	Number of Individuals (Shock)	204	Number of Individuals/seine haul	47.1	1
	Number of Individuals in Sample	725	Number of Individuals/min electrofishing	6.26	3
	# of Individuals as Non-native species	0	% of Individuals as Non-native Species	0.0	5
	# of Individuals With Disease/Anomaly	0	% of Individuals With Disease/Anomaly	0.0	5
			Index of Biotic Integrity Numeric Score:		**52**
			Aquatic Life Use:		**Exceptional**
This data should be incorporated with water quality, habitat, and other available biological data to assign an overall stream score.					
[a] Excluding Western Mosquitofish					

Supplemental Fish Collection Sites (Sites 1-26)

Methods: In addition to the intensive sampling at Village Creek State Park, fish were collected from 26 supplemental sites during three trips to the Village Creek Watershed occurring May 1-3, July 12-14, and August 1-3, 2015 (Table 1; Figure 1). The purpose of this additional effort was to assess the fish community by sampling a diversity of sites spread across the watershed, thus complementing the intensive sampling conducted at the bioassessment study area. Supplemental sites were selected with the aim of sampling many habitats, achieving broad geographic coverage, and updating or filling data gaps in the statewide Fishes of Texas database (Hendrickson and Cohen 2015). Habitats sampled varied extensively in substrate, aquatic vegetation, and riparian vegetation and included roadside ditches, temporary flood pools, permanent ponds, the mainstem river, and small tributaries. All available habitats were sampled with appropriate gear including seines, 100ft gill nets (monofilament and multifilament mesh), 50ft gill nets (experimental mesh), dip nets (1/8in mesh), backpack electrofishers, and trap nets (3ft x 4ft, 1/8in mesh). Effort continued until all mesohabitats within a site were thoroughly sampled and no additional species were produced.

Select voucher specimens of all fish species were preserved in buffered 10% formalin, verified in the lab, and are permanently housed at the Biodiversity Collections at the University of Texas in Austin. Tissues were also taken from many specimens and are held in their Genetic Resources Collection. All records will be made available through the online Fishes of Texas database (Hendrickson and Cohen 2015), as well as, via major online biodiversity data providers (GBIF – www.gbif.org, VertNet – www.vertnet.org, and FishNet2 – www.fishnet2.net).

Results: A total of 3,748 individuals comprising 54 species were collected from the 26 supplemental fish collection sites (Table 5, 6). Seven of the sites yielded 20 species or more, with the highest richness being 27 species at Site 10 (Turkey Creek at FM 1013). Average species richness across all sites was 14.62. The least species rich site, Site 5 was a disconnected ditch where only Western Mosquitofish *Gambusia affinis* were collected. This site was chosen to target Least Killifish *Heterandria formosa* habitat, a species which is thought to be expanding its range in Texas. The least species rich lotic site was Site 12 (Black Creek at CR 4770) producing only four species.

The most commonly occurring species, in order, were Western Mosquitofish (21 sites), Blackspotted Topminnow *Fundulus olivaceus* (19 sites), Largemouth Bass *Micropterus salmoides* (19 sites), Bluegill (17 sites), and Longear Sunfish *Lepomis megalotis* (16 sites) (Table 5, 6; Figure 8). This ranking is similar to historical specimen-based occurrence data for the watershed, with the exception of Largemouth Bass. Largemouth Bass frequency of occurrence in the system has increased notably, especially when compared to Spotted Bass *Micropterus punctulatus*. Village Creek Watershed historical data (1938-2009), as found in the Fishes of Texas database, contains 37 occurrences of Largemouth Bass and almost double that for Spotted Bass (71 occurrences) (Hendrickson and Cohen 2015). In addition, the presence of Blackspotted Topminnow, a species regarded as intolerant to disturbance, is indicative of a system with moderate to high water quality and stable conditions (Linam and Kleinsasser 1998).

FIGURE 8.—Common species collected during the supplemental sampling shown from left to right are Western Mosquitofish, Blackspotted Topminnow, Largemouth Bass, Bluegill, and Longear Sunfish.

Thirteen species of cyprinids were collected across the 26 sites, two of which were classified as SGCN: Blackspot Shiner and Sabine Shiner (TPWD 2012). Historic records include 20 cyprinid species for the Village Creek Watershed. Of the seven species not collected during this study, the most recent collection occurred in 2000 (Hendrickson and Cohen 2015). The family with the second highest number of species was Centrarchidae, with 13 species collected. From this family, Largemouth Bass was the most prevalent and Bluegill was the most abundant. Six species of darters were collected, with two of these species, Harlequin Darter *Etheostoma histrio* and Cypress Darter *Etheostoma proeliare*, each being found at only one site. A 1993-94 study noted both species to be rare, and that Cypress Darter may prefer backwater habitats in summer months (Moriarty and Winemiller 1997). A 1999-2001 USGS fish community baseline study of the system found four darter species, one of which, the Western Sand Darter, was a targeted SGCN, but was not observed in this survey (Moring 2003). Overall, species richness for supplemental fish collection sites was high and compares well with historical data for the watershed.

TABLE 5.—Abundance of fish by species for all gear types from Village Creek Watershed supplemental fish collection sites 1-13 in Polk and Tyler County, TX: 1. Unknown Creek at FM 1688 (8/2/2015), 2. Little Hickory Creek at US 190 (8/2/2015), 3. Horsepen Creek at US 190 (8/2/2015), 4. Little Cypress Creek at US 190 (7/13/2015), 5. Unnamed ditch at CR 300 (8/2/2015), 6. Turkey Creek at CR 300 (8/2/2015), 7. Big Sandy Creek at FM 1276 (7/13/2015), 8. Little Hickory Creek at FM 1273 (7/13/2015), 9. Big Cypress Creek at US 287 (7/12/2015), 10. Turkey Creek at FM 1013 (7/12/2015) 11. Jacks Creek at FM 1943 (7/13/2015), 12. Black Creek at CR 4770 (8/2/2015), 13. Beech Creek at FM 1943 (7/12/2015).

			Site												
Family	**Scientific Name**	**Common Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Petromyzontidae	*Ichthyomyzon gagei*	Southern Brook Lamprey							8						
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar										2			
Amiidae	*Amia calva*	Bowfin													
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad										1			
Cyprinidae	*Cyprinella venusta*	Blacktail Shiner		31	2	71		15	39	20	13	26			
	Hybognathus nuchalis	Mississippi Silvery Minnow													
	Hybopsis amnis	Pallid Shiner										6			
	Lythrurus fumeus	Ribbon Shiner	32	29	22	74		18	8	5	36				
	Lythrurus sp.				26										
	Lythrurus umbratilis	Redfin Shiner	10	8	19	44		1	16	13	3	37			
	Notemigonus crysoleucas	Golden Shiner	1									2			
	Notropis atrocaudalis	Blackspot Shiner	2	7				1							
	Notropis buchanani	Ghost Shiner							7						
	Notropis sabinae	Sabine Shiner													
	Notropis texanus	Weed Shiner						4			4	9			
	Notropis volucellus	Mimic Shiner				55		11	41	17	17	4			
	Opsopoeodus emiliae	Pugnose Minnow				3									
	Pimephales vigilax	Bullhead Minnow				26		6	3	2		7			
Catostomidae	*Erimyzon sucetta*	Lake Chubsucker										1	3		1
	Minytrema melanops	Spotted Sucker	1	6	1	1			3			3			2
	Moxostoma poecilurum	Blacktail Redhorse							1						
Ictaluridae	*Ameiurus melas*	Black Bullhead				3									
	Ameiurus natalis	Yellow Bullhead		1				1	2			1	1		7
	Ictalurus punctatus	Channel Catfish													
	Noturus gyrinus	Tadpole Madtom							1						
	Noturus nocturnus	Freckled Madtom		6		1		1	3						
Esocidae	*Esox americanus*	Redfin Pickerel	2			1			3			4	6		
Aphredoderidae	*Aphredoderus sayanus*	Pirate Perch			4			1	4				7		1
Mugilidae	*Mugil cephalus*	Striped Mullet													

TABLE 5.—Continued.

Family	Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12	13
Atherinopsidae	*Labidesthes sicculus*	Brook Silverside									2	3			2
Fundulidae	*Fundulus blairae*	Western Starhead Topminnow												19	
	Fundulus chrysotus	Golden Topminnow													
	Fundulus notatus	Blackstripe Topminnow													
	Fundulus olivaceus	Blackspotted Topminnow	2	41	4	10		2	10	4	16	10			5
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	2		2	30	32	13	1	2		22		1	17
Centrarchidae	*Centrarchus macropterus*	Flier													
	Lepomis auritus	Redbreast Sunfish													3
	Lepomis cyanellus	Green Sunfish													1
	Lepomis cyanellus x sp.														
	Lepomis gulosus	Warmouth		2		2		3	1			2	1		
	Lepomis macrochirus	Bluegill		7	1	8		3	2			26	3		2
	Lepomis marginatus	Dollar Sunfish											2		1
	Lepomis megalotis	Longear Sunfish		4	2	10		11	15	1	1	3			5
	Lepomis microlophus	Redear Sunfish			1							6			1
	Lepomis miniatus	Redspotted Sunfish		5		2		1	4			10			
	Lepomis sp.												1		
	Lepomis symmetricus	Bantam Sunfish												1	
	Micropterus punctulatus	Spotted Bass						1		2	1				1
	Micropterus salmoides	Largemouth Bass	1	2	2	1			2	2	4	9	2		5
	Micropterus sp.														
	Pomoxis nigromaculatus	Black Crappie										3		2	
Percidae	*Ammocrypta vivax*	Scaly Sand Darter				6			1	3	1	2			
	Etheostoma chlorosoma	Bluntnose Darter		7	8	8		5	1			4			
	Etheostoma gracile	Slough Darter							1						
	Etheostoma histrio	Harlequin Darter													
	Etheostoma proeliare	Cypress Darter													
	Percina sciera	Dusky Darter		1		8		14	4			2			
Elassomatidae	*Elassoma zonatum*	Banded Pygmy Sunfish										1	14		3
	Number of individuals collected		**53**	**157**	**94**	**364**	**32**	**112**	**181**	**71**	**98**	**206**	**40**	**23**	**57**
	Number of species collected		**9**	**15**	**13**	**20**	**1**	**19**	**25**	**11**	**11**	**27**	**10**	**4**	**16**

TABLE 6.—Abundance of fish by species for all gear types from Village Creek Watershed supplemental fish collection sites 14-26 in Hardin County, TX: 14. Kimball Creek below Lake Kimball (7/13/2015), 15. Unnamed slough at Gore Store Rd (7/13/2015), 16. Beech Creek at Gore Store Rd (7/13/2015), 17. Unnamed tributary of Cypress Creek at FM 1293 (7/14/2015), 18. Cypress Creek at Old Honey Island Rd (5/1/2015), 19. Village Creek near Dry Creek (8/3/2015), 20. Village Creek downstream of CR 418 (8/3/2015), 21. Dry Creek at Fire Tower Rd (8/3/2015), 22. Village Creek at 327(8/3/2015), 23. Mill Creek at 327 (5/3 and 7/14/2015), 24. Village Creek at Baby Galvez (8/3/2015), 25. Village Creek ponds at SH 96 (8/3/2015), 26. Walton Creek at Walton Creek Rd (5/2/2015)

			Site												
Family	**Scientific Name**	**Common Name**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
Petromyzontidae	*Ichthyomyzon gagei*	Southern Brook Lamprey													
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar						1							
Amiidae	*Amia calva*	Bowfin				2								1	
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad	10					1							
Cyprinidae	*Cyprinella venusta*	Blacktail Shiner			12			25	41		102	2	25		
	Hybognathus nuchalis	Mississippi Silvery Minnow							1		2				
	Hybopsis amnis	Pallid Shiner									15				
	Lythrurus fumeus	Ribbon Shiner			16			6	236	3	56		9		
	Lythrurus sp.														
	Lythrurus umbratilis	Redfin Shiner								3					
	Notemigonus crysoleucas	Golden Shiner	1			5				8	1	9		13	
	Notropis atrocaudalis	Blackspot Shiner													
	Notropis buchanani	Ghost Shiner													
	Notropis sabinae	Sabine Shiner						16	16		24		5		
	Notropis texanus	Weed Shiner							15		8		34		
	Notropis volucellus	Mimic Shiner							4				6		
	Opsopoeodus emiliae	Pugnose Minnow						1		1				4	
	Pimephales vigilax	Bullhead Minnow						8	13		210		14		
Catostomidae	*Erimyzon sucetta*	Lake Chubsucker	1											1	
	Minytrema melanops	Spotted Sucker						3	11		3			9	
	Moxostoma poecilurum	Blacktail Redhorse													
Ictaluridae	*Ameiurus melas*	Black Bullhead		2		1						1		10	
	Ameiurus natalis	Yellow Bullhead	1	4										14	1
	Ictalurus punctatus	Channel Catfish	1					3							
	Noturus gyrinus	Tadpole Madtom												2	
	Noturus nocturnus	Freckled Madtom							2			2	13	1	
Esocidae	*Esox americanus*	Redfin Pickerel	1		1	5	11	1		8		10		5	4
Aphredoderidae	*Aphredoderus sayanus*	Pirate Perch		2			4							17	7
Mugilidae	*Mugil cephalus*	Striped Mullet						1							

TABLE 6.—Continued.

Family	Scientific Name	Common Name	14	15	16	17	18	19	20	21	22	23	24	25	26
Atherinopsidae	*Labidesthes sicculus*	Brook Silverside	22		1				2	2		3	6	5	3
Fundulidae	*Fundulus blairae*	Western Starhead Topminnow	16	1				12				1			2
	Fundulus chrysotus	Golden Topminnow										1			2
	Fundulus notatus	Blackstripe Topminnow										1			
	Fundulus olivaceus	Blackspotted Topminnow	2		4		1	10	10		9	3	22	3	4
Poeciliidae	*Gambusia affinis*	Western Mosquitofish		10	6	41	10	3	8	8	6	7		385	9
Centrarchidae	*Centrarchus macropterus*	Flier		3		1	2			12		7		6	
	Lepomis auritus	Redbreast Sunfish													
	Lepomis cyanellus	Green Sunfish							1					1	
	Lepomis cyanellus x sp.		1												
	Lepomis gulosus	Warmouth		1			1	1		1				5	1
	Lepomis macrochirus	Bluegill	10			2	3	17	4	7		5	3		7
	Lepomis marginatus	Dollar Sunfish	7			1		1		1		2		12	1
	Lepomis megalotis	Longear Sunfish	1				1	4	7	2	2		5		
	Lepomis microlophus	Redear Sunfish	5					12	1	2		1		5	
	Lepomis miniatus	Redspotted Sunfish	2				2	2			1				7
	Lepomis sp.		2											4	
	Lepomis symmetricus	Bantam Sunfish			1									1	
	Micropterus punctulatus	Spotted Bass	1					3	8				12		
	Micropterus salmoides	Largemouth Bass	16			1		13	3	1	6	2	1	7	
	Micropterus sp.											2			1
	Pomoxis nigromaculatus	Black Crappie	5											16	
Percidae	*Ammocrypta vivax*	Scaly Sand Darter						6	5		26		23		
	Etheostoma chlorosoma	Bluntnose Darter	2					1	1				3		
	Etheostoma gracile	Slough Darter				1	2								
	Etheostoma histrio	Harlequin Darter											6		
	Etheostoma proeliare	Cypress Darter													1
	Percina sciera	Dusky Darter							1		2	1	11		
Elassomatidae	*Elassoma zonatum*	Banded Pygmy Sunfish		8	2									74	
	Number of individuals collected		**107**	**31**	**43**	**60**	**37**	**151**	**390**	**59**	**473**	**60**	**198**	**601**	**50**
	Number of species collected		**20**	**8**	**8**	**10**	**10**	**24**	**21**	**14**	**16**	**18**	**17**	**24**	**14**

Summary of Fish Collection Data

A total of 4,917 individuals comprising 57 fish species were collected during this study. Historically, 75 species have been collected from the Village Creek Watershed (Cohen and Hendrickson 2015). Twenty of those species were not collected during this bioassessment; however, two new species were added to the watershed species list: Blue Catfish *Ictalurus furcatus* and Smallmouth Buffalo *Ictiobus bubalus*. Those species not collected during this assessment include: Lined Sole *Achirus lineatus*, Western Sand Darter, Red Shiner *Cyprinella lutrensis*, Threadfin Shad *Dorosoma petenense*, Swamp Darter *Etheostoma fusiforme*, Goldstripe Darter *Etheostoma parvipinne*, Gumbo Darter *Etheostoma thompsoni*, Orangespotted Sunfish *Lepomis humilis*, Shoal Chub *Macrhybopsis hyostoma*, Inland Silverside *Menidia beryllina*, Emerald Shiner *Notropis atherinoides*, Ironcolor Shiner, Suckermouth Minnow *Phenacobius mirabilis*, Fathead Minnow *Pimephales promelas*, Flathead Catfish *Pylodictis olivaris*, Creek Chub *Semotilus atromaculatus*, Blackcheek Tonguefish *Symphurus plagiusa*, and Hogchoker *Trinectes maculatus*. Several of the species not collected during this bioassessment (Lined Sole, Blackcheek Tonguefish, and Hogchoker) are more often associated with estuarine habitats and were likely transient as they are only represented by one record each.

A total of 39 species were collected from five sites on the mainstem Village Creek (Study reach and Sites 19, 20, 22, and 24) as compared to 50 species collected from all tributary sites (Sites 1-4, 6-18, 21, 23, 26, A, and B). When compared to the main stem, tributary sites added 18 additional species (Southern Brook Lamprey *Ichthyomyzon gagei*, Bowfin *Amia calva*, Redfin Shiner *Lythrurus umbratilis*, Blackspot Shiner, Ghost Shiner *Notropis buchanani*, Lake Chubsucker *Erimyzon sucetta*, Black Bullhead *Ameiurus melas*, Yellow Bullhead, Tadpole Madtom *Noturus gyrinus*, Pirate Perch, Golden Topminnow *Fundulus chrysotus*, Flier *Centrarchus macropterus*, Redbreast Sunfish *Lepomis auritus*, Bantam Sunfish *Lepomis symmetricus*, Black Crappie *Pomoxis nigromaculatus*, Slough Darter *Etheostoma gracile*, and Cypress Darter, and Banded Pygmy Sunfish; Figure 9). Seven species were unique to the main stem Village Creek (Mississippi Silvery Minnow *Hybognathus nuchalis*, Sabine Shiner, Smallmouth Buffalo *Ictiobus bubalus*, Blue Catfish *Ictalurus furcatus*, Striped Mullet *Mugil cephalus*, Harlequin Darter, and Freshwater Drum *Aplodinotus grunniens*; Figure 10).

FIGURE 9.—Representative fish species collected in the tributaries, but asbent from mainstem collections shown from left to right are Southern Brook Lamprey, Redfin Shiner, Lake Chubsucker, Golden Topminnow, and Slough Darter.

FIGURE 10.—Representative fish species unique to the mainstem Village Creek shown from left to right are Sabine Shiner, Smallmouth Buffalo, Striped Mullet, and Freshwater Drum.

Overall, based on data collected during this project, the Village Creek Watershed can be characterized by high species richness and diversity among trophic levels. One notable result of these collections was the absence of non-native fish species collected from the mainstem Village Creek and only one non-native species (Redbreast Sunfish) collected in low numbers from a supplemental site (Beech Creek- Site 13). Several generalist fish species were found throughout the watershed; however, there were noticeable differences in species composition between small tributary streams and the larger mainstem.

MUSSEL ASSEMBLAGE

Methods: Mussels were surveyed for a minimum of four person-hours using timed snorkel surveys or tactile searches in all available mesohabitat types (Strayer and Smith 2003) at the study reach on Village Creek. All live mussels encountered during timed searches were enumerated and returned to the habitat in which they were found. Photograph vouchers were taken of each species and sent to Texas A&M-Institute of Renewable and Natural Resources for species identification verification. In addition, a subsample of mussels collected were sent off for genetic verification to the U. S. Geological Survey (USGS) and inclusion in the mussel genetic database Uniobarcode.

Results and Discussion: A total of six person-hours of search time was conducted in Village Creek within the boundaries of Village Creek State Park. A total of 241 live mussels comprising 18 species were collected (Figure 11; Table 7) at an overall catch rate (CPUE) of 40.17 mussels per hour. Three state-listed species: Texas Pigtoe, Sandbank Pocketbook, and Southern Hickorynut were collected during the surveys and ranked second, seventh, and tenth, respectively, in abundance.

Historically, 33 species of mussels are known from the Neches River Basin (TPWD 2008). A 2001 mussel survey at 22 sites throughout Village Creek Watershed collected 18 species of mussels (Bordelon and Harrel 2004; Table 7), including three species that were not found in this bioassessment: Wabash Pigtoe *Fusconaia flava*, Louisiana Pigtoe, and Pondhorn *Uniomerus tetralasmus*. Additionally, three species were collected in this bioassessment that were not collected in the 2001 survey: Round Pearlshell *Glebula rotundata*, Southern Mapleleaf *Quadrula apiculata*, and Fawnsfoot *Truncilla donaciformis*. Although the present study was limited to the reach of Village Creek within Village Creek State Park, the most abundant species, Western Pimpleback *Quadrula mortoni*, Texas Pigtoe, and Threeridge *Amblema plicata* respectively, were similar to the most abundant species collected in 2001 by Bordelon and Harrel (2004). Because the Bordelon and Harrel (2004) study encompassed a much larger area of Village Creek, it is difficult to assess changes in the mussel community between studies. Based on sampling sites near Village Creek State Park identified in Bordelon and Harrel (2004), the mussel community appears to be very similar, with similar relative abundances of the most abundant species.

FIGURE 11.—Photos from mussel collections in the study reach on Village Creek from left to right are all mussels collected during one timed search; Western Pimpleback, the most abundant mussel collected within the study reach; and the state threatened Pigtoe, the second most abundant mussel collected within the study reach.

TABLE 7.—Historical species list of freshwater mussels from the Neches River Basin (TPWD 2008) with species collected in Village Creek by Bordelon and Harrel (2004), and abundances of live individuals collected by species with CPUE (catch/hour) in parentheses from the Village Creek study reach.

Species	**Common Name**	**Status**	**Bordelon and Harrel (2004) Village Creek**	**TPWD Bioassessment (2015) Village Creek**
Amblema plicata	Threeridge		X	25 (4.17)
Arcidens confragosus	Rock Pocketbook			
Fusconaia askewi	Texas Pigtoe	ST	X	53 (8.83)
Fusconaia flava	Wabash Pigtoe		X	
Fusconaia lananensis	Triangle Pigtoe	ST, FP		
Glebula rotundata	Round Pearlshell			1 (0.17)
Lampsilis hydiana	Louisiana Fatmucket		X	9 (1.50)
Lampsilis satura	Sandbank Pocketbook	ST	X	10 (1.67)
Lampsilis teres	Yellow Sandshell		X	11 (1.83)
Leptodea fragilis	Fragile Papershell		X	3 (0.50)
Ligumia subrostrata	Pond Mussel			
Megalonaias nervosa	Washboard			
Obliquaria reflexa	Threehorn Wartyback		X	18 (3.00)
Obovaria jacksoniana	Southern Hickorynut	ST	X	6 (1.00)
Plectomerus dombeyanus	Bankclimber		X	23 (3.83)
Pleurobema riddellii	Louisiana Pigtoe	ST, FP	X	
Potamilus amphichaenus	Texas Heelsplitter	ST, FP		
Potamilus purpuratus	Bleufer		X	3 (0.50)
Pyganodon grandis	Giant Floater			
Quadrula apiculata	Southern Mapleleaf			1 (0.17)
Quadrula mortoni	Western Pimpleback		X	62 (10.33)
Quadrula nobilis	Gulf Mapleleaf		X	1 (0.17)
Quadrula nodulata	Wartyback			
Quadrula verrucosa	Pistolgrip		X	5 (0.83)
Strophitus undulatus	Creeper			
Toxolasma parvus	Lilliput			
Toxolasma texasiensis	Texas Lilliput		X	7 (1.17)
Truncilla donaciformis	Fawnsfoot			2 (0.33)
Truncilla truncata	Deertoe			
Uniomerus declivis	Tapered Pondhorn			
Uniomerus tetralasmus	Pondhorn		X	
Utterbackia imbecillis	Paper Pondshell			
Villosa lienosa	Little Spectaclecase		X	1 (0.17)
Number of species collected			**18**	**18**
Number of individuals collected (CPUE)				**241 (40.17)**

BENTHIC MACROINVERTEBRATE ASSEMBLAGE

Methods: Aquatic macroinvertebrates were collected from Sandy Slough using a D-frame kick net following procedures in TCEQ's surface water quality monitoring procedures handbook (TCEQ 2014b). Effort was made to collect a minimum of 175 macroinvertebrates. Macroinvertebrates were preserved in 70% ethanol and transported back to the lab where they were identified to the lowest possible taxonomic group. A voucher of each taxa identified was sent to a macroinvertebrate expert at TCEQ for verification.

Results and Discussion: A total of 110 benthic macroinvertebrates representing 5 orders and 15 families (Table 8) were collected and identified from Sandy Slough (Figure 2) in Village Creek State Park. Due to limited suitable shallow water habitats within the Village Creek study reach, Sandy Slough was selected to document local benthic macroinvertebrate taxa. The number of individuals collected (110) was below the required minimum of 140 individuals for calculation of the benthic index of biotic integrity and aquatic life use. Of the seventeen benthic macroinvertebrate taxa collected, all were aquatic insects.

The primary habitat sampled was backwater habitat, which explains the high numbers of backswimmers (*Notonecta*) collected. Backswimmers, can survive lower dissolved oxygen conditions because they are found at the water surface and use atmospheric oxygen for respiration. The highest genera diversity was represented by Coleoptera (aquatic beetles), which included the families Dytiscidae (diving beetle), Elmidae (riffle beetle), Gyrinidae (whirligig beetle), Haliplidae (crawling water beetle), Hydrophilidae (water scavenger beetle), and Scirtidae (marsh beetle). The dominant macroinvertebrate taxa present were true bugs (Order: Hemiptera), beetles (Order: Coleoptera), and true flies (Order: Diptera) making up 68.47%, 15.32%, and 11.17% of the total catch respectively. Total taxa richness by genus was 17, and the EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa abundance was represented only by Ephemeroptera. The ratio of intolerant to tolerant taxa was very low as higher abundance of the tolerant taxa was collected. This is likely due to a lack of flowing water habitat in Sandy Slough.

TABLE 8.—Abundance of aquatic benthic macroinvertebrates with their associated trophic guilds collected from Sandy Slough at Village Creek State Park (Site B), August 2015. Trophic guilds are abbreviated as collector gatherer (CG), filtering collector (FC), predator (P), scraper (SCR), and shredder (SHR). Life stages are abbreviated as adult (A) and larvae (L).

Order	**Family**	**Genus**	**Trophic**	**Life Stage**	**Site B**
Coleoptera	Dytiscidae	*Coptotomus*	P	A	2
		Thermonectus	P	A	7
	Elmidae	*Stenelmis*	SCR/CG	A	1
	Gyrinidae	*Dineutus*	P	A	3
	Haliplidae	*Peltodytes*	SHR/P	L	1
	Hydrophilidae	*Enochrus*	CG	A	1
	Scirtidae	*Scirtes*	SHR	L	2
Diptera	Chaoboridae	*Chaoborus*	P		4
	Chironomidae		P/CG/FC		9
Ephemeroptera	Baetidae	*Procloeon*	SCR/CG		1
	Caenidae	*Caenis*	SCR/CG		1
Hemiptera	Gerridae	*Limnoporus*	P		5
		Trepobates	P		1
	Nepidae	*Ranatra*	P		16
	Notonectidae	*Notonecta*	P		54
Odonata	Aeschnidae	*Boyeria*	P		1
	Corduliidae	*Epitheca*	P		1
Number of taxa collected					**17**
Number of individuals collected					**110**

CRAYFISH

Methods: No dedicated crayfish sampling took place during this study; however, as crayfish are a typically understudied genera in Texas we felt it important to document species encountered during the course of this assessment. All crayfish captured while seining or in various traps set were photo-vouchered for species identification. Photo vouchers and locality information were placed on the website iNaturalist (http://www.inaturalist.org/) for species verification. We thank Dan Johnson for his immense help in identifying crayfish collected during this study.

Results and Discussion: Five species of crayfish were collected during this study (Table 9; Figure 12), with Village Creek containing the highest species richness. However, it should be noted that Village Creek also had the highest sampling effort. All three species collected in Village Creek were present in the study reach at Village Creek State Park. Two of these species (Red Swamp Crayfish and Southwestern Creek Crayfish) have wide distributions and are common within their ranges and have thus been listed with a conservation status of Least Concern (Crandall 2010a; 2010b). The third species (Texas River Crayfish) is newly described and thus no conservation status assessment has been conducted; however, its geographic range is currently thought to include several basins and 34 counties in Texas (Fetzner 2016). Of the other species collected, Shrimp Crayfish is also listed as Least Concern due to its wide distribution and abundant habitat availability (Adams et al. 2010). Lastly, Southern White River Crayfish, found in overflow ponds near Village Creek, is thought to be currently stable; however, better range information is needed (NatureServe 2015).

TABLE 9.—Species of crayfish encountered during fish sampling and the sites they were found at.

Scientific Name	Common Name	Sites Collected
Orconectes lancifer	Shrimp Crayfish	Village Creek- Site 22
Orconectes texanus	Texas River Crayfish	Village Creek- Study Reach Village Creek- Site 22
Procambarus clarkii	Red Swamp Crayfish	Sandy Slough- Site B Village Creek- Study Reach
Procambarus dupratzi	Southwestern Creek Crayfish	Big Sandy Creek- Site 7 Turkey Creek- Site 6 Village Creek- Study Reach
Procambarus zonangulus	Southern White River Crayfish	Ponds near Village Creek- Site 25

FIGURE 12.—Crayfish species collected during the Village Creek Watershed bioassessment shown from left to right are Shrimp Crayfish, Texas River Crayfish, Red Swamp Crayfish, Southwestern Creek Crayfish, and Southern White River Crayfish.

RIPARIAN ASSEMBLAGE

Methods: A qualitative visual assessment of the Village Creek riparian area was conducted within the study reach at Village Creek State Park on August 4, 2015 to obtain a basic understanding of the overall functioning condition of the riparian area. Dominant species present, age-class distribution, and vigor of the plants within the riparian corridor were noted. Non-native plant species were also recorded.

Results and Discussion: Common tree species observed within the Village Creek riparian area included: loblolly pine *Pinus teada*, sweetgum *Liquidambar styraciflua*, river birch *Betula nigra*, Water oak *Quercus nigra*, white oak *Quercus alba*, willow oak *Quercus phellos*, chinquapin oak *Castanea pumila*, and bald cypress *Taxodium distichum*. Common herbaceous and shrub species observed included: yaupon holly *Ilex vomitoria*, sweetbay *Magnolia virginiana*, American beautyberry *Callicarpa americana*, paw *Asimina triloba*, trumpet creeper *Campsis radicans*, inland sea oats *Chasmanthium latifolium*, Virginia creeper *Parthenocissus quinquefolia*, grape *Vitis* sp., sedges *Carex* sp., switchgrass *Panicum virgatum*, and poison ivy *Toxicodendron radicans*. Non-native species noted during the qualitative assessment included Coral Ardisia *crenata*, Japanese climbing fern *Lygodium japonicum*, Japanese honeysuckle *Lonicera japonica*, and Chinese tallow tree *Sapium sebiferum*. Coral Ardisia, also known as Christmas berry, is known to be hard to eradicate, but is being monitored by park staff (Kathy Smith, TPWD, Village Creek State Park, personal communication). Overall, the riparian area was in good functioning condition as indicated by the wide, contiguous riparian zone, the diverse mixture of appropriate riparian species, high plant vigor, and presence of multiple age classes. Recruitment of young tree species was high. There was no evidence of excessive herbivory. Measures may be needed to manage invasive plant species (particularly Christmas berry) to prevent further spread. Trails appeared to be well-used, and in some cases, they may need to be reinforced to reduce erosion and keep visitors from widening them further into the riparian area.

STREAM HEALTH

Methods: To obtain a snapshot of riparian habitat and overall stream condition at each site, a modified Stream Visual Assessment Protocol (SVAP2; TPWD 2015) was conducted on the study reach at Village Creek State Park on August 4, 2015 (Table 1). The modified SVAP2 is based on the SVAP protocol created by the Natural Resources Conservation Service (NRCS 1998), but includes updates to make it more relevant to Texas streams. This protocol allows for a basic level of ecological assessment to qualitatively evaluate the condition of aquatic ecosystems associated with wadeable streams. The modified SVAP2 utilizes scores from thirteen major scoring elements including: channel condition, hydrological alteration, bank stability, riparian area quantity, riparian area quality, water appearance, nutrient enrichment, barriers to aquatic species movement, stream habitat complexity, pools, aquatic invertebrate community, riffle embeddedness, and salinity. After scoring each element, scores are summed and divided by the number of elements to provide an overall SVAP2 score. Scores are graded as follows: 1-2.9 = Severely Degraded, 3-4.9 = Poor, 5 to 6.9 = Fair, 7 to 8.9 = Good, 9 to 10 = Excellent. It is important to note that these scores are based on characteristics of a particular stream reach and are not indicative of the health of the entire stream. The utility in this protocol is that a discrete stream reach can be monitored over time to determine if the general health of the ecosystem in that reach is improving, declining, or maintaining.

Results and Discussion: Overall stream health for the Village Creek study reach rated as "Good" (SVAP2 Score=8.66, Table 10). This value can be used as a general statement about the state of the aquatic ecosystem at Village Creek State Park, meaning that Village Creek is functioning well. The metric that scored lowest during this assessment was bank stability; however, this is to be expected due to the shifting nature of sand banks on Village Creek. Maintaining trails through the riparian area to prevent further erosion (Element 3, Bank Stability in Table 10) and managing for invasive plant species (Element 5, Riparian Area Quality) will help ensure that the SVAP2 score doesn't decline.

TABLE 10.—Element scores from the Stream Visual Assessment Protocol (SVAP2) conducted at Village Creek State Park on August 4, 2015. Element scores are rated from 1 (severely degraded) to 10 (excellent). The average of the element scores is listed as the stream health score.

Element	**Score**
Channel Condition	8
Hydrologic Alteration	8
Bank Stability	6.5
Riparian Area Quantity	9.5
Riparian Area Quality	7
Water Appearance	9
Nutrient Enrichment	8.6
Barriers to Movement	10
Stream Habitat Complexity	10
Pools	10
Aquatic Invertebrate Community	n/a
Riffle Embeddedness	n/a
Salinity	n/a
Stream Health Score	**8.6**

IMPERILED SPECIES

Sabine Shiner (NatureServe Global Conservation Status: G4-apparently secure; NatureServe 2015) was the only fish species of SGCN status collected from the Village Creek State Park during this bioassessment. This species was collected from the study reach on Village Creek in low abundance. The Sabine Shiner can be found in East Texas and along the Gulf Coast and Mississippi River Drainage in Louisiana, Mississippi, Arkansas, and Missouri (NatureServe 2015). Populations are currently thought to be stable (NatureServe 2015); however, Sabine Shiner has a life history strategy that makes it vulnerable to environmental changes. This species is considered a fluvial specialist, meaning it needs flowing water to complete its life cycle. In particular, Sabine Shiner spawn during flow pulses releasing eggs that drift downstream as they hatch (Williams and Bonner 2006). This life history strategy can be disrupted by stream impoundments and modified instream flows; therefore, the presence of this species is an indicator of stream connectivity and a natural flow regime.

Three state threatened and SGCN mussel species were collected from Village Creek at the state park: Texas Pigtoe (G2G3-imperiled/vulnerable), Sandbank Pocketbook (G2-imperiled), and Southern Hickorynut (G2-imperiled). Texas Pigtoe occurs in East Texas and Louisiana (NatureServe 2015) and can be found in a diversity of habitats. It is currently listed as imperiled throughout its range due to declining numbers and a small geographic distribution (NatureServe 2015). Texas Pigtoe was the second most numerous species collected during this study, making up 22% of the total catch.

The Sandbank Pocketbook is found in East Texas, Arkansas, Louisiana, and Mississippi and is considered imperiled throughout its range (NatureServe 2015). There are few records for this species nationally, and it is usually found in low abundance when encountered (NatureServe 2015). This species was collected in the Village Creek Watershed in previous surveys (Bordelon and Harrel 2004). Ten individuals were collected in this bioassessment, making up just over 4% of the total catch.

The Southern Hickorynut, which can be found in East Texas and along the Mississippi River and Gulf Coast drainages (Cummings and Cordeiro 2012), is sensitive to disturbances (Howells 2014), making it a good indicator of an ecologically healthy and stable stream system. Throughout the southern United States, this species is thought to be declining (Cummings and Cordeiro 2012). During this study, Southern Hickorynut made up a little over 2% of the total catch.

Supplemental fish collections also contained Sabine Shiner and captured one additional SGCN fish species: Blackspot Shiner. Sabine Shiner was only collected from mainstem Village Creek sites (Sites 19, 20, 22, and 24) in addition to the study reach at Village Creek State Park. The Blackspot Shiner can be found across the western gulf slope drainages and is currently considered stable across its distribution; however, it is considered critically imperiled and partially extirpated in Oklahoma (NatureServe 2015). During this study, the Blackspot Shiner was collected from Sites 1, 6, and 8 in low abundance.

Four of the six SGCN fish species reported from the Village Creek Watershed in previous studies were not collected during this study: American Eel, Ironcolor Shiner, Western Creek Chubsucker, and Western Sand Darter. The Western Sand Darter had previously been collected from several sites on Village Creek, including Sites 19, 22, and 24 from this study. This species was collected near the state park in 1993 at the Roy E. Larson Sandyland Sanctuary (Hendrickson and Cohen 2015; Figure 1). The most recent, publically available collections of Ironcolor Shiner in the watershed occurred in Big Cypress Creek (upstream of Site 9) in 2008 (Hendrickson and Cohen 2015). Historical data showed Ironcolor Shiners captured at two of the supplemental sites from this study (Sites 3 and 7); however, these collections date back to the late 1950s and 1970s (Hendrickson and Cohen 2015).

RECREATIONAL ACCESS

Village Creek is a very unique Texas stream in that the majority of its riparian area is publically owned. This provides numerous opportunities for recreation in the form of boating, paddling, fishing, swimming, and nature watching. Several entities own land along Village Creek including TNC, TPWD, and NPS. NPS owns the majority of riverfront property within the Village Creek Watershed (Figure 13). This property is part of Big Thicket National Preserve, a 175 sq mi preserve which offers hiking, camping, fishing, kayaking, and hunting.

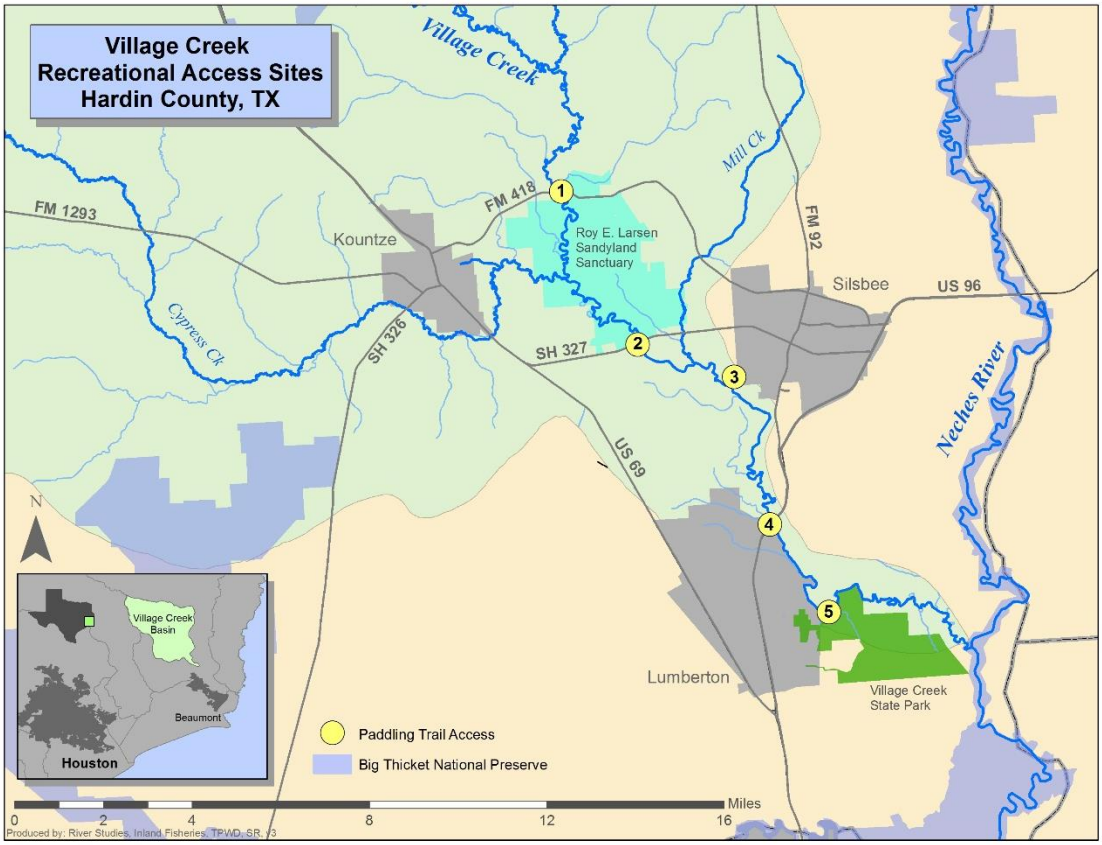

FIGURE 13.—Village Creek public recreational access locations in Hardin County, TX. See Table 11 for site information.

TABLE 11.—List of Village Creek public access locations in Hardin County, TX. See Figure 13 for locations.

Site Name	Location	Fee Charged	Use	Controlling Authority	Comments
Big Thicket Preserve	Along the Neches River and tributaries	free	kayaking, bank fishing	NPS	primitive camping free with permit
Sandyland Sanctuary	Village Creek near Kountze, TX	free	kayaking	TNC	day use only
1. FM 418	Lat: 30.3978027 Long: -94.2646555	free	paddling trail access	Hardin County	
2. SH 327	Lat: 30.3470277 Long: -94.2390500	free	paddling trail access	public	
3. Baby Galvez	Lat: 30.3343194 Long: -94.2041388	free	paddling trail access	public	
4. US 96	Lat: 30.2855277 Long: -94.1915416	free	paddling trail access, boat ramp	Hardin County	
5. Village Creek State Park	Lat: 30.2556833 Long: -94.1707033	$3/person*	paddling trail access, bank fishing	TPWD	camping $7-15/night

* 12 and under free

Additional properties on Village Creek include TPWD's Village Creek State Park and TNC's Roy E. Larsen Sandyland Sanctuary. The Sandyland Sanctuary is an 8.8 square mile preserve that is open to the public during daylight hours for hiking, kayaking, and nature watching.

Village Creek also has a 21 mi paddling trail with five access points (Figure 13; Table 11). Each segment of the trail can be completed in approximately one to six hours and distances between access points range from 2.1 miles (access point 2 to 3) to 8.6 miles (access point 1 to 2; TPWD 2016c). The paddling trail access site at US HWY 96 (Site 4) has a concrete boat ramp that can accommodate motorized boats as well (Table 11).

SPORT FISHING OPPORTUNITIES

Several sport fish species were collected from Village Creek at Village Creek State Park including Largemouth and Spotted bass, Channel Catfish *Ictalurus punctatus*, and Blue Catfish (Figure 14). Despite hoop net and low pulse electrofishing effort to specifically target catfish species, only two Channel and one Blue Catfish were collected within the study reach. The Blue Catfish collected was under legal harvest length, while both Channel Catfish exceeded the minimum length limit of 10 inches.

FIGURE 14.—Some of the fish species that offer angling potential within Village Creek State Park include from left to right Longear Sunfish, Largemouth Bass, Channel Catfish, and Bluegill.

Two harvestable Largemouth Bass and several large Spotted Bass were collected from Village Creek. Despite low sampling catch rates, length frequency histograms for both species (Figure 15) show a wide distribution of lengths suggesting recruitment is taking place. Boat electrofishing catch-per-unit-effort (CPUE) was relatively low for both Largemouth Bass (14.7/hr) and Spotted Bass (22.1/hr); however, CPUE was low for all species and bass were not specifically targeted. Two additional Largemouth Bass were collected from Sandy Slough in Village Creek State Park; however, both of these individuals were under three inches in total length. Largemouth Bass were collected from all (Sites 19, 20, 22, and 24), and Spotted Bass were collected from all but one collection site on Village Creek (Sites 19, 20, and 24); however, no length data was recorded at supplemental sites.

Additional sport fish species available at Village Creek State Park include seven sunfish species and Black Crappie. Bluegill and Longear Sunfish were among the more numerous species collected in Village Creek and both sloughs. Bluegill were also found in Mandy Lake.

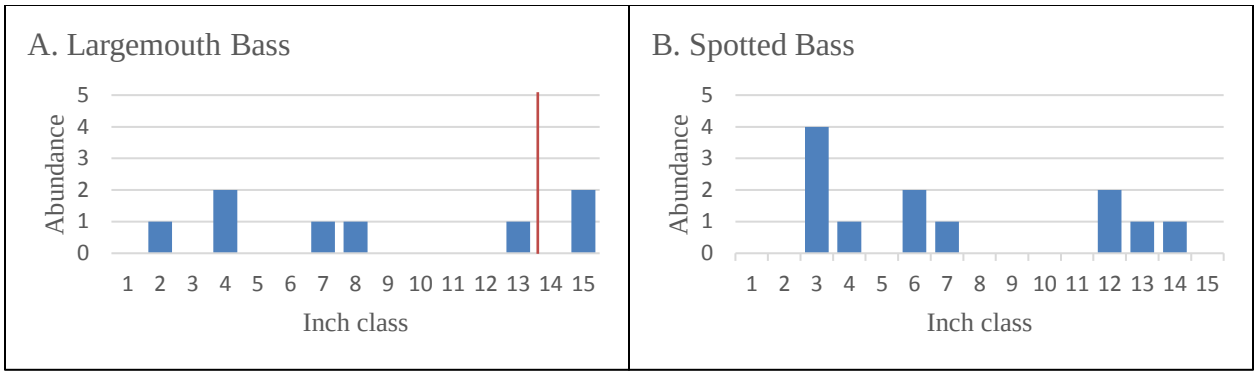

FIGURE 15.—Length frequency histogram of A. Largemouth Bass and B. Spotted Bass collected from Village Creek at Village Creek State Park by inch class. Red line represents minimum length limit for Largemouth Bass at the time of sampling. There is no minimum length limit for Spotted Bass. Abundance (y-axis) is total number collected from all sampling gear types.

SUMMARY AND RECOMMENDATIONS

Village Creek Watershed

Fish assemblage sampling occurred at a diversity of sites across the Village Creek Watershed including a roadside ditch, sloughs, tributaries, oxbows, and five mainstem Village Creek sites. Overall, 57 species of fish were collected from 30 sites throughout the watershed including those sites at Village Creek State Park. These collections included two fish species of SGCN status (Blackspot Shiner and Sabine Shiner). Only one non-native fish species was collected from one location.

Village Creek State Park

Forty fish species, 18 freshwater mussel species, 17 aquatic macroinvertebrate taxa, 3 crayfish species, 8 riparian tree species, and 11 riparian shrubs and herbaceous species were documented from Village Creek State Park. The study reach on Village Creek received an exceptional aquatic life use score for the fish community based on the regionalized Index of Biotic Integrity. Several species collected from Village Creek State Park provide angling opportunities including Largemouth and Spotted bass, Channel and Blue catfish, and several sunfish species. One fish species classified as SGCN and three state threatened mussel species were collected from the Village Creek study reach at Village Creek State Park.

Overall, stream health was categorized by the SVAP2 as good for the study reach on Village Creek. In particular, this reach of river scored high due to the lack of barriers to movement of aquatic species, high stream complexity, and presence of sufficient pool habitats. Water quality data collected from the Village Creek study reach met established water quality standards with the exception of one dissolved oxygen reading. Low dissolved oxygen levels have been found in previous studies of Village Creek and in similar streams is often attributed to decaying organic matter (LNVA 2015). A wide riparian corridor was intact throughout much of the park with high species richness, good recruitment, and low herbivory. Village Creek also had an excellent network of public access sites that offered many recreational opportunities to visitors.

Recommendations

Fish community data collected during this study from the study reach at Village Creek State Park was rated as exceptional and showed no deficiencies other than low CPUE. Periodic monitoring of the fish population in Village Creek adjacent to the park is recommended to document the status of SGCN and important sport fish species. Future boat electrofishing and netting surveys that specifically target sport fish would help to better gauge the potential of this fishery for angling.

Several sportfish species were collected during this study. Due to abundant public access along Village Creek, fishing is likely an important recreational activity for the area; however, little is known about the anglers who fish Village Creek and what species are targeted. One angler who was contacted at the US 96 boat ramp during the bioassessment indicated fishing for Largemouth and Spotted bass was excellent. A volunteer creel survey could be implemented to gain basic information on angler demographics and sportfish exploitation. The boat ramp at US 96, Village Creek State Park, and other kayak access points would be good locations for installing voluntary creel survey boxes to gather this information.

Further sampling of freshwater mussels is recommended throughout the Village Creek Watershed to build baseline mussel data within the watershed. Replication of Bordelon and Harrels' 2001 study sites would provide information to allow for assessment of trends in the mussel community (Bordelon and Harrel 2004).

Village Creek was not sampled for benthic macroinvertebrates during this study due to a lack of shallow habitats in the study reach; however 17 taxa were collected from Sandy Slough in Village Creek State Park. A high proportion of the invertebrates collected were tolerant taxa; however, this is typical of slough habitats. Suitable macroinvertebrate habitat in Village Creek should be surveyed in future studies.

Overall, the riparian area was in good functioning condition within Village Creek State Park. Continued monitoring of the exotic invasive plant species Coral Ardisia is advised. Periodic control of invasive riparian plants may be needed to prevent spreading. Hiking and river access trails in the riparian area may need to be reinforced to reduce erosion and to keep visitors from widening them further into the riparian area.

Village Creek offers significant recreational opportunities including fishing, kayaking, swimming, and nature watching. Almost the entirety of Village Creek is open for public access. Due to the extensive network of public access to Village Creek, no additional public access points are recommended at this time.

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