

# Middle and Lower Neches River Basin Bioassessment



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Cover photographs, clockwise from upper left: Washboard *Megalonaias nervosa*; Neches Crayfish *Procambarus nechesae*; seining the Angelina River at Alazan Creek Wildlife Management Area; and Longear Sunfish *Lepomis megalotis*.

# **Middle and Lower Neches River Basin Bioassessment**

## **EXECUTIVE SUMMARY**

Sampling for this study took place at two Texas Parks and Wildlife Department wildlife management areas (Alabama Creek and Alazan Bayou) and 23 supplemental fish collection sites in the middle and lower Neches River Basin in Angelina, Cherokee, Hardin, Nacogdoches, Polk, Trinity, and Tyler counties, Texas during the summers of 2015 and 2016. Sites were selected in an effort to fill gaps in statewide fish and mussel data. This data will be used to inform Texas Parks and Wildlife Department and University of Texas's Native Fish Conservation Network ([www.nativefishconservation.org](http://www.nativefishconservation.org)), an initiative striving to conserve rivers and streams through a holistic watershed approach prioritizing research and conservation efforts based on the distribution of native fish species. Additionally, this study was designed to support management needs of the wildlife management areas and recreational initiatives such as Texas Parks and Wildlife Department's Texas Paddling Trails and River Access and Conservation Areas programs.

Comprehensive data collection on fish, mussels, benthic macroinvertebrates, riparian area, stream condition, water quality, and crayfish was conducted at the study site on the Neches River at Alabama Creek Wildlife Management Area (WMA). Additionally, all tributaries in Alabama Creek and Alazan Bayou WMAs were sampled for fish, mussel, and crayfish assemblage data. Lastly, additional fish collection sites were selected throughout the middle and lower basin where previous collections were either outdated or non-existent as determined by the University of Texas' Fishes of Texas Project.

Overall 66 species of fish, 22 species of freshwater mussel, 32 aquatic macroinvertebrate taxa, eight species of crayfish, nine species of riparian trees, and 12 herbaceous and shrub riparian species were documented from the middle and lower Neches River Basin. Of that, 47 species of fish, 20 species of mussels, and one species of crayfish were collected from Alabama Creek WMA and 24 species of fish, 13 species of mussels, and two species of crayfish from Alazan Bayou WMA. This included collection of two state threatened fishes (Blue Sucker and Western Creek Chubsucker) and three state threatened mussels (Texas Pigtoe, Louisiana Pigtoe, and Texas Heelsplitter).

Of all supplemental fish collection sites, species richness ranged from 0 to 28, with the most species-rich sites occurring on the Neches River and Rocky Creek near the confluence with the Neches River. No non-native fish species were collected. Mussels were collected from seven sites with the highest diversity and abundances attributed to the Neches and Angelina rivers.

The riparian area bordering the Neches River at Alabama Creek WMA was well-functioning and diverse. Additionally, this site received an excellent overall stream health rating using the SVAP2 protocols.

This study found high fish, mussel, crayfish, benthic macroinvertebrate, and riparian plant species richness for the Neches River at Alabama Creek WMA and the Angelina River at Alazan Bayou WMA. Although this data just represents a snapshot of conditions, based on this assessment the middle and lower Neches River Basin aquatic ecosystems appear healthy and functioning.

## INTRODUCTION

### *Study Area*

Neches River: The Neches River Basin is contained entirely in Texas. The river arises in Van Zandt County southeast of Dallas, and flows approximately 670 km (416 mi) through mostly pine forestland before flowing into Sabine Lake and then to the Gulf of Mexico (TPWD 2017a). The Neches River drains a watershed of approximately 26,000 km<sup>2</sup> consisting of three ecoregions: East Central Texas Plains, South Central Plains, and Western Gulf Coastal Plain. Two major reservoirs impound the river: Lake Palestine and B.A. Steinhagen Lake. Most of the Neches River (from Lake Palestine down to Beaumont, TX) has been recognized by the Nationwide Rivers Inventory for having remarkable scenic, recreational, fisheries, and wildlife value (NPS 2010). An abundance of public access and camping sites are located along the river, including several state-owned wildlife management areas, national forests, and the Big Thicket National Preserve. Two segments of the Neches River (from Lake Palestine upstream to the confluence with Hopson Mill Creek and from Sabine Lake upstream to B. A. Steinhagen Reservoir) have also been nominated as ecologically significant stream segment and were recognized as riparian conservation areas, exceptional freshwater wetland habitats, and for having high water quality, high aesthetic value, and exceptional aquatic life, including one of the most abundant and diverse freshwater mussel assemblages in the state (TPWD 2017b).

Alabama Creek Wildlife Management Area: Alabama Creek Wildlife Management Area (WMA) is located in Trinity County, Texas and is comprised of 5,892 ha (14,561 acres) bordering the Neches River (TPWD 2017c). Alabama Creek WMA is unique in that the property is owned by the U.S. Forest Service and is part of Davy Crockett National Forest, but is managed by the Texas Parks and Wildlife Department (TPWD) as a state WMA. The WMA borders just under 12.9 km (8 mi) of the Neches River and is comprised almost entirely of forested land. While named for Alabama Creek, a tributary of the Neches River, the creek flows just south of the WMA and does not actually pass through it. The WMA contains portions of several tributaries to the Neches River and Alabama Creek: Crib Creek, Fortsythe Creek, Lancaster Creek, Carlton Branch, Slay Creek, and Sandy Creek. Alabama Creek WMA offers many recreational activities including hunting, biking, camping, kayaking, equestrian, fishing, hiking, and wildlife viewing.

Angelina River: The Angelina River, part of the Neches River Basin, begins in Rusk County, Texas at the confluence of Scober, Barnhardt and Shawnee creeks (TPWD 2017a). The river flows approximately 191 km (119 mi) through pine and hardwood forests before meeting the Neches River just upstream of B.A. Steinhagen Lake. The Angelina River is impounded southeast of Lufkin, Texas to form Sam Rayburn Reservoir, the second largest reservoir in the state. Portions of the Angelina River (the confluence with Indian Creek upstream to Sam Rayburn Dam and the confluence with Paper Mill Creek upstream to FM 1911) have been identified as ecologically significant stream segments for riparian conservation areas, the presence of imperiled species, and the presence of ecologically important bottomland hardwood habitats (TPWD 2017b).

Alazan Bayou Wildlife Management Area: Alazan Bayou WMA, located in Nacogdoches County, Texas, is comprised of 835 ha (2,063 acres) of primarily bottomland hardwood forest along the Angelina River (TPWD 2017d). Alazan Bayou WMA borders just under 8 km (5 mi) of the Angelina River and contains two tributaries (Bayou Loco and Alazan Bayou) and several

ponds. The bottomland forest adjacent to these waterbodies typically floods in winter and spring months. Alazan Bayou WMA offers a variety of recreational activities including hunting, camping, equestrian, wildlife viewing, and fishing; however, winter and spring flooding can make access to waterbodies difficult.

### *Survey and Management History*

**Biological Surveys:** Historically, 91 species of freshwater fishes have been documented from the middle and lower Neches River sub-basins, 69 of which also occurred in the Angelina River Basin (Hendrickson and Cohen 2015). A 2008 survey of fishes in the Big Thicket National Preserve found 47 species in the Neches River (Hargrave 2008). No freshwater fish surveys of Alabama Creek or Alazan Bayou WMAs were found.

East Texas exhibits the highest mussel diversity in the state. This has been attributed to factors such as climatic patterns and land use type (Burlakova et al. 2011). Historically, of the 52 species known to occur in the state, 33 are known to occur in the Neches River Basin (TPWD 2008).

A 2016 study by Dr. Zachary Loughman documented 13 crayfish species in the Big Thicket National Preserve (Big Thicket Association 2015). A 1999-2001 aquatic invertebrate survey of streams in the Big Thicket National Preserve documented 242 aquatic insect taxa; however, study sites for this survey were located in the Lower Neches River subbasin, downstream of aquatic invertebrate collections for that study (Moring 2003). No historical crayfish or aquatic invertebrate studies were available for Alabama Creek or Alazan Bayou WMAs.

No historical comprehensive riparian surveys were available for Alabama Creek or Alazan Bayou WMAs.

**Imperiled Species:** Historical fish collections from the middle and lower Neches River sub-basins documented seven freshwater and two estuarine fish species currently identified by TPWD (2012) as species of greatest conservation need (SGCN): Western Sand Darter *Ammocrypta clara*, American Eel *Anguilla rostrata*, Blue Sucker *Cycleptus elongatus*, Western Creek Chubsucker *Erimyzon claviformis*, Blackspot Shiner *Notropis atrocaudalis*, Sabine Shiner *Notropis sabiniae*, Silverband Shiner *Notropis shumardi*, Saltmarsh Topminnow *Fundulus jenkinsi*, and Southern Flounder *Paralichthys lethostigma* (Hendrickson and Cohen 2015). Blue Sucker is concurrently listed as state threatened in Texas. The Saltmarsh Topminnow is currently under review for federal listing. Historical records from the Angelina River contains a subset of the middle and lower Neches River SGCN species: Western Creek Chubsucker, Blackspot Shiner, Sabine Shiner, and Silverband Shiner (Hendrickson and Cohen 2015).

Several mussel SGCN species have been reported from the Neches River Basin (TPWD 2008): Texas Pigtoe *Fusconaia askewi*, Triangle Pigtoe *Fusconaia lananensis*, Sandbank Pocketbook *Lampsilis satura*, Southern Hickorynut *Obovaria jacksoniana*, Louisiana Pigtoe *Pleurobema riddellii*, and Texas Heelsplitter *Potamilus amphichaenus*. The Angelina River is known to contain a subset of these species: Texas Pigtoe, Sandbank Pocketbook, Southern Hickorynut, and Louisiana Pigtoe; however, Texas Pigtoe is only documented through historical records over 30 years old.

Sport Fish Harvest Regulations: Sport fishes in the Neches and Angelina rivers are managed under statewide freshwater fishing regulations, with the exception of the lower Neches River bordering Jefferson and Orange counties in which the minimum length limit for Largemouth Bass is reduced from the statewide limit of 14 in down to 12 in (TPWD 2017e).

Fish Stockings: TPWD has stocked several species in the Neches River since 1974. Stockings of Channel Catfish *Ictalurus punctatus*, Rainbow Trout *Oncorhynchus mykiss*, and Smallmouth Bass *Micropterus dolomieu* were one-time stocking events at unknown locations on the Neches River during the following respective years: 1974, 1975, and 1980 (TPWD 2017f). Subsequent to those stockings, TPWD made an effort to restore Paddlefish *Polyodon spathula* to the Neches River in the mid-to-late 1990's. These stockings coincided with similar efforts in Big Cypress Bayou, Trinity River, Angelina River, and Sabine River (Betsill 1999). In the Neches River from 1993-1998, 29,849 Paddlefish fingerlings were stocked at various locations including several locations in and around Alabama Creek WMA (TPWD 2017f). Additionally, 13,626 fry, 113,538 fingerling, and 20 adult Paddlefish were stocked in B.A. Steinhagen Reservoir from 1989-1992. These stockings failed to produce a self-sustaining population of Paddlefish in the middle Neches River. It is thought that these stockings failed due to a lack of suitable spawning habitat and loss of some fish downstream through dams (Betsill 1999).

The Angelina River was also part of the Paddlefish recovery efforts. From 1991-1998, seven adult and 212,422 fingerling Paddlefish were stocked at various locations (TPWD 2017f). Additionally, 110,435 fingerling Paddlefish were stocked in Sam Rayburn Reservoir from 1990-1995. These efforts were also unsuccessful at establishing a self-sustaining population of Paddlefish (Betsill 1999). Additional stockings in the Angelina River include Channel Catfish, Largemouth Bass *Micropterus salmoides*, Bluegill *Lepomis macrochirus*, and Smallmouth Bass over five stocking events, with the most recent occurring in 1980 (TPWD 2017f).

Water Quality: The Neches River reach between B.A. Steinhagen and Palestine reservoirs is listed by the Texas Commission on Environmental Quality (TCEQ) as Segment ID 0604 (TCEQ 2014a). The only water quality concern listed in TCEQ's 2014 Texas Integrated Report (2014a) for this river reach is elevated levels of two toxic chemicals, dioxin and mercury, in edible fish tissues. More specifically, there is a fish consumption advisory in place for Smallmouth Buffalo *Ictiobus bubalus*, Flathead Catfish *Pylodictis olivaris*, Blue Catfish *Ictalurus furcatus*, Largemouth Bass, Spotted Bass *Micropterus punctulatus*, and gar due to these two toxins (TPWD 2017g).

## STUDY SITES

The middle and lower Neches River Basin bioassessment included comprehensive sampling at two bioassessment study areas (Alazan Bayou and Alabama Creek WMAs) and supplemental fish assemblage sampling at 23 additional sites throughout the middle and lower basin (Figure 1; Table 1).

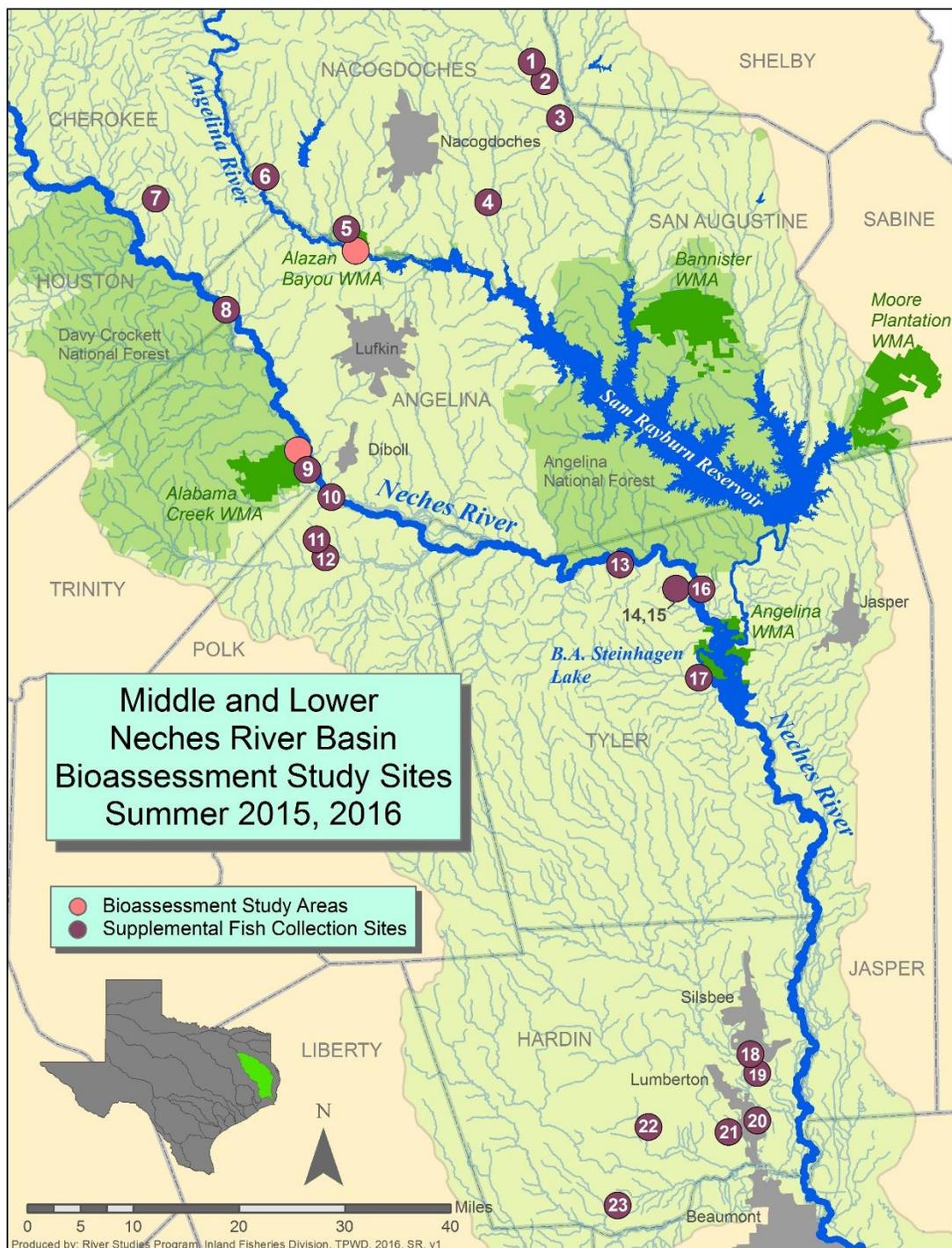


FIGURE 1.—Locations of middle and lower Neches River Basin data collection sites in Hardin, Tyler, Trinity, Cherokee, Nacogdoches, Angelina, and Polk counties, TX. See Table 1 for site location information.

TABLE 1.—Middle and lower Neches River Basin study site locations and the type of data collected during the summers of 2015 and 2016 in Hardin, Tyler, Trinity, Cherokee, Nacogdoches, Angelina, and Polk counties, TX. Sites designated with letters fall within the bioassessment study areas at Alazan Bayou and Alabama Creek Wildlife Management Areas. Sites designated with numbers represent supplemental fish collection sites.

Site	Location	Coordinates	Sampling Date	Fish	Mussels	Crayfish	Macro-inverts	Riparian	Stream Health
<i>Alazan Bayou Wildlife Management Area</i>									
A	Pond	31.49101, -94.74895	8/4/2016	X					
B	Bayou Loco	31.47903, -94.75092	8/4/2016	X	X	X			
C	Angelina River	31.47009, -94.75255	8/4/2016	X	X	X			
<i>Alabama Creek Wildlife Management Area</i>									
D	Neches River at Holly Bluff Rd.	31.19407, -94.85988	9/15/2016	X	X	X	X	X	X
E	Sandy Creek at FM 2262	31.20232, -94.89390	8/5/2016	X	X	X			
F	Carlton Branch at FM 2262	31.15342, -94.87876	8/5/2016	X	X	X			
G	Lancaster Creek	31.15715, -94.90665	8/5/2016	X	X				
H	Forsythe Creek at FM 357	31.14193, -94.90159	8/5/2016	X	X	X			
I	Crib Creek at Mt Zion Rd.	31.16325, -94.95327	8/6/2016	X	X	X			
<i>Supplemental Fish Collection Sites</i>									
1	Naconiche Creek at FM 95	31.71332, -94.44938	6/15/2016	X					
2	Waffleflow Creek at FM 95	31.69187, -94.43801	6/15/2016	X					
3	Terrapin Creek at FM 95	31.63864, -94.41483	6/15/2016	X					
4	Atascoso Creek at FM 226	31.52771, -94.53664	6/15/2016	X					
5	Alazan Bayou at CR 635	31.49757, -94.75078	8/4/2016	X					
6	Angelina River at CR 789	31.57746, -94.89181	6/15/2016	X					
7	Sandy Creek at CR 2816	31.50905, -95.04807	6/15/2016	X					
8	Neches River at SH 7	31.39704, -94.96481	6/15/2016	X					
9	Alabama Creek at FM 357	31.13472, -94.87054	8/6/2016	X					
10	Neches River at US 59	31.13281, -94.81039	6/16/2016	X					
11	Rocky Creek (West) at CR 245	31.06059, -94.83565	6/16/2016	X					
12	Piney Creek at US 59	31.05020, -94.82414	6/16/2016	X					
13	Beale Branch at CR 3400	31.02078, -94.35482	6/14/2016	X					
14	Rocky Creek (East) at CR 3725	30.98605, -94.26408	6/14/2016	X					
15	Rocky Creek (East) at mouth	30.98363, -94.24468	6/14/2016	X					
16	Primrose Slough at SH 255	30.98235, -94.23086	6/14/2016	X					
17	Wolf Creek at FM 92	30.86975, -94.23853	6/14/2016	X					
18	Unnamed ditch at US 96	30.33393, -94.18430	7/14/2015	X					
19	Unnamed Creek at Cooks Rd.	30.31639, -94.17956	5/2/2015	X					
20	Unnamed Creek at Alma Rd.	30.24651, -94.18281	5/2/2015	X					
21	Boggy Creek at FM 421	30.23267, -94.22932	5/3/2015	X					
22	Black Creek at Blue Jay Dr.	30.24554, -94.35541	7/12/2015	X					
23	Sour Lake at Steele Rd.	30.13986, -94.41039	7/12/2015	X					

### Alabama Creek Wildlife Management Area

Six sites were sampled for fish, mussel, and crayfish assemblage data within Alabama Creek WMA in August and September 2016 (Figure 2): Neches River (Site D), Sandy Creek (Site E), Carlton Branch (Site F), Lancaster Creek (Site G), Forsythe Creek (Site H), and Crib Creek (Site I)(Figure 2). The Neches River Site (D) was also assessed for aquatic invertebrates, water quality, stream health, and riparian area. The Neches River site contained mostly low current velocities, averaged 20-30 m in width, had depths ranging from 0.15-3.5 m, was predominantly comprised of sand and some clay substrates, and contained moderate amounts of large and small woody debris instream cover (Figure 3).

All tributary sites had several things in common, regardless of stream order, including predominantly sand and clay substrates, large amounts of woody debris, and a variety of depths and mesohabitats (Figure 3). Alabama Creek does not flow through Alabama Creek WMA; however, the creek was sampled at FM 357 just south of the WMA (Site 9) and is included with the supplemental sites.

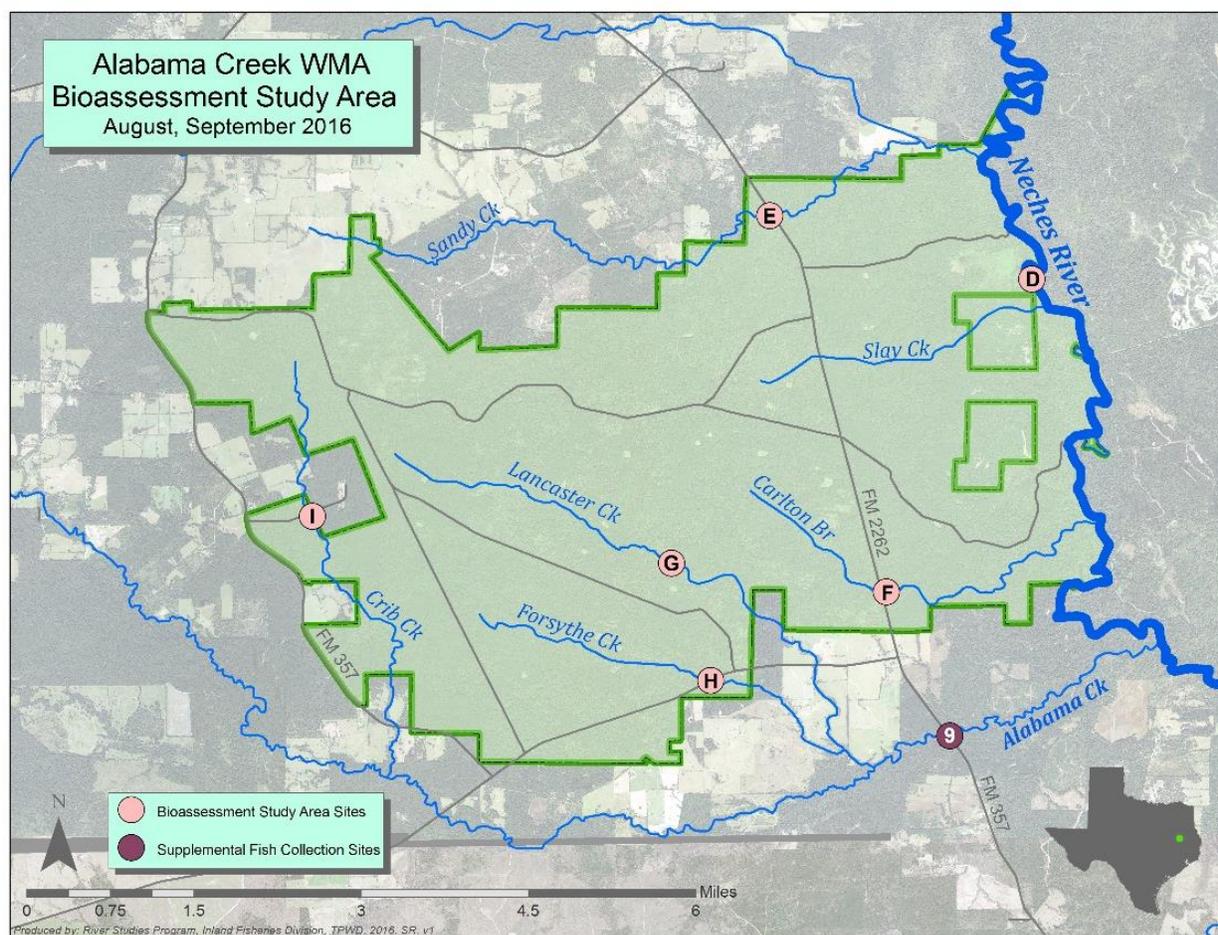


FIGURE 2.—Locations of study sites within the bioassessment study area at Alabama Creek Wildlife Management Area, Trinity County, TX. See Table 1 for site location information.



FIGURE 3.— Photos showing representative habitats of sites sampled within Alabama Creek Wildlife Management Area in Trinity County, TX in August and September 2016. Photos are labeled with the corresponding site letters found in Table 1 and Figure 2.

### *Alazan Bayou Wildlife Management Area*

Three study sites were sampled for fish and mussel assemblage data within Alazan Bayou WMA in August 2016 (Figure 4): an unnamed pond (Site A), Bayou Loco (Site B), and the Angelina River (Site C). The pond was adjacent to the main WMA road and was shallow with large amounts of silt and high water temperatures at the time of sampling (Figure 5). Study Site B on Bayou Loco was not flowing and contained clay substrates, shallow depths, and moderate amounts of small woody debris (Figure 5). Lastly, the study site on the Angelina River was dominated by run mesohabitats, sandy substrates, large and small woody debris, and a range of depths (Figure 5). Portions of Alazan Bayou within the WMA were either not accessible or dry during sampling; therefore, Alazan Bayou was sampled for fish upstream of the WMA at Site 5 and is grouped with the supplemental fish collection sites.

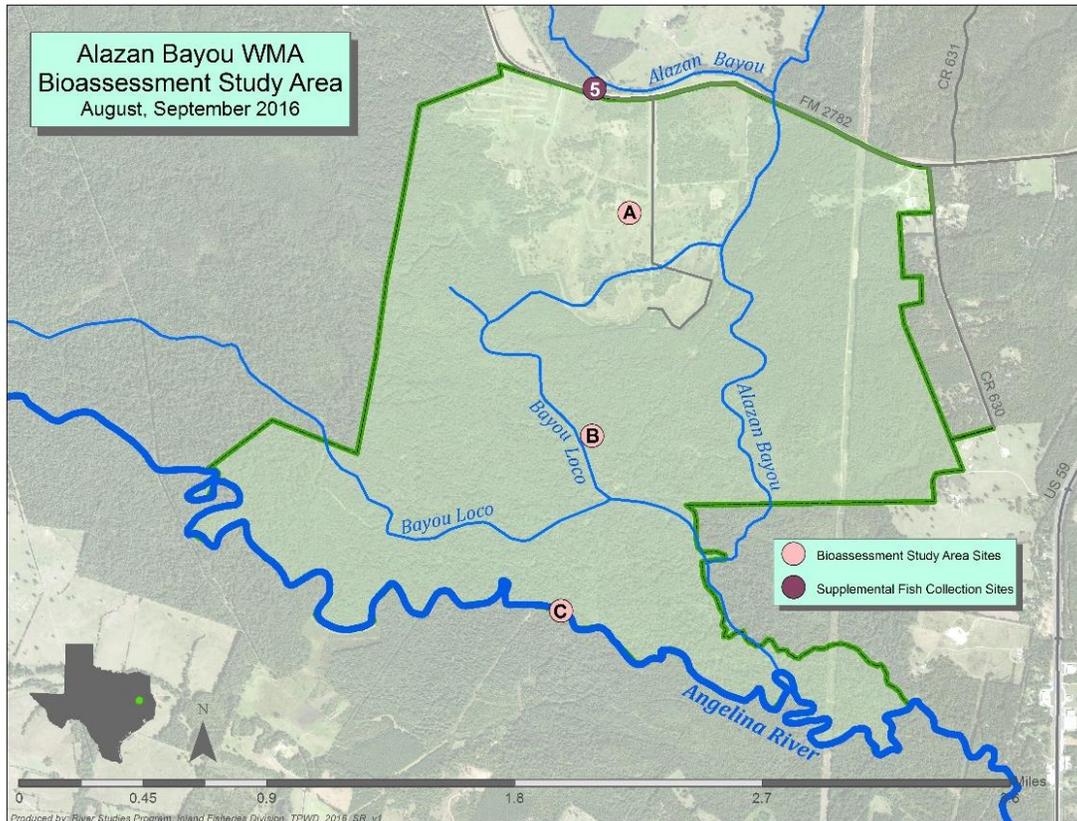


FIGURE 4.—Locations of study sites within the bioassessment study area at Alazan Bayou Wildlife Management Area, Nacogdoches County, TX. See Table 1 for site location information.



FIGURE 5.—Photos showing representative habitats of sites sampled within Alazan Bayou Wildlife Management Area in Nacogdoches County, TX in August 2016. Photos are labeled with the site letters found in Table 1 and Figure 4.

### *Supplemental Fish Collection Sites*

Twenty-three supplemental fish collection sites were sampled throughout the middle and lower Neches River Basin in Nacogdoches, Cherokee, Angelina, Trinity, Polk, Tyler, Jasper, and Hardin counties, Texas (Sites 1-23; Figure 1; Table 1). These included two additional sites on the Neches River, 19 sites on 18 tributaries, and two unnamed ditches. These sites were sampled to fill gaps or update fish assemblage data in the statewide Fishes of Texas database (Hendrickson and Cohen 2015). 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 1-23 which were sampled in 2015 and 2016. Photos are labeled with the corresponding site numbers found in Table 1.

FIGURE 6.— Continued.



FIGURE 6.— Continued.



### WATER QUALITY AND QUANTITY

**Methods:** Water temperature ( $^{\circ}\text{C}$ ), specific conductivity ( $\mu\text{S}/\text{cm}$ ), dissolved oxygen ( $\text{mg}/\text{L}$ ), and pH were recorded for a 24-hour period in 15 min increments starting the afternoon of September 14, 2016 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 ( $\text{ft}^3/\text{sec}$ ) data were collected from United States Geological Survey (USGS) Gage No. 08033000 Neches River near Diboll, Texas – located about 5 km downstream of the Alabama Creek WMA.

**Results and Discussion:** Water temperature, dissolved oxygen, and pH recorded during this study were within their designated water quality standards (Table 2). 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). Although water quality parameters are not a concern, the Neches River is listed as impaired by TCEQ because of elevated dioxin and mercury concentrations in edible tissue (TCEQ 2014a). Fish tissue contaminants, bacteria, and metals were not evaluated during this study.

Stream discharge at the time of sampling was considerably higher than what is typical of historical conditions during September. Median discharge during the two-day sampling period was  $324 \text{ ft}^3/\text{sec}$ . Daily median discharge for September 14-15, calculated from data reported from this USGS gage for the period of record (1923-2016), is  $121 \text{ ft}^3/\text{sec}$ .

TABLE 2. —Water quality summary of data collected over a 24-hour period on September 14-15, 2016 from the Neches River at Holly Bluff Rd. (Site D) in Trinity County, TX. Texas Commission on Environmental Quality (TCEQ) water quality standards for Segment 0604, Neches River Below Lake Palestine, are reported for comparison (TCEQ 2014a).

	Temperature (°C)	Specific Conductivity ( $\mu$ S/cm)	Total Dissolved Solids (mg/L)	Dissolved Oxygen (mg/L)	pH
Mean	28.5	150	96	5.6	6.8
Minimum	28.0	144	92	5.5	6.6
Maximum	28.9	154	99	6.8	6.9
TCEQ Standard	$\leq 32.3$	N/A	$\leq 200$	24 hr avg: $\geq 5$ 24 hr min: $\geq 3$	6.0-8.5

## FISH ASSEMBLAGE

### *Alabama Creek Wildlife Management Area (Sites D-I)*

**Methods:** Fish were collected from the Neches River (Site D) on September 15, 2016 utilizing boat electrofishers, seines, hoop nets, and minnow traps. Sampling was also conducted at five additional sites in Alabama Creek WMA (Sites E-I) on August 5-6, 2016 using seines, gill nets, and minnow traps.

Sampling techniques were selected based on effectiveness of capturing fish at each 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 at Site D; however, additional sampling continued as needed until all habitat types had been effectively sampled and new species were not collected. Hoop nets and minnow traps were also deployed at Site D and left overnight for a minimum of 12 hours. All other sites within the WMA were sampled using seines until all available mesohabitats were sampled and no new species were collected. Minnow traps were also deployed overnight at each of these sites. Lastly, gill nets were deployed, where appropriate, for the duration of seining, typically 1-2 hours.

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

**Results and Discussion:** A total of 1,875 individuals comprised of 12 families and 47 species were collected across all sites in Alabama Creek WMA (Table 3). Site D on the Neches River yielded the most species, with 29 collected, while the five tributary sites (Sites E-I) had moderate to high species richness ranging from eight to 20. The most abundant species collected was Western Mosquitofish *Gambusia affinis*, followed by Mississippi Silvery Minnow *Hybognathus nuchalis* (Figure 7).

Clear differences in species composition were noted between the Neches River and the five tributary sites, with 20 species unique to the mainstem and 18 to the tributaries. Specifically, three families were only found in the Neches River: Lepisosteidae (gar), Atherinopsidae (silverside), and Sciaenidae (drum).

TABLE 3.—Abundance of fish by species combined across all gear types by site collected from Alabama Creek Wildlife Management Area in August and September 2016, Trinity County, Texas.

Family	Scientific name	Common name	Site D <i>Neches River</i>	Site E <i>Sandy Creek</i>	Site F <i>Carlton Branch</i>	Site G <i>Lancaster Creek</i>	Site H <i>Forsythe Creek</i>	Site I <i>Crib Creek</i>
Lepisosteidae	<i>Lepisosteus oculatus</i>	Spotted Gar	1					
	<i>Lepisosteus osseus</i>	Longnose Gar	1					
Cyprinidae	<i>Cyprinella lutrensis</i>	Red Shiner	5					
	<i>Cyprinella venusta</i>	Blacktail Shiner	68					
	<i>Hybognathus nuchalis</i>	Mississippi Silvery Minnow	126	205			1	10
	<i>Hybopsis amnis</i>	Pallid Shiner	13					
	<i>Lythrurus funeus</i>	Ribbon Shiner	23	202	8	2	1	
	<i>Lythrurus umbratilis</i>	Redfin Shiner						4
	<i>Notemigonus crysoleucas</i>	Golden Shiner		20	5		2	2
	<i>Notropis atrocaudalis</i>	Blackspot Shiner		1	2	49	7	29
	<i>Notropis sabinæ</i>	Sabine Shiner	1					
	<i>Notropis texanus</i>	Weed Shiner	87	35				
	<i>Notropis volucellus</i>	Mimic Shiner	2					
	<i>Opsopoeodus emiliae</i>	Pugnose Minnow		22				
	<i>Phenacobius mirabilis</i>	Suckermouth Minnow	2					
	<i>Pimephales vigilax</i>	Bullhead Minnow	17					
Catostomidae	<i>Cycleptus elongatus</i>	Blue Sucker	2					
	<i>Erimyzon claviformis</i>	Western Creek Chubsucker			1	9	1	
	<i>Erimyzon sucetta</i>	Lake Chubsucker			7			
	<i>Ictiobus bubalus</i>	Smallmouth Buffalo	5					
	<i>Minytrema melanops</i>	Spotted Sucker		5				
	<i>Moxostoma poecilurum</i>	Blacktail Redhorse	1					
Ictaluridae	<i>Ameiurus melas</i>	Black Bullhead			11			
	<i>Ameiurus natalis</i>	Yellow Bullhead		30	31		5	3
	<i>Ictalurus furcatus</i>	Blue Catfish	3					
	<i>Ictalurus punctatus</i>	Channel Catfish	8	1				
	<i>Noturus nocturnus</i>	Freckled Madtom		3				
	<i>Pylodictis olivaris</i>	Flathead Catfish	3					
Esocidae	<i>Esox americanus</i>	Redfin Pickerel		1	12			
Aphredoderidae	<i>Aphredoderus sayanus</i>	Pirate Perch		1	5		1	
Atherinopsidae	<i>Labidesthes sicculus</i>	Brook Silverside	1					
Fundulidae	<i>Fundulus notatus</i>	Blackstripe Topminnow	42	61				2
Poeciliidae	<i>Gambusia affinis</i>	Western Mosquitofish	18	97	35	109	18	142
Centrarchidae	<i>Centrarchus macropterus</i>	Flier			4			
	<i>Lepomis cyanellus</i>	Green Sunfish		1	2	4	9	11
	<i>Lepomis gulosus</i>	Warmouth	1	1	2		3	1
	<i>Lepomis macrochirus</i>	Bluegill	2	5	2	1	1	1
	<i>Lepomis marginatus</i>	Dollar Sunfish			14			
	<i>Lepomis megalotis</i>	Longear Sunfish	33	15		5	11	22
	<i>Lepomis microlophus</i>	Redear Sunfish						1
	<i>Lepomis</i> sp. (hybrid)	Hybrid sunfish sp.					7	
	<i>Lepomis</i> sp. (juvenile)	Juvenile sunfish sp.				13		
	<i>Micropterus punctulatus</i>	Spotted Bass	15					
	<i>Micropterus salmoides</i>	Largemouth Bass		2			1	
Percidae	<i>Ammocrypta vivax</i>	Scaly Sand Darter	12					
	<i>Etheostoma thompsoni</i>	Gumbo Darter	1					
	<i>Etheostoma gracile</i>	Slough Darter		1	14	1	3	23
	<i>Percina sciera</i>	Dusky Darter	1					
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater Drum	2					
	<b>Number of species collected</b>		<b>29</b>	<b>20</b>	<b>16</b>	<b>8</b>	<b>14</b>	<b>13</b>
	<b>Number of individuals collected</b>		<b>496</b>	<b>709</b>	<b>155</b>	<b>193</b>	<b>71</b>	<b>251</b>

Aside from Brook Silverside *Labidesthes sicculus*, species collected from these families are typically large-bodied residents of moderate to large river systems. Conversely, two families were only collected from tributary sites: Esocidae (pike) and Aphredoderidae (pirate perch). Redfin Pickerel *Esox americanus* and Pirate Perch *Aphredoderus sayanus* are the two species represented by these families and both often associate with smaller stream systems that contain habitats with slow to moderate current velocities and high amounts of instream cover such as aquatic vegetation, small woody debris, root wads, and undercut banks (Thomas et al. 2007).

Fourteen native cyprinid (minnow) species were collected across all sites within Alabama Creek WMA, with seven species only occurring at Site D on the Neches River and four species only in tributaries (Table 3).

Six catostomid (sucker) species were collected in relatively low numbers across all sites with three species limited to Site D on the mainstem (Table 3). Two of these are Blue Sucker and Smallmouth Buffalo, both species that primarily inhabit large rivers with moderate to swift current velocities, deeper depths, and instream cover such as large woody debris (Moss et al. 1983). Conversely, Western Creek Chubsucker and Lake Chubsucker *Erimyzon sucetta* were only collected in the tributary sites, likely due to their preference for habitats with little to no flow and instream cover (Thomas et al. 2007).

Nine centrarchid (sunfish and bass) species were collected across all sites (Table 3). Longear Sunfish *Lepomis megalotis*, Green Sunfish *Lepomis cyanellus*, and Bluegill were the most common and widely distributed sunfish species throughout Alabama WMA. A couple of species unique to the tributary sites include Flier *Centrarchus macropterus* and Dollar Sunfish *Lepomis marginatus*. Also, while few black bass were collected, they were segregated between mainstem and tributary sites with Spotted Bass only collected in the mainstem study reach and Largemouth Bass only collected in the tributary sites.



FIGURE 7.—The most abundant fish species collected within the Alabama Creek WMA from left to right are Western Mosquitofish, Mississippi Silvery Minnow, Ribbon Shiner, and Weed Shiner.

### *Alazan Bayou Wildlife Management Area (Sites A-C)*

**Methods:** Fish were collected from three sites within Alazan Bayou WMA (Sites A-C) on August 4<sup>th</sup>, 2016 using seines and minnow traps (Figure 4). Sampling techniques and preservation of species mirror methods used at sites in the Alabama Creek WMA. One additional gear type, eel pot, was deployed at Site C on the Angelina River to selectively target American Eel.

**Results and Discussion:** A total of 680 individuals consisting of 24 species were collected across three sites in Alazan Bayou WMA (Table 4). Two sites possessed moderate to high species richness with 14 species collected at Site B on Bayou Loco and 17 species at Site C on the Angelina River; six species were unique to Site B and 10 unique to Site C. No fish were collected at Site A; only crayfish and tadpoles were observed. Site A was a large, shallow pond with high water temperature and relatively stagnant water that likely precluded fish from utilizing the site on a regular basis.

Nine families of fish were collected at Alazan Bayou WMA, all represented at Site B on Bayou Loco. Three families were only found at Site B and were absent from Site C on the Angelina River: Catostomidae (sucker), Esocidae (pike) and Aphredoderidae (pirate perch). Redfin Pickerel and Pirate Perch are the two species represented by the latter two families. As previously mentioned, both of these species often associate with smaller stream systems that contain habitats with slow to moderate current velocities and high amounts of instream cover (Thomas et al. 2007).

TABLE 4.—Abundance of fish by species combined across all gear types by site from Alazan Bayou WMA from August 2016, Nacogdoches County, Texas.

Family	Scientific name	Common name	Site A Pond	Site B Bayou Loco	Site C Angelina River
Cyprinidae	<i>Cyprinella venusta</i>	Blacktail Shiner			10
	<i>Hybopsis amnis</i>	Pallid Shiner			30
	<i>Lythrurus fumeus</i>	Ribbon Shiner		15	199
	<i>Notemigonus crysoleucas</i>	Golden Shiner		52	
	<i>Notropis texanus</i>	Weed Shiner			107
	<i>Opsopoeodus emiliae</i>	Pugnose Minnow		16	3
	<i>Phenacobius mirabilis</i>	Suckermouth Minnow			2
	<i>Pimephales vigilax</i>	Bullhead Minnow			15
Catostomidae	<i>Erimyzon sucetta</i>	Lake Chubsucker		1	
	<i>Minytrema melanops</i>	Spotted Sucker		15	
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead		29	
	<i>Ictalurus punctatus</i>	Channel Catfish			1
	<i>Noturus gyrinus</i>	Tadpole Madtom			1
Esocidae	<i>Esox americanus</i>	Redfin Pickerel		1	
Aphredoderida	<i>Aphredoderus sayanus</i>	Pirate Perch		4	
Fundulidae	<i>Fundulus notatus</i>	Blackstripe		37	23
Poeciliidae	<i>Gambusia affinis</i>	Western Mosquitofish		65	2
Centrarchidae	<i>Lepomis megalotis</i>	Longear Sunfish		4	4
	<i>Micropterus salmoides</i>	Largemouth Bass		18	4
	<i>Pomoxis nigromaculatus</i>	Black Crappie		9	
Percidae	<i>Etheostoma chlorosoma</i>	Bluntnose Darter		1	5
	<i>Etheostoma histrio</i>	Harlequin Darter			2
	<i>Etheostoma thompsoni</i>	Gumbo Darter			2
	<i>Percina sciera</i>	Dusky Darter			3
<b>Number of species collected</b>			<b>0</b>	<b>14</b>	<b>17</b>
<b>Number of individuals collected</b>			<b>0</b>	<b>267</b>	<b>413</b>

Eight native cyprinid (minnow) species were collected across two sites in Alazan Bayou WMA with one species only occurring at Site B and five species only occurring at Site C (Table 4). The most abundant cyprinids were Ribbon Shiner *Lythrurus fumeus*, Weed Shiner *Notropis texanus*, and Golden Shiner *Notemigonus crysoleucas* (Table 4; Figure 8).



FIGURE 8.—The most abundant fish species collected within the Alazan Bayou WMA from left to right are Ribbon Shiner, Weed Shiner, Western Mosquitofish, and Blackstripe Topminnow.

Four percid (darter) species were collected in relatively low numbers across the two sites with three species only occurring at Site C on the Angelina River: Harlequin Darter *Etheostoma histrio*, Gumbo Darter *Etheostoma thompsoni*, and Dusky Darter *Percina sciera* (Table 4). These species were likely

only found at Site C due to preference for swift current velocities which were absent from Site B (Thomas et al. 2007).

Three centrarchid (sunfish and bass) species were collected across two sites (Table 4). Longear Sunfish and Largemouth Bass were collected at both sites, while Black Crappie *Pomoxis nigromaculatus* were only collected at Site B. Black Crappie are associated with pools and backwaters with little to no flow and some degree of instream cover (Thomas et al. 2007), habitats consistent with Site B.

### *Supplemental Fish Collection Sites (Sites 1-23)*

**Methods:** Outside of the two WMA's, an additional 23 sites were sampled in the Neches River Basin from May to July 2015 and from June to August 2016 (Table 1, Figure 1). The majority of sampling took place June 14-16, 2016 (15 sites) and focused on the reach of the Neches River in the vicinity of Alabama Creek and Alazan Bayou WMAs and upstream of Steinhagen Reservoir. Efforts at supplemental sites aim to provide a broader picture of the fish community for the focal watershed by sampling a diversity of habitats and fill historical data gaps occurring in the statewide Fishes of Texas database (Hendrickson and Cohen 2015). All representative habitat types were sampled at each site using seines until no new species were collected, with the exception of sites 18 and 23 in which dip nets and frame nets were used. A minimum of five seine hauls were conducted at each site, with an average of 13 hauls per site. In addition, monofilament experimental gill nets were deployed when deeper, wadeable waters were present. Nets were deployed for the duration of seining, typically one to two hours.

Specimens were preserved in a buffered 10% formalin solution and brought back to the lab for identification, enumeration, and deposition into the University of Texas at Austin, Biodiversity Collections. Photos of representative species were also taken in the field and can be found on the iNaturalist Fishes of Texas Project (<http://www.inaturalist.org/projects/fishes-of-texas>). At select sites, tissues were taken and have been included in the university's Genetic Resource Collection. All data will be made available on the Fishes of Texas website ([www.fishesoftexas.org](http://www.fishesoftexas.org)) and uploaded to other major biodiversity data sites such as GBIF ([www.gbif.org](http://www.gbif.org)) and iDigBio ([www.idigbio.org](http://www.idigbio.org)).

**Results:** A total of 60 species were found throughout the supplemental sites, comprising 13 families and 3,317 individual specimens (Tables 5 and 6). Species richness was highest in Rocky Creek (East) at the confluence with the Neches River (Site 15), with the Neches River at US 59 a close second (Site 10). These sites yielded 28 and 27 species, respectively. Also high in richness was the CR 789 crossing of the Angelina River (Site 6), where 22 species were found. The least species rich localities were two ditches and one disconnected creek (Sites 18, 20, 23) that were targeted as potential Least Killifish *Heterandria formosa* habitat and produced two to three species each. The lowest richness for a connected stream was observed at Black Creek at Blue Jay Rd. (Site 22), where four species were collected.

Western Mosquitofish was the most abundant and widespread species throughout the system, collected at all but three sites. The next most common fishes to occur were Bluegill (17 sites), Blackstripe Topminnow (14 sites), Largemouth Bass (13 sites), Longear Sunfish (11 sites), and Slough Darter *Etheostoma gracile* (11 sites). Other species that were fairly common or high in overall number of individuals collected were Ribbon Shiner, Golden Shiner, Weed Shiner, Pugnose Minnow *Opsopoeodus*

TABLE 5.—Fish species and abundances by site (1-12) collected in summer 2016 in Nacogdoches, Cherokee, Angelina, Trinity, and Polk counties, TX: 1. Naconiche Creek at FM 95, 2. Waffleflow Creek at FM 95, 3. Terrapin Creek at FM 95, 4. Atascoso Creek at FM 226, 5. Alazan Bayou at CR 635, 6. Angelina River at CR 789, 7. Sandy Creek at CR 2816, 8. Neches River at SH 7, 9. Alabama Creek at FM 357, 10. Neches River at US 59, 11. Rocky Creek (West) at CR 245, 12. Piney Creek at US 59.

Family	Scientific Name	Common Name	Site												
			1	2	3	4	5	6	7	8	9	10	11	12	
Lepisosteidae	<i>Atractosteus spatula</i>	Alligator Gar													
	<i>Lepisosteus oculatus</i>	Spotted Gar		3										1	
	<i>Lepisosteus osseus</i>	Longnose Gar													
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad	1							2	6				
	<i>Dorosoma petenense</i>	Threadfin Shad	2												
Cyprinidae	Cyprinidae sp.	unknown larval minnow											9		
	<i>Cyprinella lutrensis</i>	Red Shiner							6				1		
	<i>Cyprinella venusta</i>	Blacktail Shiner	8	2	6			3					1	1	
	<i>Hybognathus nuchalis</i>	Mississippi Silvery Minnow								7	13	24		15	
	<i>Hybopsis amnis</i>	Pallid Shiner						51		1	2	29			
	<i>Lythrurus fumeus</i>	Ribbon Shiner		3	99	13						57	13		
	<i>Lythrurus</i> sp.	Juvenile shiner									4				
	<i>Lythrurus umbratilis</i>	Redfin Shiner			4					1					
	<i>Notemigonus crysoleucas</i>	Golden Shiner	7	2	1	9				2			2	2	4
	<i>Notropis atrocaudalis</i>	Blackspot Shiner	1		5	1	1							5	
	<i>Notropis buchanani</i>	Ghost Shiner							51						
	<i>Notropis sabinae</i>	Sabine Shiner							1				5		
	<i>Notropis texanus</i>	Weed Shiner	3		28				47		52	336	67		8
	<i>Notropis volucellus</i>	Mimic Shiner	2												
	<i>Opsopoeodus emiliae</i>	Pugnose Minnow		6					10		81	8	143		
<i>Phenacobius mirabilis</i>	Suckermouth Minnow														
<i>Pimephales vigilax</i>	Bullhead Minnow	1			4			15					21		
Catostomidae	Catostomidae sp.	unknown larval sucker		3											
	<i>Erimyzon claviformis</i>	Western Creek Chubsucker			2									1	
	<i>Erimyzon</i> sp.	Juvenile chubsucker													
	<i>Ictiobus bubalus</i>	Smallmouth Buffalo													
	<i>Minytrema melanops</i>	Spotted Sucker		5		4	1			1	5	4		1	
	<i>Moxostoma poecilurum</i>	Blacktail Redhorse							1						
Ictaluridae	<i>Ameiurus melas</i>	Black Bullhead	7												
	<i>Ameiurus natalis</i>	Yellow Bullhead				2	5				1	5	1	1	
	<i>Ictalurus punctatus</i>	Channel Catfish				1									
	<i>Noturus nocturnus</i>	Freckled Madtom												2	
Esocidae	<i>Esox americanus</i>	Redfin Pickerel	2		1							1	2		

TABLE 5.—Continued

Family	Scientific Name	Common Name	1	2	3	4	5	6	7	8	9	10	11	12
Aphredoderidae	<i>Aphredoderus sayanus</i>	Pirate Perch				7	1						1	
Atherinopsidae	<i>Labidesthes sicculus</i>	Brook Silverside				1		1		5		21		
Fundulidae	<i>Fundulus chrysotus</i>	Golden Topminnow												
	<i>Fundulus notatus</i>	Blackstripe Topminnow	2	1	2	13	2	13		11	3	27	2	11
	<i>Fundulus olivaceus</i>	Blackspotted Topminnow											2	
Poeciliidae	<i>Gambusia affinis</i>	Western Mosquitofish	3	12	6	45	12	8	4	45	1	65		27
	<i>Heterandria formosa</i>	Least Killifish												
Centrarchidae	<i>Centrarchus macropterus</i>	Flier	6						1				4	11
	<i>Lepomis cyanellus</i>	Green Sunfish		1		2						2	1	
	<i>Lepomis gulosus</i>	Warmouth	1								1			1
	<i>Lepomis humilis</i>	Orangespotted Sunfish												
	<i>Lepomis macrochirus</i>	Bluegill	8	7	2	6	5	1	1		4	1		5
	<i>Lepomis marginatus</i>	Dollar Sunfish												
	<i>Lepomis megalotis</i>	Longear Sunfish			5			6	3			5	1	5
	<i>Lepomis microlophus</i>	Redear Sunfish		1		3	1							1
	<i>Lepomis miniatus</i>	Redspotted Sunfish			1									
	<i>Lepomis</i> sp.	Juvenile sunfish	3							12		4		
	<i>Lepomis symmetricus</i>	Bantam Sunfish												
	<i>Micropterus punctulatus</i>	Spotted Bass						1		6				
	<i>Micropterus punctulatus x salmoides</i>	Hybrid black bass												
	<i>Micropterus salmoides</i>	Largemouth Bass	7	3	1		9	1				15		4
	<i>Pomoxis annularis</i>	White Crappie	5					1			1			1
	<i>Pomoxis nigromaculatus</i>	Black Crappie		8						2	1			
Percidae	<i>Ammocrypta</i> sp.	Juvenile sand darter						1						
	<i>Ammocrypta vivax</i>	Scaly Sand Darter						1				3		
	<i>Etheostoma artesia</i>	Redspot Darter			2								1	
	<i>Etheostoma chlorosoma</i>	Bluntnose Darter		11	3	16		12		4		25	2	7
	<i>Etheostoma gracile</i>	Slough Darter	6	4	4	36		2		2		4	1	3
	<i>Etheostoma histrio</i>	Harlequin Darter						1						
	<i>Etheostoma proeliare</i>	Cypress Darter										4		2
	<i>Etheostoma thompsoni</i>	Gumbo Darter										1		
	<i>Percina macrolepida</i>	Bigscale Logperch										1		
	<i>Percina sciera</i>	Dusky Darter				5		2		1		12		
Elassomatidae	<i>Elassoma zonatum</i>	Banded Pygmy Sunfish												
	<b>Number of individuals</b>		<b>75</b>	<b>72</b>	<b>172</b>	<b>168</b>	<b>37</b>	<b>236</b>	<b>12</b>	<b>236</b>	<b>439</b>	<b>515</b>	<b>28</b>	<b>109</b>
	<b>Number of species</b>		<b>18</b>	<b>15</b>	<b>17</b>	<b>17</b>	<b>9</b>	<b>22</b>	<b>6</b>	<b>16</b>	<b>14</b>	<b>27</b>	<b>15</b>	<b>19</b>

TABLE 6.—Fish species and abundances by site (13-23) collected in summer 2015 and 2016 in Tyler, Jasper, and Hardin counties, TX: 13. Beale Branch at CR 3400, 14. Rocky Creek (East) at CR 3725, 15. Rocky Creek (East) at mouth, 16. Primrose Slough at SH 255, 17. Wolf Creek at FM 92, 18. Unnamed ditch at US 96, 19. Unnamed Creek at Cooks Rd, 20. Unnamed Creek at Alma Rd, 21. Boggy Creek at FM 421, 22. Black Creek at Blue Jay Dr, 23. Sour Lake at Steele Rd.

Family	Scientific Name	Common Name	Site										
			13	14	15	16	17	18	19	20	21	22	23
Lepisosteidae	<i>Atractosteus spatula</i>	Alligator Gar			1								
	<i>Lepisosteus oculatus</i>	Spotted Gar											
	<i>Lepisosteus osseus</i>	Longnose Gar			2								
Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard Shad			1								
	<i>Dorosoma petenense</i>	Threadfin Shad			7								
Cyprinidae	Cyprinidae sp.	unknown larval fish											
	<i>Cyprinella lutrensis</i>	Red Shiner			4								
	<i>Cyprinella venusta</i>	Blacktail Shiner			3						8		
	<i>Hybognathus nuchalis</i>	Mississippi Silvery Minnow			20	1							
	<i>Hybopsis amnis</i>	Pallid Shiner					1						
	<i>Lythrurus fumeus</i>	Ribbon Shiner		13						8		16	
	<i>Lythrurus</i> sp.	Juvenile shiner											
	<i>Lythrurus umbratilis</i>	Redfin Shiner											
	<i>Notemigonus crysoleucas</i>	Golden Shiner		2		8							
	<i>Notropis atrocaudalis</i>	Blackspot Shiner		6									
	<i>Notropis buchanani</i>	Ghost Shiner											21
	<i>Notropis sabiniae</i>	Sabine Shiner											
	<i>Notropis texanus</i>	Weed Shiner											110
	<i>Notropis volucellus</i>	Mimic Shiner											
	<i>Opsopoeodus emiliae</i>	Pugnose Minnow		1		11		1		6			5
<i>Phenacobius mirabilis</i>	Suckermouth Minnow				2								
<i>Pimephales vigilax</i>	Bullhead Minnow				14							2	
Catostomidae	Catostomidae sp.	Juvenile sucker											
	<i>Erimyzon claviformis</i>	Western Creek Chubsucker											
	<i>Erimyzon</i> sp.	Juvenile chubsucker	14										
	<i>Ictiobus bubalus</i>	Smallmouth Buffalo				1							
	<i>Minytrema melanops</i>	Spotted Sucker				1		2					
	<i>Moxostoma poecilurum</i>	Blacktail Redhorse											
Ictaluridae	<i>Ameiurus melas</i>	Black Bullhead				1				1			
	<i>Ameiurus natalis</i>	Yellow Bullhead		1			15						
	<i>Ictalurus punctatus</i>	Channel Catfish											
	<i>Noturus nocturnus</i>	Freckled Madtom											
Esocidae	<i>Esox americanus</i>	Redfin Pickerel	1	1					4		26	3	
Aphredoderidae	<i>Aphredoderus sayanus</i>	Pirate Perch	1										
Atherinopsidae	<i>Labidesthes sicculus</i>	Brook Silverside				7							

TABLE 6.— Continued

Family	Scientific Name	Common Name	13	14	15	16	17	18	19	20	21	22	23
Fundulidae	<i>Fundulus chrysotus</i>	Golden Topminnow				1					1		1
	<i>Fundulus notatus</i>	Blackstripe Topminnow			3				63		23		
	<i>Fundulus olivaceus</i>	Blackspotted Topminnow		1									
Poeciliidae	<i>Gambusia affinis</i>	Western Mosquitofish		2	65	18	1	10	78		74	31	308
	<i>Heterandria formosa</i>	Least Killifish											3
Centrarchidae	<i>Centrarchus macropterus</i>	Flier	1			7							
	<i>Lepomis cyanellus</i>	Green Sunfish		1	1			1					
	<i>Lepomis gulosus</i>	Warmouth											
	<i>Lepomis humilis</i>	Orangespotted Sunfish		1									
	<i>Lepomis macrochirus</i>	Bluegill		3	4		4		19	6	10	1	
	<i>Lepomis marginatus</i>	Dollar Sunfish	1						1				
	<i>Lepomis megalotis</i>	Longear Sunfish		1	2		6		26			3	
	<i>Lepomis microlophus</i>	Redear Sunfish			2		1			2		1	
	<i>Lepomis miniatus</i>	Redspotted Sunfish							15				
	<i>Lepomis</i> sp.	Juvenile sunfish			6	1							
	<i>Lepomis symmetricus</i>	Bantam Sunfish										1	
	<i>Micropterus punctulatus</i>	Spotted Bass											
	<i>Micropterus punctulatus x salmoides</i>	Hybrid black bass							1				
	<i>Micropterus salmoides</i>	Largemouth Bass		1	10	2	1		10			5	
	<i>Pomoxis annularis</i>	White Crappie				1							
	<i>Pomoxis nigromaculatus</i>	Black Crappie			3	1							
Percidae	<i>Ammocrypta</i> sp.	Juvenile sand darter											
	<i>Ammocrypta vivax</i>	Scaly Sand Darter											
	<i>Etheostoma artesia</i>	Redspot Darter											
	<i>Etheostoma chlorosoma</i>	Bluntnose Darter			2							1	
	<i>Etheostoma gracile</i>	Slough Darter			1							3	
	<i>Etheostoma histrio</i>	Harlequin Darter											
	<i>Etheostoma proeliare</i>	Cypress Darter											
	<i>Etheostoma thompsoni</i>	Gumbo Darter											
	<i>Percina macrolepida</i>	Bigscale Logperch											
<i>Percina sciera</i>	Dusky Darter			1									
Elassomatidae	<i>Elassoma zonatum</i>	Banded Pygmy Sunfish				5			6				
	<b>Number of individuals</b>		<b>18</b>	<b>34</b>	<b>307</b>	<b>59</b>	<b>17</b>	<b>11</b>	<b>237</b>	<b>9</b>	<b>178</b>	<b>36</b>	<b>312</b>
	<b>Number of species</b>		<b>5</b>	<b>13</b>	<b>28</b>	<b>10</b>	<b>8</b>	<b>2</b>	<b>11</b>	<b>3</b>	<b>14</b>	<b>4</b>	<b>3</b>

*emiliae*, Spotted Sucker *Minytrema melanops*, Redfin Pickerel, and Bluntnose Darter *Etheostoma chlorosoma* (Tables 5 and 6; Figure 9).



FIGURE 9.—Common fish species collected during the supplemental sampling shown from top left to right are Spotted Sucker, Slough Darter, and Pugnose Minnow. Bottom left to right: Golden Shiner, and Redfin Pickerel.

The family Cyprinidae had the most representative species, 15 total, with Golden Shiner and Pugnose Minnow being the most widely distributed. Blacktail Shiner *Cyprinella venusta*, Ribbon Shiner, and Weed Shiner were also relatively common, however abundances for Blacktail Shiner were low (1-8 individuals per site) for a species that is known as typically being abundant in Texas rivers (Lee et al. 1980). Two SGCN cyprinids (TPWD 2012) were found in the system, Blackspot Shiner and Sabine Shiner, as well as, three cyprinids that have been recommended to be added to the upcoming SGCN list update: Mississippi Silvery Minnow, Pallid Shiner *Hybopsis amnis*, and Suckermouth Minnow *Phenacobius mirabilis* (Hendrickson et al. 2016).

The next most numerous family in species representation was Centrarchidae. A total of fourteen centrarchids were collected, as well as one suspected hybrid black bass, *Micropterus punctulatus x salmoides* Spotted Bass x Largemouth Bass. Only four species of suckers from the family Catostomidae were found, with one being the SGCN Western Creek Chubsucker. Nine species from the family Percidae were found with Gumbo Darter *Etheostoma thompsoni* being a new addition to the middle Neches River sub-basin checklist. Another addition to the subbasin was Freckled Madtom *Noturus nocturnus*. It should be noted that both checklist additions are found throughout the Neches River Basin and their lack of historical records for this centrally located sub-basin supports the need for this type of data gap sampling.

### *Summary of Fish Data Collection*

A total of 5,872 individuals comprising 66 fish species were collected during this study. Historically, 96 freshwater fish species have been collected from the Neches River Basin (Hendrickson and Cohen 2015). While no new species were added to the overall basin checklist, 16 species were added to the middle Neches River subbasin checklist, emphasizing the need for more intensive fish surveys to update current distribution knowledge and publically available records such as those found in the Fishes of Texas database (Hendrickson and Cohen 2015).

## MUSSEL ASSEMBLAGE

**Methods:** Mussels were surveyed using timed snorkel or tactile searches in all available mesohabitat types (Strayer and Smith 2003) at each site. All live mussels encountered during timed searches were enumerated and returned to the habitat in which they were found. Recently dead mussels were noted. The mainstem Neches and Angelina rivers were surveyed, as well as, six tributary sites (Table 1).

**Results and Discussion:** Sampling effort for this survey totaled 14.4 person-hours of total search time over eight sampling sites with 392 total live mussels collected representing 22 species (Table 7; Figure 10). Of all eight sampling sites, the larger order streams (Neches and Angelina rivers) had the highest richness and abundance of mussels. The Neches River had the highest species richness (18 species) and abundance (293 individuals) with a catch-per-unit-effort (CPUE) of 65.1 per person-hour. The Angelina River had 55 total individuals comprised of 13 species at a CPUE of 27.5 per person-hour. The most abundant species at both of these sites was Western Pimpleback *Quadrula mortoni* (Figure 10). The remaining six tributary sites had mussel assemblages typical of small streams with a total of four species collected: Tapered Pondhorn *Unio merus declivis*, Pondhorn *Unio merus tetralasmus*, Texas Lilliput *Toxolasma texasense*, and Pondmussel *Legumia subrostrata*. Only one site sampled, Alazan Bayou, returned no mussels. Of the tributaries, Sandy Creek had the highest richness and abundance with 27 individuals representing four species (Table 7).



FIGURE 10.—Mussels collected during time searches of the Neches River (left) and the Angelina River (right) and the most abundant species collected at those sites, Western Pimpleback (center).

Three of six Texas state-threatened species historically found in the basin were collected during our surveys (Texas Pigtoe, Louisiana Pigtoe, and Texas Heelsplitter), although in relatively low numbers. Recent surveys in other portions of the Neches River found Texas Pigtoe and Louisiana Pigtoe to be relatively abundant and Texas Heelsplitter to be relatively rare (Ford et al. 2014, Ford et al. 2016).

For the remaining three state-listed species (Triangle Pigtoe, Sandbank Pocketbook, and Southern Hickorynut) not encountered during our survey efforts, Ford et al. (2014) and Ford et al. (2016) have also shown these species to be relatively rare within the Neches River Basin. A previous survey conducted within Alazan Bayou WMA (Robert Baker, Texas Parks and Wildlife Dept., personal communication) collected Southern Hickorynut and two additional species (Flat Floater *Anodonta suborbiculata* and Giant Floater *Pyganodon grandis*) that were not encountered during this effort.

TABLE 7.—Mussel species historically known from the Neches River Basin (TPWD 2008) and number of live mussels collected from Alazan Bayou and Alabama Creek Wildlife Management areas during summer 2016.

Species	Common Name	Alazan Bayou WMA		Alabama Creek WMA					
		Site B Bayou Loco	Site C Angelina River	Site D Neches River	Site E Sandy Creek	Site F Carlton Branch	Site G Lancaster Creek	Site H Forsythe Creek	Site I Crib Creek
<i>Amblema plicata</i>	Threeridge		11	38					
<i>Arcidens confragosus</i>	Rock Pocketbook								
<i>Fusconaia askewi</i>	Texas Pigtoe <sup>1</sup>			2					
<i>Fusconaia flava</i>	Wabash Pigtoe								
<i>Fusconaia lananensis</i>	Triangle Pigtoe <sup>1,2</sup>								
<i>Glebulula rotundata</i>	Round Pearlshell		1						
<i>Lampsilis hudsoniana</i>	Louisiana Fatmucket		1	1					
<i>Lampsilis satura</i>	Sandbank			3					
<i>Lampsilis teres</i>	Yellow Sandshell		5	44					
<i>Legumia subrostrata</i>	Pondmussel				1			1	
<i>Leptodea fragilis</i>	Fragile Papershell			3					
<i>Megaloniaia nervosa</i>	Washboard		3	2					
<i>Obliquaria reflexa</i>	Threehorn Wartyback		5	8					
<i>Obovaria jacksoniana</i>	Southern Hickorynut <sup>1</sup>								
<i>Plectomerus dombeyanus</i>	Bankclimber		7	5					
<i>Pleurobema riddellii</i>	Louisiana Pigtoe <sup>1,2</sup>		3	3					
<i>Potamilus amphichaenus</i>	Texas Heelsplitter <sup>1,2</sup>			2					
<i>Potamilus purpuratus</i>	Bleufer		1	12					
<i>Pyganodon grandis</i>	Giant Floater								
<i>Quadrula apiculata</i>	Southern Mapleleaf		1						
<i>Quadrula mortoni</i>	Western Pimpleback		14	156					
<i>Quadrula nobilis</i>	Gulf Mapleleaf								
<i>Quadrula nodulata</i>	Wartyback								
<i>Quadrula verrucosa</i>	Pistolgrip		1	8					
<i>Strophitus undulatus</i>	Creeper								
<i>Toxolasma parvus</i>	Lilliput								
<i>Toxolasma texasense</i>	Texas Lilliput			1	5		1	5	
<i>Truncilla donaciformis</i>	Fawnsfoot			3					
<i>Truncilla truncata</i>	Deertoe			1					
<i>Unioemerus declivis</i>	Tapered Pondhorn		2	1	2				
<i>Unioemerus tetralasmus</i>	Pondhorn				19	3	4	2	1
<i>Utterbackia imbecillis</i>	Paper Ponshell								
<i>Villosa lienosa</i>	Little Spectaclecase								
	<b>Total Species</b>	<b>0</b>	<b>13</b>	<b>18</b>	<b>4</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>1</b>
	<b>Abundance</b>	<b>0</b>	<b>55</b>	<b>293</b>	<b>27</b>	<b>3</b>	<b>5</b>	<b>8</b>	<b>1</b>
	<b>Search Time (hrs)</b>	<b>0.7</b>	<b>2</b>	<b>4.5</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2.2</b>	<b>1</b>
	<b>CPUE (#/hr)</b>	<b>0</b>	<b>27.5</b>	<b>65.1</b>	<b>13.5</b>	<b>3</b>	<b>5</b>	<b>3.7</b>	<b>1</b>

Multiple mussel surveys have been conducted throughout the Neches River Basin (Howells 1995, 1997, 2006; Karatayev and Burlakova 2007; Ford et al. 2014; Ford et al. 2016). Since 1995, all but two species known to occur in the basin have been collected live: Wabash Pigtoe *Fusconaia flava* and Lilliput *Toxolasma parvus*. In 1997 Howells collected a recently dead Lilliput specimen. Although the mussel assemblage within the Neches River Basin has remained largely intact over the last several decades, changes in relative abundance among species cannot be assessed given the limited distribution of sampling sites and lack of quantitative surveys.

## BENTHIC MACROINVERTEBRATE ASSEMBLAGE

**Methods:** Benthic aquatic macroinvertebrates were collected from Site D on the Neches River in Alabama Creek WMA using a D-frame kick net following procedures in TCEQ's Surface Water Quality Monitoring Procedures, Volume 2 (TCEQ 2014b). Macroinvertebrates were preserved in 70% ethanol and transported back to the lab for identification. The calculation of a benthic Index of Biotic Integrity (TCEQ 2014b) was inappropriate given the non-wadable nature Neches River.

**Results and Discussion:** A total of 175 benthic macroinvertebrates, represented by 9 orders, 26 families, and 32 genera (Table 8), were collected and identified from Site D on the Neches River. Of the 32 benthic macroinvertebrate taxa collected, only two were non-insect taxa: *Gammarus* sp. (scud) and *Oligochaeta* sp. (aquatic worms). The dominant order was Coleoptera (aquatic beetles) with five families represented. The genus with highest abundance was *Rhagovelia* (water striders). The order Ephemeroptera (mayflies) comprised 23% of the total individuals collected with seven genera present. Trichoptera (caddisflies) made up 7.5% of the total catch, with three genera present. No Plecoptera (stoneflies) taxa were present. Predators represented the most abundant functional feeding guild, comprising 52% of all individuals present.

TABLE 8.—Benthic macroinvertebrates with their associated abundances, trophic guilds (CG= collector gatherer, FC= filtering collector, P= predator, SCR= scraper, SHR= shredder), and life stages (A= adult, L= larval) collected from the Neches River at Alabama Creek WMA (Site D) on September 15, 2016.

Order	Common name	Family	Genus	Life Stage	Abundance	Feeding Guild
Amphipoda	Scuds	Gammaridae	<i>Gammarus</i>		9	CG/SHR
Coleoptera	Beetles	Dytiscidae	<i>Neoporus</i>	A	6	P
		Elmidae	<i>Ancyronyx</i>	A	1	SCR/CG
			<i>Stenelmis</i>	A	14	SCR/CG
			<i>Dineutus</i>	A	9	P
		Gyrinidae	<i>Gyretes</i>	A	8	P
			<i>Gyrinus</i>	A	17	P
			Hydrophilidae	<i>Berosus</i>	A	2
		Scirtidae	<i>Cyphon</i>	L	1	SCR/CG/SHR
Diptera	Midges	Ceratopogonidae			1	P/CG
		Chironomidae			6	P/CG/FC
		Simuliidae			1	FC
Ephemeroptera	Mayflies	Baetidae	<i>Procloeon</i>		4	CG
			<i>Pseudocloeon</i>		1	SCR/CG
		Caenidae	<i>Caenis</i>		12	SCR/CG

TABLE 8.—Continued

Order	Common name	Family	Genus	Life Stage	Abundance	Feeding Guild
		Ephemeroidea	<i>Hexagenia</i>		8	CG
		Heptageniidae	<i>Maccaffertium</i>		9	SCR/CG
			<i>Stenacron</i>		4	SCR/CG
		Tricorythidae	<i>Tricorythodes</i>		3	CG
Hemiptera	True bugs	Belostomatidae	<i>Belostoma</i>		1	P
		Nepidae	<i>Ranatra</i>		1	P
		Veliidae	<i>Rhagovelia</i>		25	P
Megaloptera	Hellgramite	Corydalidae	<i>Corydalus</i>		2	P
Odonata	Dragonflies	Aeschnidae	<i>Boyeria</i>		1	P
		Coenagrionidae	<i>Argia</i>		8	P
		Gomphidae	<i>Dromogomphus</i>		2	P
			<i>Progomphus</i>		1	P
		Macromiidae	<i>Macromia</i>		4	P
Oligochaeta	Aquatic worm	Oligochaeta	<i>Oligochaeta</i>		1	CG
Trichoptera	Caddisflies	Hydropsychidae	<i>Hydropsyche</i>		1	FC
		Leptoceridae	<i>Nectopsyche</i>		11	SHR/CG/P
		Philopotamidae	<i>Chimarra</i>		1	FC

\*Lowest taxonomic identification available if order was not determined.

## CRAYFISH

**Methods:** Minnow traps and eel pots, baited with chicken liver, were deployed in backwater and pool habitats overnight at Sites B-I in Alabama Creek and Alazan Bayou WMAs. Crayfish collected were photographed and released. Additionally any crayfish encountered while seining were photographed and released. Photo vouchers and locality information were placed on the website iNaturalist (<http://www.inaturalist.org/>) for species verification.

**Results and Discussion:** Eight species of crayfish were collected across 14 sites during this study (Table 9; Figure 11). Red Swamp Crayfish *Procambarus clarkii* was the most common species collected, being found at 5 sites.



FIGURE 11.—Photos documenting species of crayfish collected during the middle and lower Neches River Bioblitz during the summer of 2015 and 2016. From upper left through lower right: Cajun Dwarf Crayfish, Painted Devil Crayfish, White River Crayfish, Red Swamp Crayfish, Southwestern Creek Crayfish, Free State Chimney Crayfish, Neches Crayfish, and Blackbelted Crayfish.

All crayfish species collected during this study have been categorized by the IUCN Red List of Threatened Species as having an extinction risk of least concern (IUCN 2017); however, there is a need for more thorough distribution data for most crayfish species in Texas.

TABLE 9.—Species of crayfish collected from the middle and lower Neches River Basin in summer 2015 and 2016. More specific site information can be found in Table 1.

Scientific Name	Common Name	Waterbody	Site
<i>Cambarellus shufeldtii</i>	Cajun Dwarf Crayfish	Primrose Slough	16
<i>Cambarus ludovicianus</i>	Painted Devil Crayfish	Boggy Creek	21
		Atascoso Creek	4
<i>Procambarus acutus</i>	White River Crayfish	Piney Creek	12
		Pond at Alazan WMA	A
		Bayou Loco	B
<i>Procambarus clarkii</i>	Red Swamp Crayfish	Neches River	10
		Piney Creek	12
		Primrose Slough	16
		Rocky Creek	15
<i>Procambarus dupratzi</i>	Southwestern Creek Crayfish	Naconiche Creek	1
		Terrapin Creek	3
<i>Procambarus kensleyi</i>	Free State Chimney Crayfish	Sandy Creek North	7
<i>Procambarus nechesae</i>	Neches Crayfish	Crib Creek	I
<i>Procambarus nigrocinctus</i>	Blackbelted Crayfish	Beale Branch	13
<i>Procambarus sp.</i>		Lancaster Creek	G
<b>Number of species encountered</b>		<b>8 species</b>	

## RIPARIAN ASSEMBLAGE

**Methods:** A qualitative visual assessment of the riparian area was conducted at Site D at the Alabama Creek WMA on September 15, 2016 to obtain a basic understanding of the functioning condition of the riparian area. Dominant species present, age class distribution, and vigor of the plants within the riparian corridor were noted during this qualitative assessment. Non-native plant species were also recorded.

**Results and Discussion:** Common tree species observed within the Neches River riparian area included: loblolly pine *Pinus taeda*, American sycamore *Platanus occidentalis*, river birch *Betula nigra*, white oak *Quercus alba*, overcup oak *Quercus lyrata*, American beech *Fagus granifolia*, blackgum or black tupelo *Nyssa sylvatica*, sweetgum *Liquidambar styraciflua*, and red maple *Acer rubrum*. Some common herbaceous and shrub species observed included: deciduous holly *Ilex decidua*, hawthorn *Crataegus sp.*, cross vine *Bignonia capreolata*, inland sea oats *Chasmanthium latifolium*, hazel alder *Alnus serrulata*, Virginia creeper *Parthenocissus quinquefolia*, grape *Vitis sp.*, pluchea *Pluchea odorata*, sedges *Carex sp.*, greenbrier *Smilax sp.*, swamp rose mallow *Hibiscus palustris*, and peppervine *Ampelopsis arborea*. Non-native Chinese tallow tree *Sapium sebiferum* was noted during the qualitative assessment. Overall, the riparian area was in good functioning condition as indicated by the very 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. Evidence of excessive herbivory was not indicated during the qualitative assessment.

## **STREAM HEALTH**

**Methods:** To obtain a snapshot of riparian habitat and overall stream condition of the Neches River at Alabama Creek WMA, a modified Stream Visual Assessment Protocol (SVAP2 see TPWD 2017h) was conducted on September 15, 2016. The modified SVAP2 is based on the SVAP protocol created by the Natural Resources Conservation Service (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 to 2.9 = Severely Degraded, 3 to 4.9 = Poor, 5 to 6.9 = Fair, 7 to 8.9 = Good, 9 to 10 = Excellent. These scores are based on characteristics of a particular stream reach and are not making a statement on 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 is improving, declining, or maintaining.

**Results and Discussion:** Overall stream health for the Neches River at Alabama Creek WMA was rated as excellent (SVAP2 Score=9.15, Table 10). This value can be used as a general statement about the state of the stream environment at Alabama Creek WMA, meaning that the Neches River and its associated riparian area is highly functioning as is shown by the overall score of “excellent”.

TABLE 10. Element scores from the Stream Visual Assessment Protocol (SVAP2) conducted at Alabama Creek Wildlife Management Area on September 15, 2016. Element scores are rated from 1 (severely degraded) to 10 (excellent). The average of the element scores is listed as the stream health score.

<b>Element</b>	<b>Score</b>
Channel Condition	9
Hydrologic Alteration	9
Bank Stability	9.25
Riparian Area Quantity	9
Riparian Area Quality	8.5
Water Appearance	9
Nutrient Enrichment	9
Barriers to Movement	10
Stream Habitat Complexity	9
Pools	10
Aquatic Invertebrate Community	9
Riffle Embeddedness	n/a
Salinity	n/a
<b>Stream Health Score</b>	<b>9.15</b>

## IMPERILED SPECIES

Five SGCN fishes were collected during this study: Alligator Gar *Atractosteus spatula* (NatureServe Global Conservation Status: G3-vulnerable; NatureServe 2015), Blackspot Shiner (G4-apparently secure), Sabine Shiner (G4), Blue Sucker (state threatened; G3), and Western Creek Chubsucker (state threatened; G5-secure) (Figures 12 and 13). There was a noticeable separation in the distribution of these species with two being collected only in the mainstem Neches River (Sabine Shiner and Blue Sucker) and three only in tributaries (Alligator Gar, Blackspot Shiner, and Western Creek Chubsucker). In Texas, these species are considered imperiled for a number of reasons from abundance declines, rarity, reductions in recruitment, and declines outside of Texas.

Alligator Gar populations have been in decline throughout the United States in recent decades, with probable extirpations in six of the 14 states in its historical range (Buckmeier 2008). These declines are largely attributed to habitat loss, specifically spawning habitat loss. Alligator Gar utilize inundated floodplains to spawn and effects of flood pulse reduction from impoundments, channelization, and fragmentation in lateral connectivity from levees have reduced their available spawning habitat (Buckmeier 2008; USFWS 2017a). While Texas and Louisiana have been noted as strongholds of stable Alligator Gar populations, more information is needed on spawning habitat needs. Only one young-of-year Alligator Gar was collected during this study (Figure 12), in Rocky Creek adjacent to the Neches River (East; Site 15). The Neches River was on the fall of a 20,000 cfs flood pulse during this sampling and out of its banks, inundating riparian vegetation. Based on the size of the gar captured it was likely less than one month old and spawned in the area during the same flood event (Aguilera et al. 2002).



FIGURE 12.—Young-of-year Alligator Gar (left photo) collected from the mouth of Rocky Creek-East (Site 15), Tyler County, TX in inundated vegetation adjacent to the Neches River (right photo).

Blackspot Shiner (Figure 13) has a global ranking of apparently secure; however, they typically occur in low abundances in Texas where found as was the case in this study with the exception of Sites I and G, tributaries of Alabama Creek, where they were locally abundant. This species was not found in larger water bodies sampled during this survey such as Alabama Creek, the Angelina River, or the Neches River. This is consistent with previous habitat characterizations for this species (Gilbert 1980). Conversely, the Sabine Shiner also listed with a global ranking of apparently secure, was only collected in larger waterbodies (Alabama Creek, Angelina River, and Neches River; Figure 13). Declines of this species have been noted in Texas (Suttkus and Mettee 2009).

Two Blue Suckers were collected during this study, one juvenile (total length 340 mm) and one adult (627 mm) from Site D on the Neches River (Figure 13). Blue Sucker is listed as state threatened in Texas and while this species has a broad distribution across the United States, declines have been documented across its range and are attributed to water quality deterioration, impoundments, and hydrologic alteration (Edwards et al. 2004). In Texas, this species is of particular concern due to a lack of documentation of spawning activity in parts of the state and a lack of understanding of their recruitment (Mayes 2015).



FIGURE 13.—Photos of imperiled species collected during the middle and lower Neches River Bioassessment. Species from left to right: Blackspot Shiner, Sabine Shiner, Blue Sucker, and Western Creek Chubsucker.

The Western Creek Chubsucker (formerly recognized as the Creek Chubsucker) is listed as state threatened in Texas, but stable across its range. During this study it was collected at three tributary sites in Alabama Creek WMA, with relatively high abundance from Site G (Figure 13). It was also collected from several other tributaries in the basin. These sites are in keeping with previous habitat characterizations for this species which state it typically resides in small, headwater streams (Page and Burr 2011).

Freshwater fish species classified as SGCN in Texas, but not collected during this study are Western Sand Darter, American Eel, and Silverband Shiner. Western Sand Darter and Silverband Shiner have historically been collected in the mainstem Lower Neches River and Village Creek, neither of which were sampled as part of this study (Cohen and Hendrickson 2015). Despite eel traps being deployed overnight on the Angelina River, no American Eels were captured.

Three freshwater mussel species designated as state threatened and SGCN were collected during this study: Texas Pigtoe (G2- Imperiled), Louisiana Pigtoe (G1- Critically Imperiled), and Texas Heelsplitter (G1) (Figure 14). Texas Pigtoe, known from eastern river basins in Texas and limited locations in Louisiana, is considered imperiled due to a narrow distribution and an apparent decline in abundance (Natureserve 2015). The Louisiana Pigtoe also occurs in eastern Texas drainages and limited locations in Louisiana and Arkansas (USFWS 2017b). This species is typically rare where found, has possibly been extirpated from portions of its historical range (Natureserve 2015), and is currently under review for federal listing. Recent collections of Texas Heelsplitter in Texas are limited to the Sabine, Neches, and Trinity rivers (Natureserve 2015). This species is also currently under review for federal listing.



FIGURE 14.—Photos of state threatened mussel species collected during the middle and lower Neches River Bioassessment. Species from left to right: Texas Pigtoe, Louisiana Pigtoe, and Texas Heelsplitter.

## RECREATIONAL ACCESS

The Neches River is bordered by a mix of privately-owned property, national forests, national preserve land, and state WMAs. Davy Crockett and Angelina national forests, Big Thicket National Preserve, and Alabama Creek WMA provide approximately 293 km (182 mi) of public access to the Neches River (Figure 15). Additional public access sites are available at several public road crossings (Figure 15; Table 11). The entirety of the middle and lower Neches River provides adequate water for kayaking and boating under most conditions; however, downed trees can present obstacles to navigation.

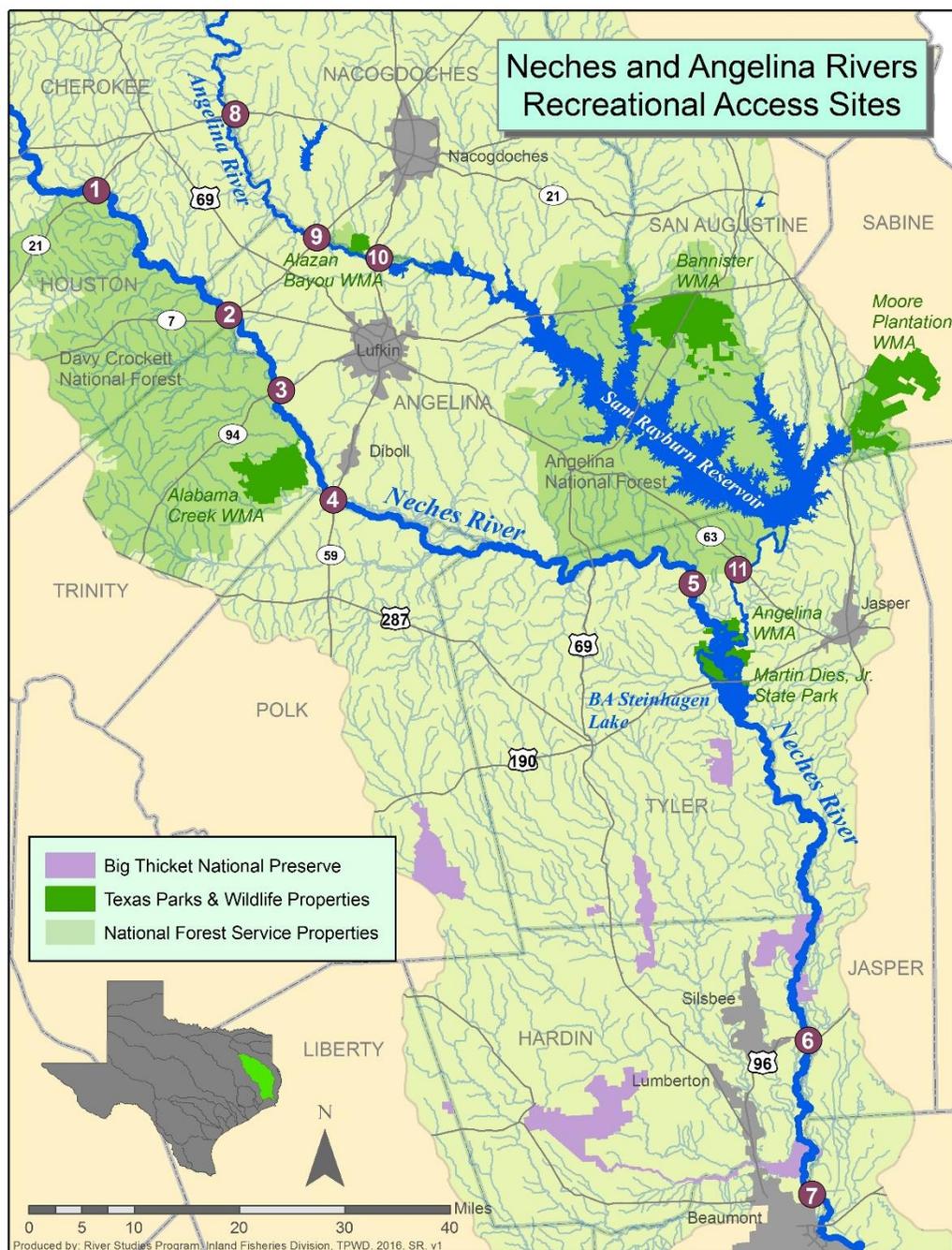


FIGURE 15.—Middle and lower Neches public recreational access locations. See Table 11 for site information.

TABLE 11.—List of Neches River and Angelina River public access locations and the amenities available at each site as of the date of this survey, September 15, 2016. Please contact the controlling authority for current status.

Site Name	Location	Fee Charged	Use	Controlling Authority
<b>Middle and Lower Neches River</b>				
Davy Crockett National Forest	31.39134, -95.14350	free	  	National Forest Service
Angelina National Forest	31.17614, -94.38413	free	 	National Forest Service
Big Thicket National Preserve	30.45795, -94.38687	free		National Park Service
Alabama Creek WMA	31.19407, -94.85988	\$12/year*	   	TPWD
Martin Dies Jr. State Park	30.86229, -94.18172	\$4/day	   	TPWD
Angelina-Neches/ Dam B WMA	30.85420, -94.21596	\$12/year*	 	TPWD
1. SH 21	31.57983, -95.16556	free	 	TXDOT
2. SH 7	31.39671, -94.96548	free	  	
3. SH 94	31.28876, -94.88426	free	 	TXDOT
4. SH 59	31.13279, -94.81041	free	  	TXDOT
5. RR 255	30.98348, -94.24423	free	 	TXDOT
6. US 96	30.35558, -94.09390	free	  	TXDOT
7. Collier's Ferry Park	30.13256, -94.09596	free	  	City of Beaumont
<b>Angelina River</b>				
Angelina National Forest	31.17614, -94.38413	free	 	National Forest Service
Alazan Bayou WMA	31.47009, -94.75255	\$12/year*	 	TPWD
Angelina-Neches/ Dam B WMA	30.92397, -94.15655	\$12/year*	   	TPWD
8. SH 21	31.67173, -94.95288	free	 	TXDOT
9. SH 7	31.48662, -94.82333	free	  	TXDOT
10. SH 59	31.45649, -94.72611	free	 	TXDOT
11. SH 63	31.01397, -94.16125	free	  	TXDOT



Camping



Bank fishing access



Kayak launch



Boat ramp

\* Permits must be purchased prior to visit at a TPWD license retailer, covers access to all WMAs. 16 and under free with permitted adult.

The Angelina River has more limited public access, with most of the Angelina National Forest bordering Sam Rayburn Reservoir and not flowing portions of the river. Alazan Bayou WMA borders approximately 8 km (5 mi) of the river; however, due to the dense forested landscape of the WMA access to river by foot is difficult. Access is potentially available to the Angelina River bordering the WMA via boat or kayak; however, in its current condition large amounts of downed trees and riparian growth make navigation difficult.

Currently there are three paddling trails within the study area. Martin Dies Jr. State Park offers access to two of these: the Neches Paddling Trail and the Bevilport Paddling Trail. The Neches Paddling Trail, a 5 to 25 km (3.2 to 16 mi) loop trail, begins at the Walnut boat ramp at the park and crosses part of B. A. Steinhagen Lake to the Neches River (TPWD 2017i). The Bevilport Paddling Trail, 15 to 19 km (9.6 to 12 mi), is a loop trail that cuts across part of B.A. Steinhagen Lake and travels up the Neches River into the Angelina River. The third paddling trail, the 15 km (9.2 mi) Neches-Davy Crockett Paddling Trail, occurs on the Neches River adjacent to the Davy Crockett National Forest and runs from CR 1155 to SH 7 (TPWD 2017i).

### SPORT FISHING OPPORTUNITIES

Five sport fish species were collected from Alabama Creek WMA: Largemouth Bass, Spotted Bass, Flathead Catfish, Channel Catfish, and Blue Catfish (Figure 16). Largemouth Bass, Channel Catfish, and Black Crappie were collected from the Angelina River at Alazan Bayou WMA; however, fishing access is primarily limited to paddle-in access and downed trees sometimes make access difficult.



FIGURE. 16—Some of the fish species that offer angling potential within Alabama Creek WMA and Alazan Bayou WMA include from left to right Spotted Bass, Black Crappie, Blue Catfish, and Channel Catfish.

Of sites sampled, Site D at Alabama Creek WMA produced the most sport fish of harvestable size; however, this was also the only site where hoop nets and boat electrofishing were utilized and all Channel Catfish, Blue Catfish, and Flathead Catfish from this site were collected using these methods. Spotted Bass collected from Site D ranged in total length from 2.5 to 9.0 inches (Figure 17). This data provides evidence of recent recruitment; however, few individuals large enough to provide adequate sport fishing opportunities were collected.

Of the catfish species documented from Site D, a handful of legal harvest size Channel Catfish were collected ranging from 12 to 18 inches (Figure 17). Only one Channel Catfish below the minimum harvest length was collect at this site, and few others throughout either WMA. Blue Catfish were only collected from Site D in low numbers, all under the minimum harvest length (Figure 17). Lastly, three Flathead Catfish were collected from Site D with total lengths of 6.5, 16, and 17 inches, none of which were of harvestable size (minimum length limit of 18 in; TPWD 2017e). No other Flathead Catfish were collected during this study.

In addition, three species of sunfish were collected at Alabama Creek WMA that offer angling opportunities: Warmouth *Lepomis gulosus*, Bluegill, and Longear Sunfish. In particular, high abundances of Longear Sunfish were collected across all sites sampled at Alabama Creek WMA with the exception of Carlton Branch (Site F). Longear were additionally collected from the Angelina River at Alazan Bayou WMA.

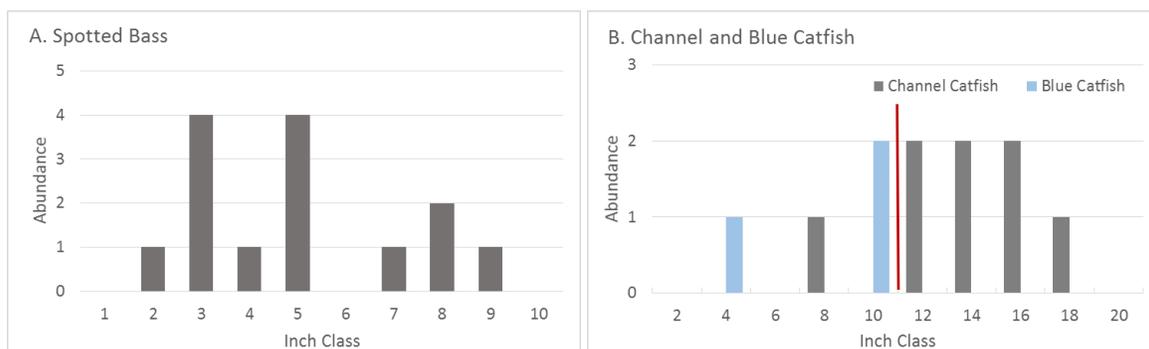


FIGURE 17.—Length frequency distributions of A. Spotted Bass and B. Channel and Blue Catfish collected from Site D on the Neches River at Alabama Creek WMA on September 15, 2016. No minimum harvest size regulations exist for Spotted Bass, but the minimum harvest size for Channel and Blue Catfish is denoted by a red line (12 inches).

## SUMMARY AND RECOMMENDATIONS

### *Middle and Lower Neches River Basin*

Fish assemblage sampling occurred at 32 sites across the middle and lower portions of the Neches River Basin. These spanned a diversity of conditions and included sites on the Neches and Angelina rivers, numerous tributaries, roadside ditches, and one WMA pond. Overall, 66 species of fish were collected, including 5 fish classified as SGCN (Alligator Gar, Blackspot Shiner, Sabine Shiner, Blue Sucker, and Western Creek Chubsucker) and several sport fish species (Blue Catfish, Channel Catfish, Flathead Catfish, Spotted Bass, Largemouth Bass, and Black Crappie). These new records will be used to update statewide fish distribution maps which will guide future Native Fish Conservation Area initiatives in the basin.

Thanks to an extensive network of national forest and preserve lands, state parks and WMAs, paddling trails, city parks, and public access at road crossings, the middle and lower Neches River Basin offers ample public access for recreation. Numerous boat ramps on the Angelina and Neches rivers, both primitive and paved, offer a variety of locations to launch kayaks and motorized vessels. Additionally, the availability to camp at area national forests, WMAs, and state parks along these rivers offers the opportunity for multi-day paddling and fishing trips.

### *Alabama Creek Wildlife Management Area*

Forty-seven species of fish, 20 species of mussels, 32 macroinvertebrate taxa, one species of crayfish, nine riparian tree species, and 12 herbaceous riparian species were documented from Alabama Creek WMA during this study. Seven of the fish and mussel species collected are classified as SGCN, five of which are concurrently listed as state threatened (Blue Sucker, Western Creek Chubsucker, Texas Pigtoe, Louisiana Pigtoe, and Texas Heelsplitter). Additionally several sport fish species were collected from Site D on the Neches River which provide angling opportunities to recreationalists.

The riparian area bordering Site D was in good functioning condition as indicated by the wide, contiguous riparian zone, diverse mixture of appropriate riparian species, high plant vigor, and presence of multiple age classes. Recruitment of young trees was high and evidence of excessive herbivory was not indicated. Overall, stream health was categorized by the SVAP2 as Excellent. This reach of river scored high for every metric assessed, receiving the highest possible score for lack of barriers to movement and presence of pool habitats.

### *Alazan Bayou Wildlife Management Area*

Twenty-four species of fish, 13 species of mussels, and two species of crayfish were documented from Alazan Bayou WMA during this study. One mussel species collected from the Angelina River at Alazan Bayou WMA is listed as state threatened and classified as SGCN (Louisiana Pigtoe). Several species collected provide angling opportunities including Largemouth Bass, Black Crappie, and Longear Sunfish; however, access to Bayou Loco and the Angelina River by land or boat is sometimes difficult due to seasonal flooding and downed trees.

### *Recommendations*

Fish community data collected from Alabama Creek and Alazan Bayou WMAs was species rich, contained no non-native species, and documented several rare or imperiled species currently listed as SGCN. While sport fish were documented at both units, there were some notable differences in catch based on gear type used, particularly with Blue Catfish and Flathead Catfish being restricted to boat electrofishing and hoop nets. Given the presence of important recreational species in this area and evidence of recreational use, it is recommended that follow up sampling be conducted utilizing these gear types at other sites on the Angelina and Neches rivers to better understand sport fish populations in these systems and gauge the potential of this fishery for angling.

The presence of a boat ramp at Alabama Creek WMA provides the unique opportunity to target a TPWD owned property for additional sport fish research and promotion to the public of fishing, kayaking and boating opportunities on the Neches River. In addition to further targeted sport fish sampling, it is recommended that volunteer creel survey boxes be installed near the boat ramp to gage use of this resource. Lastly, it is recommended that signage be installed with potential angling species, relevant harvest regulations and consumption advisories, and rules regarding reducing the risk of transporting non-native species in Texas waterways.

The Neches River is an extremely important area for freshwater mussel diversity in Texas, as is indicated by the detection of three state threatened species during this project. Mussel sampling during this study was limited to the two WMAs. Additional mussel surveys are recommended to build baseline mussel data within the watershed. Current mussel distribution data is not widely available in Texas and this information will be vital in prioritizing research and conservation objectives through the Native Fish Conservation Area initiative. Additionally, this data will inform TPWD regulatory and management decisions in the basin.

The riparian area was in good functioning condition within Alabama Creek WMA and the only recommended action is monitoring and/or treatment of existing Chinese tallow stands.

The lower and middle Neches River Basin offers significant recreational opportunities including fishing, kayaking, boating, camping, and nature watching. Due to the large existing network of federal, state, and city access points, the leasing of additional public access points is not recommended at this time; however, if resources are available, it is recommended that signage be installed at existing access points currently lacking it to promote fishing and inform users of harvest regulations and other river access points in the basin.

Overall, the areas sampled during this study in the middle and lower Neches River Basin appeared healthy and functioning with no notable deficits found. This region is important both biologically and recreationally to the state of Texas and should be conserved as such.

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