Little River Watershed Bioassessment

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River Studies Report No. 33

Inland Fisheries Division
Texas Parks and Wildlife Department
Austin, Texas

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December 2024

Cover photos from top left to bottom right: San Gabriel River Bioassessment Study Site, Orangethroat Darter, Virile Crayfish, seine crew, *Helicopsyche* caddisfly, Paper Pondshell, and South Brushy Creek Bioassessment Study Site, Williamson County, Texas

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ACKNOWLEDGMENTS

This study was a collaborative effort between the Texas Parks and Wildlife Department and the University of Texas. Without the collective effort of these individuals this study would not have been possible.

Texas Parks and Wildlife Department, Inland Fisheries Division: Beth Bendik, Alana Hoffmann, Kevin Kolodziejcyk, Stephan Magnelia, Ryan McGillicuddy, Travis Tidwell and Dillan Wulf

Texas Parks and Wildlife Department, Coastal Division: Jennifer Bronson-Warren and Marty Kelly

University of Texas: Adam Cohen, Dean Hendrickson, Roy Kleinsasser, Doug Martin, and Ryan Rash

We also thank Dan Johnson for his help in identifying crayfish collected during this study.

We thank Dr. Michael Collins, founder of the Gault School of Archaeological Research, for river access and assistance in the field.

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

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EXECUTIVE SUMMARY

Two aquatic bioassessment study areas and 63 supplemental collection sites were sampled across nine counties in the Little River watershed of the Brazos River Basin during the spring and summer of 2018. The bioassessment study areas included one site on South Brushy Creek at Champion Park and one site on the San Gabriel River at County Road 100 where data were collected including water quality, fish, mussels, benthic macroinvertebrates, riparian area, and stream health. Fish were collected from all 63 supplemental sites and all crayfish were documented.

Overall, 50 species of fish were documented from the Little River Watershed. Fish species richness by site ranged from zero to 21 species. Three fishes classified as Species of Greatest Conservation Need (SGCN) were documented (Silverband Shiner, Shoal Chub, and Guadalupe Bass) with Silverband Shiner and Shoal Chub only occurring at two sites while Guadalupe Bass were broadly distributed. Federal and state-listed species historically found within this range were not encountered (Smalleye Shiner and Chub Shiner). Four species of crayfish were documented throughout the watershed.

Biological surveys on South Brushy Creek in Champion Park documented 16 species of fish, one mussel species, 32 benthic macroinvertebrate taxa, and one species of crayfish. Seventeen species of fish, 34 benthic macroinvertebrate taxa, and one species of crayfish were documented on the San Gabriel River at County Road 100. No mussel species were collected on the San Gabriel; however, suitable mussel habitat was lacking at the bioassessment study area. Several fish species were collected that offer angling opportunities such as Guadalupe and Largemouth Bass, Common Carp, Flathead and Channel Catfish, Rio Grande Cichlid, and multiple species of sunfish.

Public access for recreational activities such as boating, paddling, and fishing vary across the watershed with greater opportunities for access in the middle to lower reaches of the watershed. Most rivers and streams in the upper reaches of the watershed including the Leon and Lampasas rivers have low and inconsistent stream flows limiting kayaking or canoeing opportunities. Both bioassessment study areas provide public bank fishing access to South Brushy Creek and the San Gabriel River. Multiple riverine trails exist on both waterways including the Brushy Creek Regional Trail System along Brushy Creek, San Gabriel River Trail on the North Fork of the San Gabriel, and the South San Gabriel River Trail on the South Fork of the San Gabriel. Several city and county parks are located along the primary tributaries throughout the watershed and provide varying degrees of public access for bank fishing.

This study updated fish occurrence records for 65 sites across the Little River watershed. This information will be used in conservation planning by Texas Parks and Wildlife Department for their Native Fish Conservation Areas initiative (Birdsong et al. 2019b). Sport fish species data and recreational access information will also inform the agency's recreational access initiatives such as the Texas Paddling Trails and the River Access and Conservation Areas programs, both of which work with local landowners and partners to increase public access for fishing and paddling.

INTRODUCTION

Study Area

Little River: The Little River is a major tributary of the Brazos River Basin with a watershed area of approximately 19,720 km^2 (SWRC 2020). The watershed primarily consists of five major tributaries including the Leon River, Cowhouse Creek, Lampasas River, San Gabriel River, and the Little River. The headwaters of the Leon River begin in Eastland County and flow southeast until they reach Lake Belton which is also fed by Cowhouse Creek (TPWD 1974). The Lampasas River arises in Hamilton County and likewise flows southeast through the rugged hill country where it eventually reaches Stillhouse Hollow Reservoir. The Leon and Lampasas join below the two reservoirs to form the Little River which flows for another 120 km until it reaches the Brazos River in Milam County. The San Gabriel River is formed in Georgetown with the union of the North and South Forks where it flows for another 80 km until it reaches the Little River (TPWD 1974). The watershed spans several Texas ecoregions: Cross Timbers, Edwards Plateau, Texas Blackland Prairies, and East Central Texas Plains (Griffith et al. 2007). Additional reservoirs within the watershed include Proctor, Georgetown, and Granger along with a few small fishing lakes such as Brushy Creek Lake and Pflugerville.

Multiple segments within the Little River watershed have been nominated as ecologically significant stream segments: Colony Creek, Little River (Texas Commission on Environmental Quality (TCEQ) Segment 1213), San Gabriel River (TCEQ Segment 1214), and Willis Creek (TCEQ segment 1247A; TPWD 2021). All four segments have been recognized as having high water quality and high aesthetic value. Colony Creek and Willis Creek have been recognized as having exceptional aquatic life use with diverse benthic macroinvertebrate communities (TPWD 2021). The Little River and San Gabriel River have both been recognized for having high aquatic life and unique communities including a thriving mussel population in the Little River and exemplary natural fish community in the San Gabriel River. Additionally, the San Gabriel River has been nominated for its value as a riparian conservation area (Pecan Grove Wildlife Area – Williamson County; TPWD 2021).

The geographic bounds for this study include nine counties within the Little River Watershed upstream of the confluence of the Little River and the Brazos River (Bell, Burnet, Comanche, Coryell, Eastland, Hamilton, Lampasas, Milam, and Williamson counties).

Champion Park: Champion Park is a 33-acre county park located in southwest Williamson County, TX (Halff Associates 2018). South Brushy Creek runs along the southeast border of the park where the seven-mile Brushy Creek Regional Trail system can be accessed. Champion Park offers multiple amenities including plenty of open space, a half mile loop trail, picnic tables, pavilions, playgrounds, boulders for climbing, and castings of dinosaur bones for digging (Williamson County 2021).

County Road 100: County Road 100 is located in Williamson County, TX and crosses the San Gabriel River just downstream of Highway 29. This low-water crossing is a popular access point for fly fisherman and other river enthusiasts as the site has plenty of parking alongside the river and under the Hwy 29 bridge. County Road 100 offers many river recreational opportunities and provides wadeable access downstream of the crossing where anglers like to target sunfish, small bass and carp (Texas Flyfishing 2021). Multiple species of catfish and bass are popular targets upstream of the crossing where the river is much deeper.

Survey and Management History

Biological Surveys: University of Texas' Fishes of Texas database has historic records for 53 species of freshwater fishes from the Little River watershed (Hendrickson and Cohen 2015). Most collection events for this watershed have occurred prior to 2000 with heavy sampling in the 1970s due in large part to intensive sampling at 184 sites throughout the watershed from 1977-1978 (Rose 1979).

Sixteen species of freshwater mussels have been documented in the Little River watershed (Randklev et al. 2020). Mussel surveys conducted by TPWD in the 1990s-2000s yielded 13 species from the Little River watershed (Howells 1993-2004). More recently, mussel surveys to assess distribution, abundance and habitat use of candidate and petitioned species have been conducted throughout portions of the Little River watershed by Randklev et al. 2017 and Bonner et al. 2018. No comprehensive crayfish or benthic macroinvertebrate surveys within the study area were found.

Imperiled Species: Historical fish collections from the Little River watershed documented four freshwater species identified by TPWD (2012) as SGCN at the time of the study: Guadalupe Bass *Micropterus treculii*, Chub Shiner *Notropis potteri*, Silverband Shiner *Notropis shumardi*, and Smalleye Shiner *Notropis buccula* (Hendrickson and Cohen 2015). Smalleye Shiner is listed as state and federally endangered. Additionally, Mountain Mullet *Agonostomus monticola*, Pallid Shiner *Hybopsis amnis*, and Shoal Chub *Macrhybopsis hyostoma* were added to TPWD's SGCN list in 2020 and have been reported from the Little River watershed (Hendrickson and Cohen 2015; TPWD 2023).

Eight SGCN mussel species, two of which are federally listed and one state listed, have been documented in the Little River watershed: Pimpleback *Cyclonaias pustulosa*, Tampico Pearlymussel *Cyrtonaias tampicoensis*, Balcones Spike *Fusconaia iheringi* (Federal Endangered), Louisiana Fatmucket *Lampsilis hydiana*, Brazos Heelsplitter *Potamilus streckersoni* (State Threatened), Mapleleaf *Quadrula quadrula*, Pistolgrip *Tritogonia verrucosa*, and Texas Fawnsfoot *Truncilla macrodon* (Federal Threatened) (Randklev et al. 2023).

Sport Fish Harvest Regulations: At the time of sampling, sport fishes in rivers and streams of the Little River watershed were managed under statewide fishing regulations (TPWD 2019). As of 2024, Brushy Creek Lake and South Brushy Creek/Brushy Creek downstream from the lake to the Williamson/Milam county line are now managed under Community Fishing Lake (CFL) regulations per recommendation by Ireland and DeJesus (2019) (TPWD 2024c). Regulations include a daily limit of five fish (all species combined), of which only one may be a black bass. There are no minimum length limits except for black bass which must be 14 inches or greater. Fishing is restricted to pole and line only with no more than two poles per angler.

Fish Stockings: A total of 146 riverine stocking events have occurred throughout the Little River watershed between 1973 and 2024 (TABLE 1; TPWD 2025). Seven species and one hybrid have been stocked including: Channel Catfish *Ictalurus punctatus* (n = 41,982), Rainbow Trout *Oncorhynchus mykiss* (n = 123,668), Bluegill *Lepomis macrochirus* (n = 37,554), Smallmouth Bass *Micropterus dolomieu* (n = 114,000), Largemouth Bass *Micropterus salmoides* (n = 1,055), Guadalupe Bass (n = 64), Red Drum *Sciaenops ocellatus* (n = 74,346), and a Black Drum *Pogonias cromis* x Red Drum hybrid (n =

86,800). Most of the large reservoirs and Community Fishing Lakes throughout the Little River watershed are stocked on a regular basis and are managed by Texas Parks & Wildlife Department.

TABLE 1.—Fish stocking records including the timeframe, number of events, species stocked, and number of individuals stocked at multiple locations throughout the Little River Watershed from 1973-2024.

	Location	Date Range	Number of Events	Species	Number Stocked
Leon River Subwatershed	Leon River at Mother Neff State Park	1990-1991	2	Rainbow Trout	4,040
	Leon River in Bell County	1990-1991	2	Channel Catfish	9,446
		1991	1	Bluegill	25,000
	Nolan Creek in Bell County	1991-2024	55	Rainbow Trout	59,896
Lampasas River Subwatershed	Lampasas River at US 281	1998	1	Channel Catfish	549
	Salado Creek in Bell County	1989-1993	10	Rainbow Trout	19,305
	Sulphur Creek at Brooks Park	2017	1	Channel Catfish	220
San Gabriel River Subwatershed	Brushy Creek Lake at Brushy Creek Lake Park	2001-2021	11	Channel Catfish	11,744
		1986	1	Rainbow Trout	4,446
		2020	1	Bluegill	12,554
		2014	1	Largemouth Bass	55
	Lake Creek in McLennan County	1975-1981	2	Red Drum	74,346
		1983	1	Black Drum x Red Drum Hybrid	86,800
	North Fork San Gabriel River	1984-1990	11	Rainbow Trout	15,556
		1977-1978	2	Smallmouth Bass	114,000
	San Gabriel River at San Gabriel Park	1992-2014	18	Channel Catfish	14,668
		2007-2023	11	Rainbow Trout	14,311
	San Gabriel River in Milam County	2019	1	Guadalupe Bass	64
	South Fork San Gabriel River	1995-2004	9	Channel Catfish	5,355
		1988-2002	4	Rainbow Trout	6,114
Little River Subwatershed	Little River	1973	1	Largemouth Bass	1,000
		Total:	**146**	**7***	**479,469**

*seven species plus one hybrid

Rainbow Trout and Channel Catfish have been stocked most frequently in rivers and riverine impoundments to provide and promote recreational fishing opportunities with a strong focus on urban areas. Both species are primarily stocked as part of the Neighborhood Fishin' Program and for outreach activities such as Kid Fish events. Channel Catfish are stocked from spring to fall, and Rainbow Trout are stocked annually in the winter to offer anglers a unique species to target but do not persist during warm weather.

Smallmouth Bass were stocked in rivers and streams throughout Central Texas in the late 1970s in hopes of establishing a Smallmouth Bass fishery (Birdsong et al. 2019a). Efforts quickly ceased after 1980 when it was discovered that Smallmouth Bass were hybridizing with Guadalupe Bass. Texas Parks &

Wildlife Department is currently working to assess the status of Guadalupe Bass in the San Gabriel River and conserve one of several genetically intact populations that occur in Brushy Creek.

Water Quality: Several stream segments within the study area are listed by TCEQ for water quality impairments: Little River (TCEQ segment 1213), Big Elm Creek (1213A), Nolan Creek/South Nolan Creek (1218), Leon River Below Proctor Lake (1221), Coryell Creek (1221G), Duncan Creek (1222A), Sabana River (1222C), Sweetwater Creek (1222E), Leon River Below Leon Reservoir (1223), and Brushy Creek (1244; TCEQ 2020). Each of these streams is listed for presence of elevated bacteria levels; the Leon River Below Leon Reservoir is also listed for depressed dissolved oxygen values. In each of these cases TCEQ recommended a review of standards or additional data collection (TCEQ 2020).

STUDY SITES

The Little River watershed bioassessment consisted of sampling at 65 sites across nine counties in Central Texas (TABLE 2; FIGURE 1). Two sites were selected as bioassessment study areas (Sites A and B) and were the locations of intensive data collection including water quality, fish, benthic macroinvertebrate, and mussel data. The other 63 sites (Sites 1–63) were selected as supplemental fish collection sites to update or fill data gaps.

TABLE 2.—Little River watershed study site locations and the type of gear utilized for fish collections at each location in 2018 in Bell, Burnet, Comanche, Coryell, Eastland, Hamilton, Lampasas, Milam, and Williamson counties, TX.

Site	Location	Coordinates	Sampling Date	Seine	Gill net	Trammel	Backpack	Bag Seine	Boat EF	Frame Net
			Leon River Subwatershed							
1	Leon River at RM 2214	32.3247, -98.6529	3/14/2018	x						
2	Leon River at SH 16	32.1722, -98.5315	3/15/2018	x						
3	Leon River at CR 454	32.1418, -98.5043	3/15/2018	x	x	x				
4	Leon River at FM 1702	31.8609, -98.3310	6/19/2018	x		x				
5	Leon River at CR 301	31.6942, -97.9843	6/19/2018	x	x		x			
6	Leon River at FM 1829	31.3364, -97.6434	6/20/2018	x						
7	Lake Belton at Leona Park	31.2186, -97.4666	6/20/2018	x		x				
8	Leon River at Mill Spring Park	31.1046, -97.4701	6/6/2018	x	x	x				
9	Leon River at Taylors Valley Rd	31.0488, -97.4268	5/9/2018	x						
10	Lake Eastland at public beach	32.4161, -98.839	3/14/2018	x	x					
11	NF Leon River at SH 112	32.4076, -98.8179	3/14/2018	x	x					
12	SF Leon River at SH 6	32.3683, -98.8287	3/14/2018	x						
13	Colony Creek at RR 2461	32.4180, -98.6988	3/14/2018	x	x					
14	Sabana River at CR 290	32.1927, -98.8944	3/14/2018	x						
15	Sabana River at CR 408	32.1936, -98.8340	3/14/2018	x	x					
16	Sabana River at FM 2318	32.0903, -98.5917	3/15/2018	x						
17	Sabana River at CR 435	32.0662, -98.5840	3/15/2018	x	x					
18	Sweetwater Creek at FM 2247	31.9825, -98.6382	3/15/2018	x						
19	Duncan Creek at FM 2247	31.9408, -98.6121	3/15/2018	x						
20	Duncan Creek at SH 16	31.9700, -98.5628	3/15/2018	x						
21	Pecan Creek at CR 301	31.7097, -98.0250	6/19/2018	x						
22	Plum Creek at FM 2412	31.5005, -97.8618	6/20/2018	x	x					
23	Coryell Creek at FM 107	31.3936, -97.5996	6/20/2018	x						
24	South Nolan Creek at Backstroms Crsg	31.0767, -97.5276	6/7/2018	x						
25	Nolan Creek at E Ave A	31.0526, -97.4507	6/6/2018	x			x			
			Cowhouse Creek Subwatershed							
26	Cowhouse Creek at CR 505	31.6188, -98.1826	6/19/2018	x	x					
27	Cowhouse Creek at CR 137	31.4077, -97.9340	6/20/2018	x		x				

Site	Location	Coordinates	Sampling Date	Seine	Gill net	Trammel	Backpack	Bag Seine	Boat EF	Frame Net
			Lampasas River Subwatershed							
28	Lampasas River at FM 2313	31.1187, -98.0566	6/18/2018	x						
29	Lampasas River at SH 195	30.9725, -97.7781	6/7/2018	x	x					
30	Lampasas River at FM 1123	30.9901, -97.4450	6/6/2018	x			x			
31	Simms Creek at US 281	31.2681, -98.1741	6/19/2018	x						
32	Sulphur Creek at Naruna Rd	31.0504, -98.1853	6/19/2018	x						
33	Sulphur Creek at FM 1715	31.0855, -98.0508	6/18/2018	x	x					
34	Little Rocky Creek at US 183	30.9270, -97.9927	6/18/2018	x	x					
35	Buttermilk Creek at Gault site	30.8915, -97.7102	5/23/2018	x	x					
36	Salado Creek at E Amity Rd	30.9628, -97.4872	6/7/2018	x	x					
			San Gabriel River Subwatershed							
A	South Brushy Creek at Champion Park	30.5132, -97.7553	5/24/2018	x			x			
B	San Gabriel River at CR 100	30.6436, -97.5821	5/24/2018	x			x			
37	San Gabriel River at Booty's Rd Park	30.6627, -97.7156	5/23/2018	x	x					
38	San Gabriel River below Granger Lake	30.7003, -97.3267	5/9/2018	x	x				x	
39	San Gabriel River at FM 487	30.7278, -97.0383	7/17/2018	x	x					
40	Russell Fork San Gabriel at FM 1174	30.8058, -98.0664	6/18/2018	x						
41	Oatmeal Creek at FM 1174	30.7033, -98.0644	6/18/2018	x	x					x
42	Bear Creek on Collins Ranch	30.7363, -97.9181	5/23/2018	x	x	x				
43	NF San Gabriel River at Bear Ck conf.	30.7358, -97.9159	5/23/2018	x						
44	SF San Gabriel at Ronald Regan Blvd	30.6118, -97.8196	6/18/2018	x	x		x			
45	Brushy Creek at Veterans Park	30.5154, -97.6745	7/24/2018	x	x	x	x			
46	Lake Creek at Lake Creek Park	30.5087, -97.6689	7/31/2018	x	x					
47	Brushy Creek oxbow at FM 973	30.4770, -97.4595	7/24/2018	x						
48	Brushy Creek oxbow at FM 112	30.5337, -97.2547	7/17/2018	x	x					
49	Brushy Creek at FM 908	30.6941, -97.0784	7/17/2018	x						
			Little River Subwatershed							
50	Little River at Sunshine Rd	30.8963, -97.3190	6/6/2018	x	x					
51	Little River at FM 437	30.8691, -97.2480	5/9/2018	x	x					
52	Little River at FM 486, isolated channel	30.7924, -97.1138	4/26/2018	x	x					
53	Little River at FM 486	30.7993, -97.1094	4/26/2018		x			x		
54	Little River at US 77	30.8332, -96.9484	7/17/2018	x	x					
55	Big Elm Creek at FM 438	31.1246, -97.2325	5/9/2018	x						
56	Big Elm Creek at FM 1915	30.9473, -97.1044	4/26/2018	x						
57	Big Elm Creek at US 77	30.9032, -96.9792	5/10/2018	x	x					
58	Big Elm Creek at CR 240	30.9018, -96.9583	4/26/2018	x	x					
59	Knob Creek at Reed Cemetery Rd	30.9074, -97.3022	6/6/2018	x						
60	Little Elm Creek at Seaton Rd	31.0269, -97.2219	5/9/2018	x						
61	Donahoe Creek at FM 437	30.8134, -97.2553	4/26/2018	x	x					
62	Sandy Creek at US 77	30.8022, -96.9569	5/10/2018	x	x					
63	Pin Oak Creek at FM 2095	30.8166, -96.7704	5/10/2018	x						

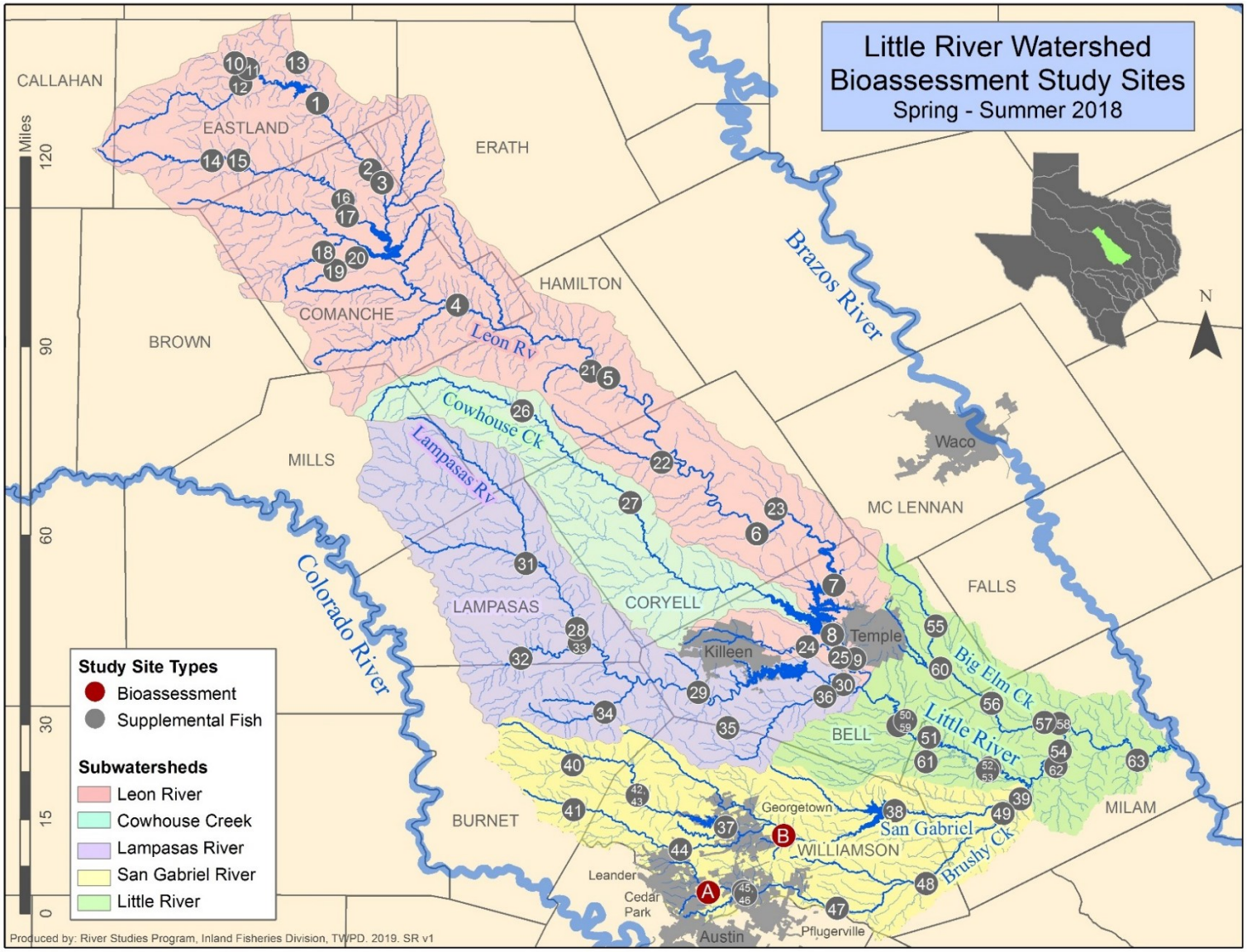


FIGURE 1.—Locations of Little River watershed data collection sites in Bell, Burnet, Comanche, Coryell, Eastland, Hamilton, Lampasas, Milam, and Williamson counties, TX in 2018. See TABLE 2 for specific site locations.

Bioassessment Study Sites

The Little River watershed was chosen for this study because fish locality records were sparse, temporally and spatially (Hendrickson and Cohen 2015). Additionally, the San Gabriel River, a tributary to the Little River, has been identified by TPWD as a priority for Guadalupe Bass restoration, while the Lampasas River, another tributary, has been identified as a priority for Guadalupe Bass conservation (Bean 2017). This study provides an opportunity to re-evaluate Guadalupe Bass genetics and hybridization rates within these priority sub-watersheds. The two bioassessment study areas were selected because they are known sites utilized by anglers and they fall within the San Gabriel sub-watershed. Data collected at these sites included water quality and benthic macroinvertebrate, mussel, and fish assemblage data.

Site A was located at Champion Park on South Brushy Creek. Champion Park, managed by Williamson County, offers hiking and fishing opportunities. South Brushy Creek, within the bounds of the park, consists of primarily shallow run and riffle habitats (FIGURE 2) with some backwaters and shallow pools. Depths ranged from 0.06 to 0.5 m (0.2–1.7 ft) with current velocities averaging 0.04 cms (1.38 cfs). Substrates were predominately gravel (67%), with some bedrock (13%), cobble (18%), and silt (2%) present. Instream cover included aquatic macrophytes (FIGURE 2) and overhanging vegetation with limited amounts of small and large woody debris. The dominant aquatic macrophyte present was non-native Hydrilla *Hydrilla verticillata*.

FIGURE 2.—A shallow run typical of predominant habitats found at site A (left photo) on South Brushy Creek at Champion Park in Williamson County, Texas. Cover present at the site included aquatic macrophytes (right photo) such as Hydrilla.

Site B was located at a county road crossing on the San Gabriel River. All sampling took place downstream of the crossing, where the river consists of primarily shallow riffle, run, and backwater habitats (FIGURE 3). Depths ranged from 0.06 to 0.6 m (0.2–2.0 ft) with current velocities averaging 0.03 cms (1.15 cfs). Substrates were predominately bedrock (87%) with limited gravel (7%), boulder (4%), and cobble (2%) present. Instream cover included limited quantities of periphyton, aquatic macrophytes, overhanging vegetation, small woody debris, and large woody debris (FIGURE 3).

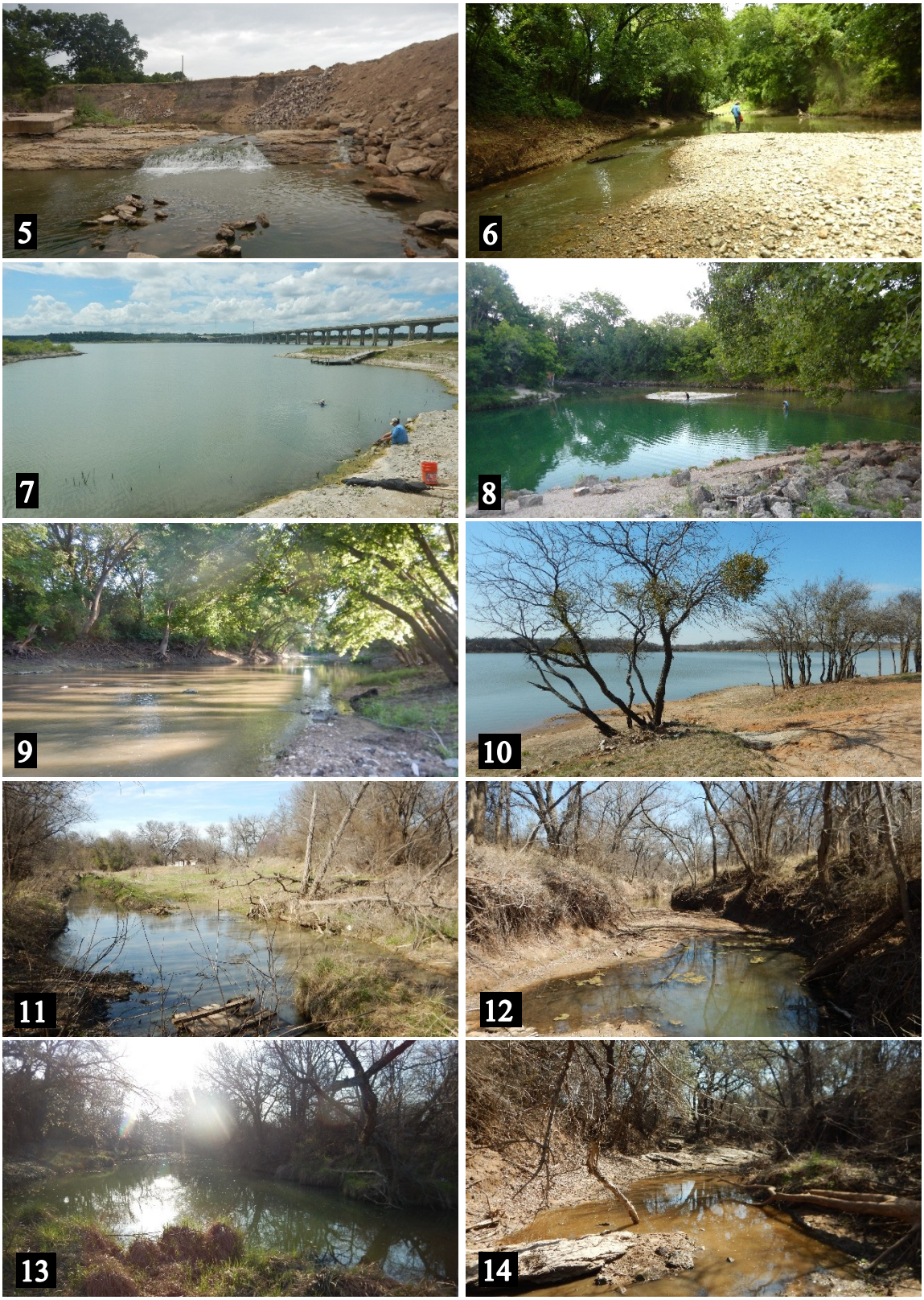
FIGURE 3.—Shallow run, riffle, and backwater habitats typical of the area sampled at site B (left photo) on the San Gabriel River at CR 100 in Williamson County, Texas. Cover present at the site included limited quantities of periphyton, aquatic macrophytes, overhanging vegetation, and large and small woody debris (right photo).

Supplemental Collection Sites

Sixty-three supplemental collection sites were sampled throughout the Little River watershed in Bell, Burnet, Comanche, Coryell, Eastland, Hamilton, Lampasas, Milam, and Williamson counties, Texas (Sites 1–63; FIGURE 1; TABLE 2). Sites were spread across five sub-watersheds: Leon River, Cowhouse Creek, Lampasas River, San Gabriel River, and Little River (FIGURE 1). Supplemental sites included 33 tributaries, two lakes, and five mainstem Little River sites. These sites were sampled to fill gaps or update fish occurrence data in the statewide Fishes of Texas Project database (Hendrickson and Cohen 2015). Limited habitat data was collected from supplemental sites; however, photos of each site are included to provide reference to site conditions at the time of sampling (FIGURE 4).

FIGURE 4.—Supplemental sites 1–63 sampled in 2018 in Bell, Burnet, Comanche, Coryell, Eastland, Hamilton, Lampasas, Milam, and Williamson counties TX. See TABLE 2 for specific site location information.

FIGURE 4.—Continued.



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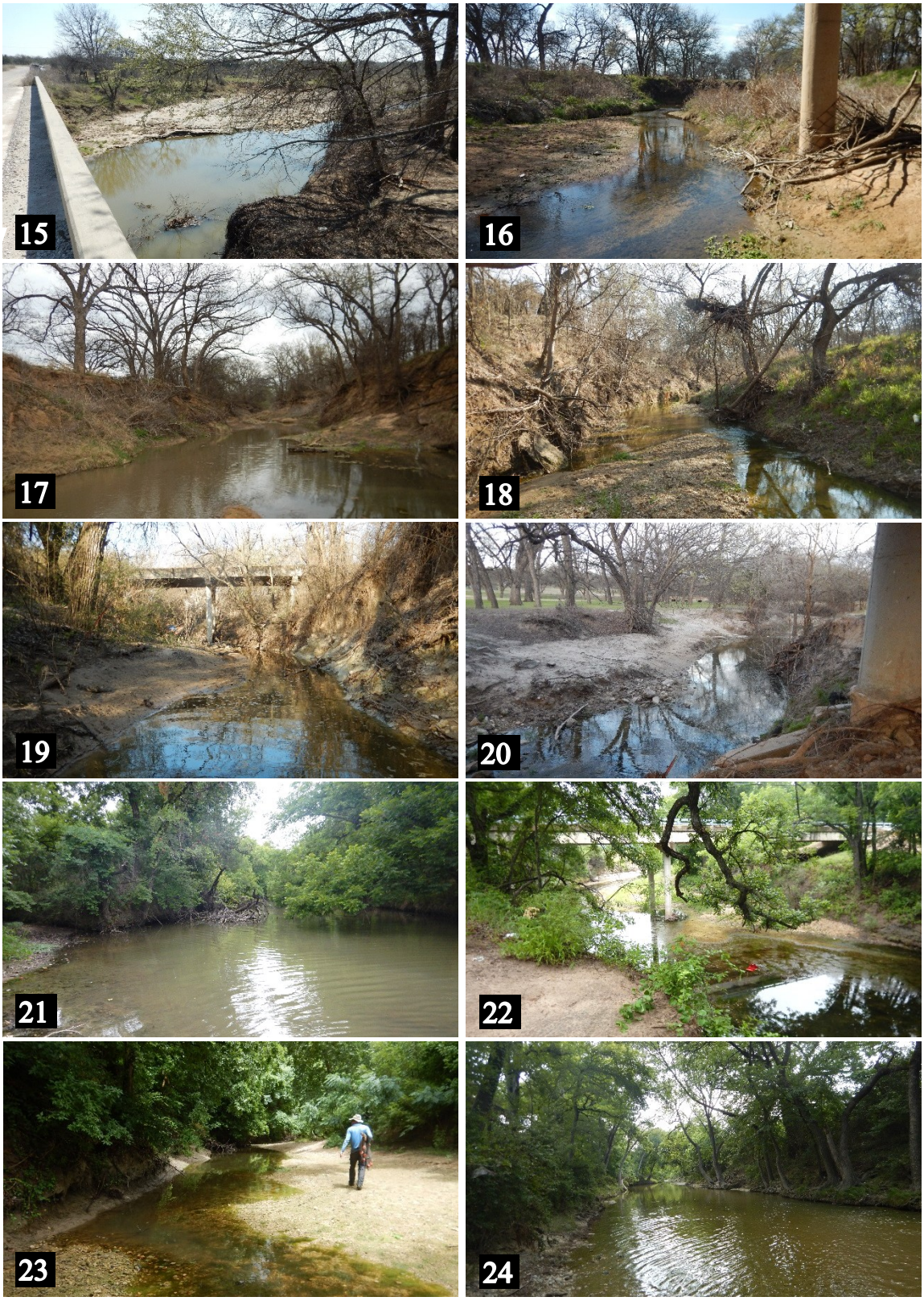

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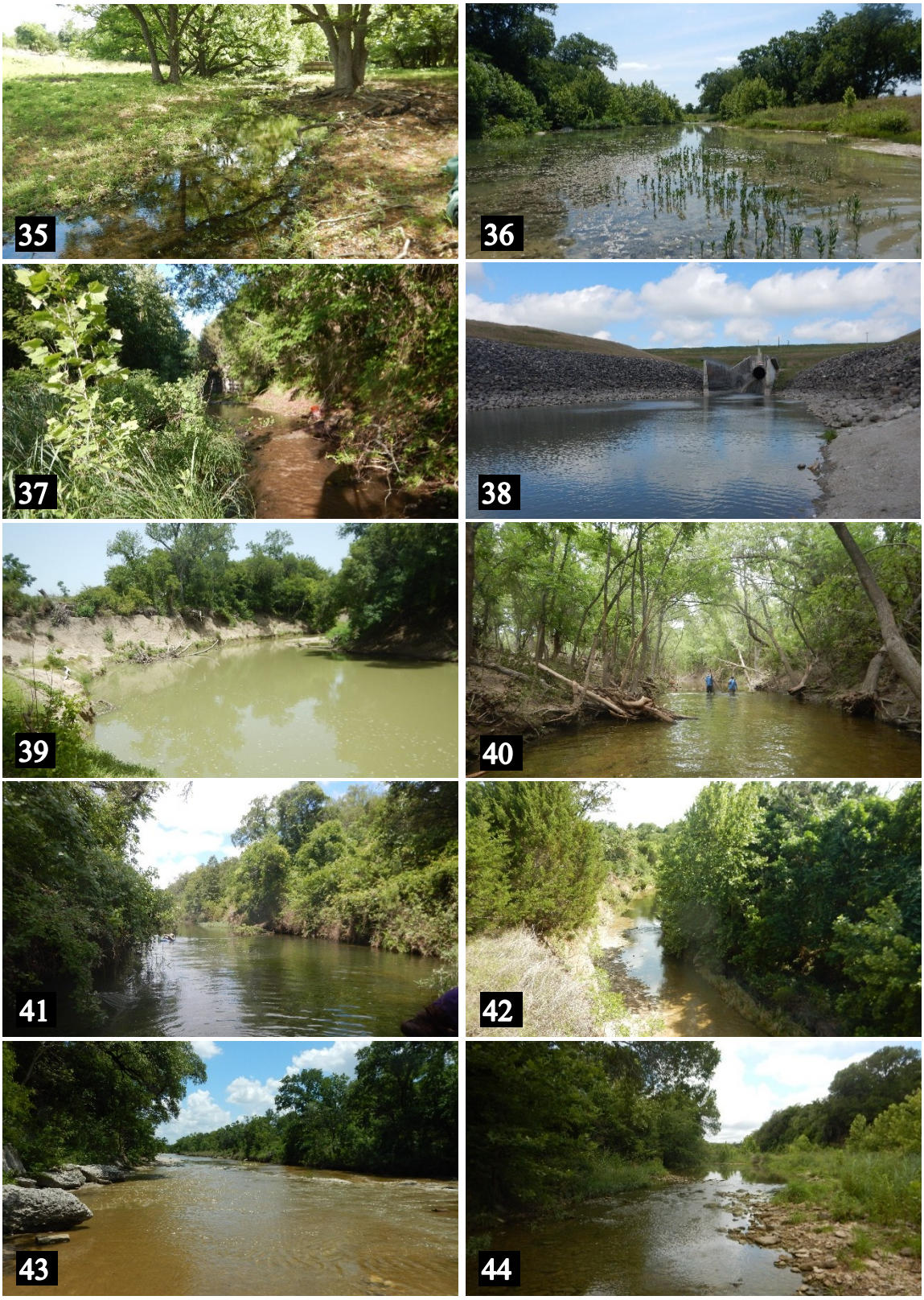

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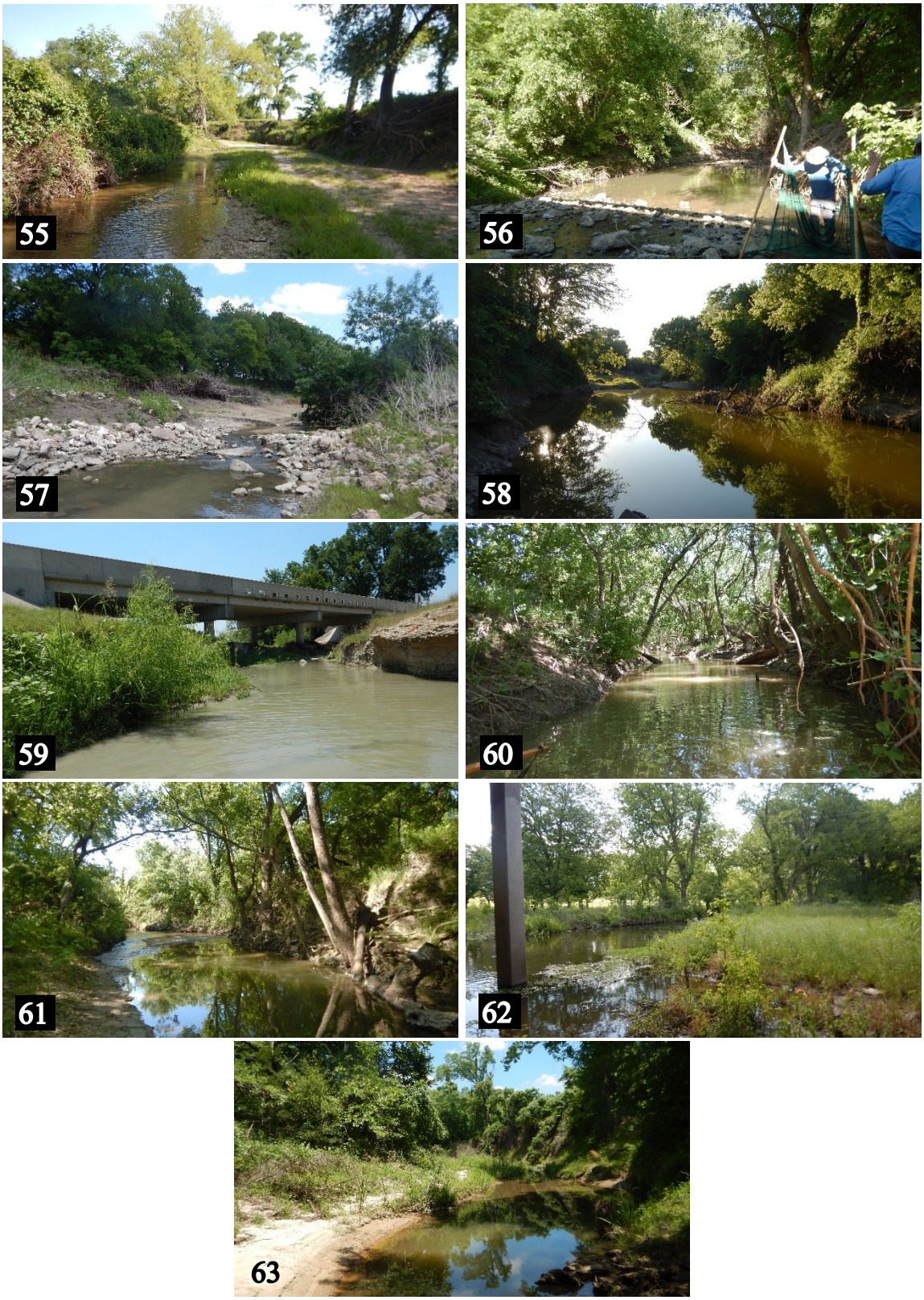

WATER QUALITY AND QUANTITY

Methods: Three-point measurements for water temperature, specific conductivity, dissolved oxygen, and pH were recorded from each bioassessment study site using a YSI multi-parameter water quality sonde. A mean was then calculated for each study site. Total dissolved solids (TDS) concentrations were calculated by multiplying specific conductivity by 0.64 (Atekwana et al. 2004). Data were verified using Texas Commission on Environmental Quality (TCEQ) quality assurance procedures (TCEQ 2014). Point measurements were evaluated in context of the surface water quality standards (TCEQ 2020).

Results and Discussion: Site A on South Brushy Creek is located on an unclassified water segment and by default is assigned water quality standards associated with a High aquatic life use (ALU). The closest classified stream segment to our study site is TCEQ Segment 1244_04. This segment is on Brushy Creek and runs from the confluence of Lake Creek upstream to the confluence of South Brushy Creek.

Site B on the San Gabriel River falls within TCEQ Segment 1248, which is described as the San Gabriel/North Fork San Gabriel River from a point 1.9 km downstream of SH 95 in Williamson County to North San Gabriel Dam in Williamson County. A use concern for nitrate is documented due to 21 of 82 samples collected between Dec 2011 and Nov 2018 exceeding the established stream standard.

Water temperature, pH, and dissolved oxygen measurements recorded during this study were within their designated water quality standards in the San Gabriel River; however, the dissolved oxygen concentration in South Brushy Creek was not (TABLE 3). Given the diverse fish assemblage identified in South Brushy Creek during this study, it appears these low dissolved oxygen levels were likely an anomaly rather than a regular occurrence. While no standard exists for specific conductivity, it can be used as a means of indirectly measuring TDS. Based upon specific conductivity, TDS was also within established standards (TABLE 3). Bacteria and nutrients were not evaluated during this study.

TABLE 3.—Top: Water quality data collected from Site A on South Brushy Creek at Champion Park (Williamson County, TX) on May 24, 2018. TCEQ water quality standards for Segment 1244 (Brushy Creek from the confluence with the San Gabriel River to the confluence of South Brushy Creek) are reported for comparison (TCEQ 2020). *Bottom*: Water quality data collected from Site B on the San Gabriel River at CR 100 (Williamson County, TX) on May 24, 2018; TCEQ water quality standards for Segment 1248 (San Gabriel/North Fork San Gabriel River from a point 1.9 km downstream of SH 95 to North San Gabriel Dam) are reported for comparison (TCEQ 2020).

	Temperature (°C)	**Specific Conductivity** (µS/cm)	**Total Dissolved Solids** (mg/L)	**Dissolved Oxygen** (mg/L)	**pH**
Site A: South Brushy Creek	26.5	465	298	1.6	7.9
TCEQ Standard	≤ 32.8	N/A	≤800	grab min: 3.0	6.5-9.0
Site B: San Gabriel River	30.2	475	304	9.2	8.2
TCEQ Standard	≤ 35	N/A	≤350	grab min: 3.0	6.5-9.0

Stream discharge at the time of sampling was less than what is typical of historical conditions during May. Discharge on the day of sampling was about 12 ft^3/sec based upon the values reported from an

upstream gage on the San Gabriel River near Georgetown (USGS 08104700) combined with gages located on two tributaries entering the San Gabriel River downstream of the Georgetown gage but upstream of our study site (USGS 08104900 – South Fork San Gabriel River at Georgetown; USGS 08105095 – Berry Creek at Airport Road near Georgetown). Daily median discharge for May 24, calculated from data reported from the three aforementioned USGS gages for their respective periods of record (USGS 08104700: 1979-2018; USGS 08104900: 1967-2018; USGS 08105095: 2003-2018), is 34 ft^3/sec.

FISH ASSEMBLAGE

Bioassessment Study Sites (A and B)

Methods: Fish were sampled from the two bioassessment study sites on South Brushy Creek (Site A) and the San Gabriel River (Site B) on May 24, 2018. Fish were collected from all available habitat types at each location by seining and backpack electrofishing. Two seining crews each conducted a minimum of 10 seine hauls at each locality, expanding upon TCEQ sampling protocols (TCEQ 2014), and continued seining until no additional species were collected. Backpack electrofishing was conducted for a minimum of 900 seconds at each site using pulsed DC current.

Large fish captured were identified, photographed, measured, and released. Smaller specimens were identified and enumerated in the field and individual representatives of each species were photographed or retained as voucher specimens (Hubbs et al. 2008). All fish were examined for external deformities, disease, lesions, and other abnormalities. Voucher specimens were fixed in 10% formalin and deposited in the Biodiversity Collections at the University of Texas at Austin. Names of fishes and their hybrids in this report follow Page et al. (2013) with exceptions noted by Hendrickson and Cohen (2022). These data will be made available online through the Fishes of Texas Project (Hendrickson and Cohen 2015).

The fish community at each site was assessed using a regionalized Index of Biotic Integrity (IBI; Ecoregion 30 – Site A and Ecoregion 32 – Site B) resulting in an assigned aquatic life use (ALU) score with possible ratings of Exceptional, High, Intermediate, and Limited (Linam et al. 2002). Fish data from two TCEQ Surface Water Quality Monitoring stations that were close to both bioassessment sites were referenced for historical comparison: Station 17374 on Brushy Creek upstream of the confluence with South Brushy Creek (30.538361, -97.77916) was sampled in May and July of 2004 and Station 12102 on the San Gabriel River at the bioassessment site (30.645834, -97.584724) was sampled in April and July of 2008 (TCEQ 2018).

Results: A total of 20 fish species from eight families were collected across the two bioassessment sites. Sixteen species totaling 555 individuals were detected at Site A on South Brushy Creek at Champion Park, and 17 species totaling 4,071 individuals were detected at Site B on the San Gabriel River at CR 100 (TABLE 4). For both localities, Blacktail Shiner *Cyprinella venusta*, Western Mosquitofish *Gambusia affinis*, and Central Stoneroller *Campostoma anomalum* were the most abundant species (FIGURE 5). Largemouth Bass, particularly juvenile stage, was also found in high numbers at each locality, while

Inland Silverside *Menidia beryllina* and Red Shiner *Cyprinella lutrensis* were abundant only at Site B on the San Gabriel River.

TABLE 4.—Abundance of fish collected by species for all gear types combined by site from the two Little River watershed bioassessment sites on May 24, 2018, Williamson County, TX. Collated species collected during historical TCEQ monitoring events at Brushy Creek in 2004 and the San Gabriel River in 2008 are noted with an 'X'.

			Brushy Creek	**Site A:** *South Brushy Creek*	**Site B:** *San Gabriel River*	
Family	**Scientific Name**	**Common Name**	Historical	Current	Historical	Current
Cyprinidae	*Campostoma anomalum*	Central Stoneroller	X	127	X	962
	Cyprinella lutrensis	Red Shiner			X	227
	Cyprinella venusta	Blacktail Shiner	X	88	X	1,142
	Cyprinus carpio	Common Carp		1	X	10
	Notropis volucellus	Mimic Shiner	X	3	X	8
	Pimephales vigilax	Bullhead Minnow			X	5
Catostomidae	*Moxostoma congestum*	Gray Redhorse				6
Ictaluridae	*Ameiurus natalis*	Yellow Bullhead			X	
	Ictalurus punctatus	Channel Catfish		1	X	
	Pylodictis olivaris	Flathead Catfish			X	2
Atherinopsidae	*Menidia beryllina*	Inland Silverside		1		280
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	X	90	X	1,127
	Poecilia latipinna	Sailfin Molly		7		
Centrarchidae	*Lepomis auritus*	Redbreast Sunfish	X	43	X	15
	Lepomis cyanellus	Green Sunfish		8	X	4
	Lepomis macrochirus	Bluegill		34	X	9
	Lepomis megalotis	Longear Sunfish	X	45	X	70
	Lepomis microlophus	Redear Sunfish	X			
	Micropterus punctulatus	Spotted Bass			X	
	Micropterus salmoides	Largemouth Bass	X	72	X	176
	Micropterus treculii	Guadalupe Bass		1		15
Percidae	*Etheostoma pulchellum*	Plains Orangethroat Darter	X	24	X	13
Cichlidae	*Herichthys cyanoguttatus*	Rio Grande Cichlid		10	X	
		Number of species	**9**	**16**	**18**	**17**
		Number of individuals	**–**	**555**	**–**	**4,071**
		Regionalized IBI Score	**37 & 42**	**48**	**44 & 44**	**53**

Six species from the family Centrarchidae (black bass and sunfish) were collected, all at both sites, with Redbreast Sunfish *Lepomis auritus* being the only non-native. Sunfish (Lepomis spp.) showed a higher relative abundance at Site A on South Brushy Creek, making up ~25% of the assemblage compared to 2.4% at Site B on the San Gabriel River. Another centrarchid member, Guadalupe Bass, was the only SGCN (TPWD 2012) detected during the bioassessments, with relative abundances of 0.18% and 0.37% for Site A on South Brushy Creek and Site B on the San Gabriel River, respectively.

Six cyprinids (carp and minnows) were collected between the two sites, with two (Red Shiner and Bullhead Minnow *Pimephales vigilax*) only found at the Site B on the San Gabriel River. Two additional

species (Gray Redhorse *Moxostoma congestum* and Flathead Catfish *Pylodictis olivaris*), outside of the family Cyprinidae, were unique to Site B on the San Gabriel River, and three species (Channel Catfish, Sailfin Molly *Poecilia latipinna*, and Rio Grande Cichlid *Herichthys cyanoguttatus*) were only found at Site A on South Brushy Creek (TABLE 4).

Five non-native species (Common Carp *Cyprinus carpio*, Inland Silverside, Sailfin Molly, Redbreast Sunfish, and Rio Grande Cichlid) were collected at Site A on South Brushy Creek while three species (Common Carp, Inland Silverside, and Redbreast Sunfish) were collected at Site B on the San Gabriel River. Rio Grande Cichlid has also been previously detected at Site B on the San Gabriel River during broodstock collections for Guadalupe Bass (Bean 2017).

The fish assemblage at Site A on South Brushy Creek received an ALU of High (48) compared to historical ALU ratings of Intermediate (37) and High (42) on nearby Brushy Creek (TABLE 4). While these sites are located within 5.4 river kilometers from each other, they are technically on separate waterbodies, so these comparisons are presented simply for reference. Sixteen species were documented in the current study compared to nine from historical samples with Redear Sunfish *Lepomis microlophus* being the only species not collected during this survey.

Site B on the San Gabriel River received an ALU of Exceptional (53) compared to historical ALU ratings of Intermediate (44) at the same location (TABLE 4). Species richness was similar between current and historical samples with four species documented only in historical collections and three species documented only in the current study. It is important to note that seining effort in the current study was twice as high as historical collections which potentially contributed to higher IBI scores.

Site A on South Brushy Creek had a narrower stream channel with gravel and cobble substrates and greater amounts of non-periphyton instream cover, whereas Site B on the San Gabriel River had a wide stream channel with predominantly bedrock substrates and abundant periphyton. Corresponding to these habitat differences, species considered to be intolerant of degraded habitats (e.g., Plains Orangethroat Darter *Etheostoma pulchellum*) were overall more abundant at Site A whereas more tolerant species (e.g., Red Shiner, Inland Silverside, and Common Carp) were more abundant at Site B (Linam and Kleinsasser 1998).

FIGURE 5.—The most abundant species collected across the two bioassessment study sites shown from left to right, top to bottom are Blacktail Shiner, Western Mosquitofish, Central Stoneroller, and Inland Silverside.

Supplemental Little River Watershed Fish Collection Sites (Sites 1-63)

Methods: For the supplemental fish collection portion of the study, nine trips were made to the Little River watershed between March 14 – July 31, 2018 to sample a total of 63 sites (TABLE 2; FIGURE 1). Sites were spread throughout the entirety of the watershed and targeted a diversity of habitats aimed at illustrating a more complete representation of the fish community, when combined with the bioblitz sites, and filling in spatial and temporal data gaps in the Fishes of Texas database (Hendrickson and Cohen 2015). Appropriate gear type was chosen based on available habitat and included: seines (10 & 15 ft. 1/8 in. and 12 & 15 ft. 3/16 in. mesh - straight, 15 ft. 1/4 in. mesh - bag), backpack electrofisher, trammel nets (30.5 m x 1.8 m multifilament mesh), gill nets (36 m x 1.8 m experimental monofilament mesh), and a frame net (3 x 4 ft. 1/8 in. mesh). Seines were deployed at every site and most often coupled with gill nets when deeper pools were present. Effort for all gear types continued until all habitats were effectively sampled and no new species were collected at the site.

All specimens, or a subset collection of all species found, were preserved in buffered 10% formalin and taken back to the University of Texas' Biodiversity Center for identification and deposit into their ichthyology collection. In addition, photographs of representative vouchers for each site were taken in the field and can be found online at the iNaturalist Fishes of Texas Project (http://www.inaturalist.org/projects/fishes-of-texas). Tissues were taken from specimens at select sites, with an emphasis on *Micropterus* specimens as part of the black bass genetics analyzation portion of this study and deposited in the university's Genetic Resource Collection. A brief summary of the black bass genetics methods and results are discussed further in the Imperiled Species section. All data has been fully processed and can be viewed and downloaded on the university's online Specify database portal (http://specify-portal.tacc.utexas.edu/ichthyology/).

Results: A total of 25,632 individuals comprised of 50 species and 14 families were collected from the 63 supplemental fish collection sites (TABLE 5-TABLE 8). Site 45, Brushy Creek at Veterans Park, was the most diverse with 21 species found. No fish were found at sites 13 and 14 (Colony Creek at RR2461 and

Sabana River at CR290) which both occur in the uppermost reaches of the watershed within the Leon River subwatershed. In addition to the fish-depauperate outliers of sites 13 and 14, three other sites showed low species richness (≤5 species) and also occur at the top reaches of the Leon River subwatershed.

Longear Sunfish *Lepomis megalotis* was collected at 59 of the 63 sites, making it the most widespread in occurrence for the watershed (FIGURE 6). The next most common species found were Western Mosquitofish (58 sites), Bluegill (45 sites), Blacktail Shiner (43 sites), and Largemouth Bass (41 sites). When compared to Dennis Rose's 1979 survey of 184 locations throughout the Little River watershed during the summers of 1977-1978, the ranking of dominant species collected during this survey are overall consistent with his findings (Rose 1979). Furthermore, Rose's species list for the family Centrarchidae, which had the highest number of representatives in this survey, was identical to this study with the exception of an isolated population of Redspotted Sunfish *Lepomis miniatus* that were found at Site 32 (Sulphur Creek at Naruna Rd.). Redspotted Sunfish are native to the Brazos River but had not previously been collected in the Little River watershed (Hendrickson and Cohen 2015).

Ten cyprinid species in total were found throughout the system, all native with the exception of Common Carp. Blacktail Shiner, Bullhead Minnow, and Red Shiner were the most widely distributed, each occurring at more than half of the sites. Two SGCN species, Silverband Shiner and the more recently added Shoal Chub, were collected at sites 53, 54, and 58 (Little River at FM486, Little River at US 77, and Big Elm Creek at CR 240) which are near the confluence of the mainstem Brazos.

Three suckers from the family Catostomidae were collected across all supplemental sites, with Smallmouth Buffalo *Ictiobus bubalus* being an addition to the Little River subwatershed checklist. Six species from the family Ictaluridae were collected, with Channel Catfish and Yellow Bullhead *Ameiurus natalis* being the most prevalent. Three darters and two logperch from the family Percidae were collected across all sites with one individual being identified as a hybrid Bigscale Logperch *Percina macrolepida* x Texas Logperch *Percina carbonaria* that was collected at Site 11 (North Fork Leon River at SH 112).

One new non-native was detected in the system, Brook Silverside *Labidesthes sicculus*, represented by a single specimen at Site 58 (Big Elm Creek at CR240), not far upstream from the mouth of the Little River. Brook Silverside are native to basins in the eastern part of the state and have appeared to be spreading west into the Brazos and Colorado drainages, as far back as 1972 (Hendrickson and Cohen 2015). Overall, non-native presence was scarce throughout the system with species typically occurring at few sites.

FIGURE 6.—The most widespread species collected throughout the Little River watershed shown from left to right, top to bottom are Longear Sunfish, Western Mosquitofish, Bluegill, and Blacktail Shiner.

Summary of Fish Data Collection

A total of 50 species were collected throughout the Little River watershed during this study. Historical vouchers from the basin documented 53 species (Hendrickson and Cohen 2015). This study added three species to the historical checklist: Inland Silverside, Smallmouth Buffalo, and Black Crappie *Pomoxis nigromaculatus*, with the latter two known to occur in the basin but lacking voucher specimens in museums. Seven previously documented species that were not found during this study include: Pallid Shiner, Smalleye Shiner, Chub Shiner, Fathead Minnow *Pimephales promelas*, Mountain Mullet, Gulf Killifish *Fundulus grandis*, and Smallmouth Bass. Aside from Fathead Minnow, all undetected species are known from just a few occurrences (1-3) within the watershed.

Overall, species richness from this study was high and similar to what is historically known from the basin. A further comparison to Dennis Rose's 1979 survey of the system shows an almost identical species checklist (Rose 1979). These findings suggest that the fish community has remained relatively stable over time, with the exception of possible extirpations of two native cyprinids.

TABLE 5.—Fish species and counts for supplemental collection sites 1-16 in the Little River Basin - Eastland, Comanche, Hamilton, Coryell, and Bell County, TX: 1. Leon River at RR 2214 (3/14/2018), 2. Leon River at SH 16 (3/15/2018), 3. Leon River at CR 454 (3/15/2018), 4. Leon River at FM 1702 (6/19/2018), 5. Leon River at CR 301 (6/19/2018), 6. Leon River at FM 1829 (6/20/2018), 7. Lake Belton at Leona Park (6/20/2018), 8. Leon River at Mill Spring Park (6/6/2018), 9. Leon River at Taylors Valley Rd (5/9/2018), 10. Lake Eastland at public beach (3/14/2018), 11. NF Leon River at SH 112 (3/14/2018), 12. SF Leon River at SH 6 (3/14/2018), 13. Colony Creek at RR 2461 (3/14/2018), 14. Sabana River at CR 290 (3/14/2018), 15. Sabana River at CR 408 (3/14/2018), 16. Sabana River at FM 2318 (3/15/2018).

Family	Scientific Name	Common Name	Site															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar		2	2													
	Lepisosteus osseus	Longnose Gar				1	1	1										
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad				19	121		2				4				3	
	Dorosoma petenense	Threadfin shad							253									
Cyprinidae	*Campostoma anomalum*	Central Stoneroller						7			31							
	Cyprinella lutrensis	Red Shiner	100	69		198	2417	777			53						10	44
	Cyprinella lutrensis x venusta	Red Shiner x Blacktail Shiner									1							
	Cyprinella venusta	Blacktail Shiner	46	13			20	7			120							
	Cyprinus carpio	Common Carp		1	3	1	1											
	Macrhybopsis hyostoma	Shoal Chub																
	Notemigonus crysoleucas	Golden Shiner							1									
	Notropis buchanani	Ghost Shiner					327	34			10							
	Notropis shumardi	Silverband Shiner																
	Notropis volucellus	Mimic Shiner									39							
	Pimephales vigilax	Bullhead Minnow	46	54	3	67	623	77	66		14	3					52	11
Catostomidae	*Carpiodes carpio*	River Carpsucker																
	Ictiobus bubalus	Smallmouth Buffalo								1								
	Moxostoma congestum	Gray Redhorse						1										
Characidae	*Astyanax mexicanus*	Mexican Tetra																
Ictaluridae	*Ameiurus melas*	Black Bullhead																
	Ameiurus natalis	Yellow Bullhead									1						1	2
	Ictalurus furcatus	Blue Catfish					1	68										
	Ictalurus punctatus	Channel Catfish	1	3	3	5	7	6		1			1	1				
	Noturus gyrinus	Tadpole Madtom																
	Pylodictis olivaris	Flathead Catfish						3										
Atherinopsidae	*Labidesthes sicculus*	Brook Silverside																
	Menidia beryllina	Inland Silverside		5					454		3							
Fundulidae	*Fundulus notatus*	Blackstripe Topminnow								9			4					
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	40	34	14	36	52	18	31	38	4	3	27	16			8	29
	Poecilia latipinna	Sailfin Molly																
Moronidae	*Morone chrysops*	White Bass																
Centrarchidae										2								
	Lepomis auritus	Redbreast Sunfish																
	Lepomis cyanellus	Green Sunfish		8	2			2		3			3	5				1

TABLE 5.—Continued.

Family	Scientific Name	Common Name	Site															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Lepomis gulosus	Warmouth																
	Lepomis humilis	Orangespotted Sunfish	35		1				11				4	1			6	
	Lepomis hybrid	Hybrid Sunfish																
	Lepomis macrochirus	Bluegill	6	11	10				2	21	7	7	37	40			29	4
	Lepomis megalotis	Longear Sunfish	5		2	14	52	7	5	11	8	4	1	11			3	10
	Lepomis microlophus	Redear Sunfish							1	2								
	Lepomis miniatus	Redspotted Sunfish																
	Lepomis sp.						1											
	Micropterus punctulatus	Spotted Bass																
	Micropterus salmoides	Largemouth Bass		2	1		3		25	43	1	1	4	1				2
	Micropterus treculii	Guadalupe Bass									2							
	Pomoxis annularis	White Crappie			1				1				2	2				
	Pomoxis nigromaculatus	Black Crappie			1													
Percidae	*Etheostoma gracile*	Slough Darter																
	Etheostoma pulchellum	Plains Orangethroat Darter					4	2		11	6							33
	Percina carbonaria	Texas Logperch																
	Percina macrolepida	Bigscale Logperch							1									
	Percina macrolepida x carbonaria	Bigscale Logperch x Texas Logperch											4					
	Percina sciera	Dusky Darter				1	56	39			1							
Sciaenidae	*Aplodinotus grunniens*	Freshwater Drum		1														
Cichlidae	*Herichthys cyanoguttatus*	Rio Grande Cichlid																
		Number of individuals	**279**	**203**	**43**	**342**	**3686**	**1049**	**853**	**142**	**301**	**18**	**91**	**77**	**0**	**0**	**112**	**136**
		Number of species	**8**	**12**	**12**	**9**	**14**	**15**	**13**	**10**	**15**	**5**	**10**	**8**	**0**	**0**	**8**	**9**

TABLE 6.—Fish species and counts for supplemental collection sites 17-32 in the Little River Basin - Comanche, Hamilton, Coryell, Lampasas, and Bell County, TX: 17. Sabana River at CR 435 (3/15/2018), 18. Sweetwater Creek at FM 2247 (3/15/2018), 19. Duncan Creek at FM 2247 (3/15/2018), 20. Duncan Creek at SH 16 (3/15/2018), 21. Pecan Creek at CR 301 (6/19/2018), 22. Plum Creek at FM 2412 (6/20/2018), 23. Coryell Creek at FM 107 (6/20/2018), 24. South Nolan Creek at Backstroms Crsg (6/7/2018), 25. Nolan Creek at E Ave A (6/6/2018), 26. Cowhouse Creek at CR 505 (6/19/2018), 27. Cowhouse Creek at CR 137 (6/20/2018), 28. Lampasas River at FM 2313 (6/18/2018), 29. Lampasas River at SH 195 (6/7/2018), 30. Lampasas River at FM 1123 (6/6/2018), 31. Simms Creek at US 281 (6/19/2018), 32. Sulphur Creek at Naruna Rd (6/19/2018).

Family	Scientific Name	Common Name	Site															
			17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar																
	Lepisosteus osseus	Longnose Gar					1		2									
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad																
	Dorosoma petenense	Threadfin shad																
Cyprinidae	*Campostoma anomalum*	Central Stoneroller		2			12	1	162	78	77		20	50	5	6	39	
	Cyprinella lutrensis	Red Shiner	4	273	4	40	4		180	2	62		10					
	Cyprinella lutrensis x venusta	Red Shiner x Blacktail Shiner																
	Cyprinella venusta	Blacktail Shiner					4	57	26	24	44	20	170	78	105	44	15	25
	Cyprinus carpio	Common Carp					1											
	Macrhybopsis hyostoma	Shoal Chub																
	Notemigonus crysoleucas	Golden Shiner																
	Notropis buchanani	Ghost Shiner																
	Notropis shumardi	Silverband Shiner																
	Notropis volucellus	Mimic Shiner					15	26			6		23			62	8	1
	Pimephales vigilax	Bullhead Minnow	2	62			13		94	6	25		10			6		
Catostomidae	*Carpiodes carpio*	River Carpsucker																
	Ictiobus bubalus	Smallmouth Buffalo																
	Moxostoma congestum	Gray Redhorse							70					6				
Characidae	*Astyanax mexicanus*	Mexican Tetra																
Ictaluridae	*Ameiurus melas*	Black Bullhead																
	Ameiurus natalis	Yellow Bullhead	1	1					15	7	4					9		6
	Ictalurus furcatus	Blue Catfish																
	Ictalurus punctatus	Channel Catfish					2				1	2	1			1		
	Noturus gyrinus	Tadpole Madtom														2		
	Pylodictis olivaris	Flathead Catfish									2							
Atherinopsidae	*Labidesthes sicculus*	Brook Silverside																
	Menidia beryllina	Inland Silverside																
Fundulidae	*Fundulus notatus*	Blackstripe Topminnow	1				1	9				1		25	15		43	10
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	22	55			45	20	49	62	4	47	13	43	79	17	624	42
	Poecilia latipinna	Sailfin Molly																
Moronidae	*Morone chrysops*	White Bass																
Centrarchidae																		
	Lepomis auritus	Redbreast Sunfish																
	Lepomis cyanellus	Green Sunfish	1		14	1		3	1			13	3				5	6

TABLE 6.—Continued.

Family	Scientific Name	Common Name	Site															
			17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	Lepomis gulosus	Warmouth												1				
	Lepomis humilis	Orangespotted Sunfish	1						2									
	Lepomis hybrid	Hybrid Sunfish																4
	Lepomis macrochirus	Bluegill	12				56	11	40			10		4	1		10	17
	Lepomis megalotis	Longear Sunfish	3	22	13	3	9	15	16	9	14	28	61	9	26	10	30	6
	Lepomis microlophus	Redear Sunfish					1					1	3					3
	Lepomis miniatus	Redspotted Sunfish																6
	Lepomis sp.								16									
	Micropterus punctulatus	Spotted Bass									1							
	Micropterus salmoides	Largemouth Bass	1				25	9	3	4		15	1	5	17	1	12	7
	Micropterus treculii	Guadalupe Bass									2				34	1		
	Pomoxis annularis	White Crappie	2															
	Pomoxis nigromaculatus	Black Crappie	1															
Percidae	*Etheostoma gracile*	Slough Darter																
	Etheostoma pulchellum	Plains Orangethroat Darter	2	13				2	2	12	3	1	6	49	10	16		
	Percina carbonaria	Texas Logperch																
	Percina macrolepida	Bigscale Logperch																
	Percina macrolepida x carbonaria	Bigscale Logperch x Texas Logperch																
	Percina sciera	Dusky Darter													4			
Sciaenidae	*Aplodinotus grunniens*	Freshwater Drum																
Cichlidae	*Herichthys cyanoguttatus*	Rio Grande Cichlid																
		Number of individuals	**53**	**428**	**31**	**44**	**189**	**153**	**678**	**204**	**245**	**138**	**321**	**270**	**296**	**175**	**786**	**133**
		Number of species	**13**	**7**	**3**	**3**	**14**	**10**	**14**	**9**	**13**	**10**	**12**	**10**	**10**	**12**	**9**	**11**

TABLE 7.—Fish species and counts for supplemental collection sites 33-48 in the Little River Basin - Lampasas, Burnet, Bell, Williamson, and Milam County, TX: 33. Sulphur Creek at FM 1715 (6/18/2018), 34. Little Rocky Creek at US 183 (6/18/2018), 35. Buttermilk Creek at Gault Site (5/23/2018), 36. Salado Creek at E Amity Rd (6/7/2018), 37. San Gabriel River at Booty's Rd Park (5/23/2018), 38. San Gabriel River below Granger Lake (5/9/2018), 39. San Gabriel River at FM 487 (7/17/2018), 40. Russell Fork San Gabriel at FM 1174 (6/18/2018), 41. Oatmeal Creek at FM 1174 (6/18/2018), 42. Bear Creek on Collins Ranch (5/23/2018), 43. NF San Gabriel River at Bear Creek confluence (5/23/2018), 44. SF San Gabriel River at Ronald Reagan Blvd (6/18/2018), 45. Brushy Creek at Veterans Park (7/24/2018), 46. Lake Creek at Lake Creek Park (7/31/2018), 47. Brushy Creek oxbow at FM 973 (7/24/2018), 48. Brushy Creek oxbow at FM 112 (7/17/2018).

Family	Scientific Name	Common Name	Site															
			33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar															1	
	Lepisosteus osseus	Longnose Gar							1			1	1					
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad						2	10			2			3	23	1	30
	Dorosoma petenense	Threadfin shad						2										
Cyprinidae	*Campostoma anomalum*	Central Stoneroller	7	9	1	1				12		3	141	18	24			
	Cyprinella lutrensis	Red Shiner	1					41	68									11
	Cyprinella lutrensis x venusta	Red Shiner x Blacktail Shiner																
	Cyprinella venusta	Blacktail Shiner	36	27		147	47	14	4	51	40	20	644	15	74	35		
	Cyprinus carpio	Common Carp										1						
	Macrhybopsis hyostoma	Shoal Chub																
	Notemigonus crysoleucas	Golden Shiner						2										17
	Notropis buchanani	Ghost Shiner																
	Notropis shumardi	Silverband Shiner																
	Notropis volucellus	Mimic Shiner	28			21				32	19	1	30		170	190		
	Pimephales vigilax	Bullhead Minnow						29	34							25	3	18
Catostomidae	*Carpiodes carpio*	River Carpsucker																1
	Ictiobus bubalus	Smallmouth Buffalo																2
	Moxostoma congestum	Gray Redhorse	4			5		1							4			
Characidae	*Astyanax mexicanus*	Mexican Tetra			44	3												
Ictaluridae	*Ameiurus melas*	Black Bullhead															1	
	Ameiurus natalis	Yellow Bullhead	1	2		1	2			2	6	1		3	6			
	Ictalurus furcatus	Blue Catfish																
	Ictalurus punctatus	Channel Catfish				4			1			2		1	2	1		2
	Noturus gyrinus	Tadpole Madtom																
	Pylodictis olivaris	Flathead Catfish													3			
Atherinopsidae	*Labidesthes sicculus*	Brook Silverside																
	Menidia beryllina	Inland Silverside						59							87	76		
Fundulidae	*Fundulus notatus*	Blackstripe Topminnow	9			1												
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	12	22	164	36	3	92	8	58	8	14	88	23	7	243	54	21
	Poecilia latipinna	Sailfin Molly													1	3	47	
Moronidae	*Morone chrysops*	White Bass						1										
Centrarchidae	*Lepomis auritus*	Redbreast Sunfish					23					1	3	23	14			

TABLE 7.—Continued.

Family	Scientific Name	Common Name	Site															
			33	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
	Lepomis cyanellus	Green Sunfish		2	13					4		3		10	5	1		
	Lepomis gulosus	Warmouth						2							3	8	12	7
	Lepomis humilis	Orangespotted Sunfish						14	5									176
	Lepomis hybrid	Hybrid Sunfish														1		
	Lepomis macrochirus	Bluegill	2	49		2				6	13	10	13	9	18	18	28	2
	Lepomis megalotis	Longear Sunfish	12	21	9	23	12	6	2	37	15	13	10	34	36	8	7	
	Lepomis microlophus	Redear Sunfish		3	21		1	2						3	3		1	
	Lepomis miniatus	Redspotted Sunfish																
	Lepomis sp.															11		
	Micropterus punctulatus	Spotted Bass																
	Micropterus salmoides	Largemouth Bass	1	34	1	17	13	1		1	10	2	1	55	11	9	13	1
	Micropterus treculii	Guadalupe Bass	20			29			1			1			24	2		
	Pomoxis annularis	White Crappie						3									8	105
	Pomoxis nigromaculatus	Black Crappie																
Percidae	*Etheostoma gracile*	Slough Darter															3	
	Etheostoma pulchellum	Plains Orangethroat Darter	16	2	10	35	8	4	1	4	1	1	4	21	4			
	Percina carbonaria	Texas Logperch						3										
	Percina macrolepida	Bigscale Logperch															1	
	Percina macrolepida x carbonaria	Bigscale Logperch x Texas Logperch																
	Percina sciera	Dusky Darter	4						5									
Sciaenidae	*Aplodinotus grunniens*	Freshwater Drum						7										
Cichlidae	*Herichthys cyanoguttatus*	Rio Grande Cichlid													27			
		Number of individuals	**153**	**171**	**263**	**325**	**109**	**285**	**140**	**207**	**112**	**76**	**935**	**215**	**526**	**654**	**180**	**393**
		Number of species	**14**	**10**	**8**	**14**	**8**	**19**	**12**	**10**	**8**	**16**	**10**	**12**	**21**	**14**	**14**	**13**

TABLE 8.—Fish species and counts for supplemental collection sites 49-63 in the Little River Basin - Bell and Milam County, TX: 49. Brushy Creek at FM 908 (7/17/2018), 50. Little River at Sunshine Rd (6/6/2018), 51. Little River at FM 437 (5/9/2018), 52. Little River at FM 486, isolated channel (4/26/2018), 53. Little River at FM 486 (4/26/2018), 54. Little River at US 77 (7/17/2018), 55. Big Elm Creek at FM 438 (5/9/2018), 56. Big Elm Creek at FM 191 (4/26/2018), 57. Big Elm Creek at US 77 (5/10/2018), 58. Big Elm Creek at CR 240 (4/26/2018), 59. Knob Creek at Reed Cemetery Rd (6/6/2018), 60. Little Elm Creek at Seaton Rd (5/9/2018), 61. Donahoe Creek at FM 437 (4/26/2018), 62. Sandy Creek at US 77 (5/10/2018), 63. Pin Oak Creek at FM 2095 (5/10/2018).

Family	Scientific Name	Common Name	Site														
			49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar													1		
	Lepisosteus osseus	Longnose Gar	1		1	1	1	1							2		
Clupeidae	*Dorosoma cepedianum*	Gizzard Shad		1	2	1	2	5		1	1	2	2		1	2	
	Dorosoma petenense	Threadfin shad															
Cyprinidae	*Campostoma anomalum*	Central Stoneroller		6	7				55				8		16		
	Cyprinella lutrensis	Red Shiner	73	779	957	18	121	1134		11	181	889	178	2	15		51
	Cyprinella lutrensis x venusta	Red Shiner x Blacktail Shiner													2		
	Cyprinella venusta	Blacktail Shiner	7	184	265		24	4	83	79	46	57	88	27	111		113
	Cyprinus carpio	Common Carp													1		
	Macrhybopsis hyostoma	Shoal Chub					1	19									
	Notemigonus crysoleucas	Golden Shiner														3	7
	Notropis buchanani	Ghost Shiner		91	141	9	16	62			28	202	5				
	Notropis shumardi	Silverband Shiner						8				7					
	Notropis volucellus	Mimic Shiner		37	13	3			112	66		2		4	192		31
	Pimephales vigilax	Bullhead Minnow	14	176	67	7	9	594	20	8	44	125	75	2	15		30
Catostomidae	*Carpiodes carpio*	River Carpsucker						14				1					8
	Ictiobus bubalus	Smallmouth Buffalo															
	Moxostoma congestum	Gray Redhorse		2	3		1	1	1						5		
Characidae	*Astyanax mexicanus*	Mexican Tetra															
Ictaluridae	*Ameiurus melas*	Black Bullhead															
	Ameiurus natalis	Yellow Bullhead															
	Ictalurus furcatus	Blue Catfish															
	Ictalurus punctatus	Channel Catfish	5		1		2	11	1	1							2
	Noturus gyrinus	Tadpole Madtom								2							
	Pylodictis olivaris	Flathead Catfish	1				1				1						
Atherinopsidae	*Labidesthes sicculus*	Brook Silverside										1					
	Menidia beryllina	Inland Silverside	1														
Fundulidae	*Fundulus notatus*	Blackstripe Topminnow															
Poeciliidae	*Gambusia affinis*	Western Mosquitofish		9	102	17	2	55	16	26	13	34	485	7	22	15	18
	Poecilia latipinna	Sailfin Molly															
Moronidae	*Morone chrysops*	White Bass						1									
Centrarchidae						5											
	Lepomis auritus	Redbreast Sunfish															
	Lepomis cyanellus	Green Sunfish			1		1				3	13	5	3		3	

TABLE 8.—Continued.

Family	Scientific Name	Common Name	Site														
			49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
	Lepomis gulosus	Warmouth				1							1			18	
	Lepomis humilis	Orangespotted Sunfish				22		1		1		4				1	
	Lepomis hybrid	Hybrid Sunfish															
	Lepomis macrochirus	Bluegill		1	3	26	1		1	5	1	3	12	1	16	18	23
	Lepomis megalotis	Longear Sunfish	1	15	17	8	1	3	25	9	5	34	32	10	43	4	38
	Lepomis microlophus	Redear Sunfish							1								
	Lepomis miniatus	Redspotted Sunfish															
	Lepomis sp.							14					8				
	Micropterus punctulatus	Spotted Bass			2				9						5		12
	Micropterus salmoides	Largemouth Bass		1				2					11		1		1
	Micropterus treculii	Guadalupe Bass	1	18	1			16				1					
	Pomoxis annularis	White Crappie				2	1					1					
	Pomoxis nigromaculatus	Black Crappie															
Percidae	*Etheostoma gracile*	Slough Darter				9				5		12		4		1	
	Etheostoma pulchellum	Plains Orangethroat Darter			2										18	21	
	Percina carbonaria	Texas Logperch				2											
	Percina macrolepida	Bigscale Logperch															
	Percina macrolepida x carbonaria	Bigscale Logperch x Texas Logperch															
	Percina sciera	Dusky Darter	4		8		2	2		6		5			8		2
Sciaenidae	*Aplodinotus grunniens*	Freshwater Drum										1					
Cichlidae	*Herichthys cyanoguttatus*	Rio Grande Cichlid															
		Number of individuals	**108**	**1320**	**1593**	**131**	**186**	**1947**	**324**	**220**	**323**	**1394**	**910**	**60**	**474**	**86**	**336**
		Number of species	**10**	**13**	**18**	**14**	**16**	**18**	**11**	**13**	**10**	**19**	**12**	**9**	**17**	**10**	**13**

MUSSEL ASSEMBLAGE

Methods: Mussels were surveyed at the two bioassessment sites within the Little River watershed (FIGURE 1) using timed snorkel or tactile searches in all available mesohabitat types (Strayer and Smith 2003) at each site for a minimum of two person-hour. All live mussels encountered during timed searches were enumerated and returned to the habitat in which they were found. Mussel shells that were encountered during surveys were also noted. Historical data were pulled for comparison from Mussels of Texas for each subwatershed where the bioassessment sites were located (Randklev et al. 2020).

Results and Discussion: Sampling effort for this survey totaled four person-hours of total search time (2 person-hours at site A and 2 person-hours at site B) with two live mussels collected representing only one species, Paper Pondshell *Utterbackia imbecilis* (TABLE 9). Suitable mussel habitat was present within the South Brushy Creek sampling site (site A), although there was no evidence of long-dead/sub-fossil shell of other mussel species present to indicate mussels have previously occurred besides Paper Pondshell. Suitable mussel habitat was lacking at the San Gabriel River sampling site (site B) given the majority of the site was bedrock. Additionally, no long-dead/sub-fossil shells were found at the site to indicate mussels have previously been present at the site as well.

Based on historical collections, 16 species of mussels are known from the Little River watershed (TABLE 9; Randklev et al. 2020) including two federally listed species (Balcones Spike and Texas Fawnsfoot) and a state-listed species (Brazos Heelsplitter). In general, mussel diversity and abundance increase with increasing distance from the headwaters. Given that our sampling sites were located higher in the watershed, low diversity and abundance of mussels was expected. Although only Paper Pondshell—a habitat generalist—were collected in our sampling efforts, the Little River watershed is an important mussel diversity hotspot within the Brazos River basin and protection of these headwater systems can help maintain and/or improve habitat quality for mussels lower in the watershed.

TABLE 9.—Mussel species historically known from South Brushy Creek and the San Gabriel River (Randklev et al. 2020) with number of live mussels collected at both bioassessment study sites. Species of Greatest Conservation Need with asterisk.

Common Name	Scientific Name	South Brushy Creek		San Gabriel River	
		Historical	Site A	Historical	Site B
Threeridge	*Amblema plicata*	X		X	
Pimpleback*	*Cyclonaias pustulosa*	X		X	
Tampico Pearlymussel*	*Cyrtonaias tampicoensis*	X		X	
Balcones Spike*[FE]	*Fusconaia iheringi*	X		X	
Louisiana Fatmucket*	*Lampsilis hydiana*	X			
Yellow Sandshell	*Lampsilis teres*	X		X	
Fragile Papershell	*Leptodea fragilis*	X		X	
Bleufer	*Potamilus purpuratus*			X	
Brazos Heelsplitter*[ST]	*Potamilus streckersoni*	X			
Giant Floater	*Pyganodon grandis*			X	
Mapleleaf*	*Quadrula quadrula*	X		X	
Texas Lilliput	*Toxolasma texasiense*			X	
Pistolgrip*	*Tritogonia verrucosa*	X		X	
Texas Fawnsfoot*[FT]	*Truncilla macrodon*	X			
Pondhorn	*Uniomerus tetralasmus*	X			
Paper Pondshell	*Utterbackia imbecillis*	X	2	X	

[FE] Federally Endangered; [FT] Federally Threatened; [ST] State Threatened

BENTHIC MACROINVERTEBRATE ASSEMBLAGE

Methods: Aquatic macroinvertebrates were collected from two bioassessment study sites on South Brushy Creek (Site A) and the San Gabriel River (Site B) (FIGURE 1). Macroinvertebrates were collected with a Hess sampler following the TCEQ surface water quality monitoring procedures (TCEQ 2014a). Three samples from each site were collected, preserved in 70% ethanol, and later sorted and identified in the laboratory to the lowest possible taxonomic level (typically to genus; Merritt et al. 2019).

Macroinvertebrate taxa diversity was described with Shannon's diversity index (Shannon and Weaver 1949) and Pielou's evenness index (Pielou 1966). Macroinvertebrate communities were assessed using a regionalized Benthic Index of Biotic Integrity (BIBI) developed for Hess and Surber samples for the Central bioregion (Ecoregions 30 and 32; TCEQ 2014). Data from the three samples from each site were summed to calculate a BIBI score for each site. The BIBI was developed using 12 metrices that take into consideration various traits (e.g., feeding guild, tolerance values) and abundances of the macroinvertebrates. The dominant taxa metric considers the taxa with the greatest diversity within it (e.g., order with most number of families). Stream condition was assessed using the Hilsenhoff biotic index (HBI, Hilsenhoff 1987). This index is based on the aquatic macroinvertebrate taxa's pollution index, where average HBI value >4 is poor, average HBI value between 4-3.5 is moderate, and the average HBI value <3.5 is good. The 'EPT' (Ephemeroptera, Plecoptera, and Trichoptera) to total ratio estimates the water quality by comparing relative abundance of three major macroinvertebrate orders with low tolerance to water pollution to total number of orders collected. Ratio values below 25% are poor, values between 25-50% are moderate, and 50% or greater are good. Benthic macroinvertebrate data were gathered for comparison from the same two TCEQ Surface Water Quality Monitoring stations where historical fish data were collected. Collections occurred at the same time that fish were collected (TCEQ 2018).

Results and Discussion: Aquatic macroinvertebrates from the two sampling sites in the Little River watershed were represented by 11 orders, 29 families, and 42 genera, with a total of 6,085 individuals collected (TABLE 11). The top three most abundant taxa at both the sites were Coleoptera, Trichoptera, and Ephemeroptera, in that order. Site A on South Brushy Creek produced slightly fewer taxa than site B on the San Gabriel River (32 vs 34 genera). In spite of the two sites falling in separate ecoregions and the visible differences in habitat structure, taxa diversity did not differ greatly as seen in the Shannon's diversity index and Peilou's evenness index (TABLE 11).

The BIBI score for South Brushy Creek was 35 which put it in the High ALU category, and the BIBI score for the San Gabriel River was 41 which scored in the Exceptional ALU category (TABLE 10). The metrics that contributed most to differences between the bioassessment sites were associated with indicator taxa composition including percent EPT taxa (Site A: 62% vs Site B: 32% respectively), percent Chironomidae (A: 14.5% vs B: 1% respectively), and trophic functional composition as seen in percent grazers (A: 7.4% vs B: 32.7% respectively) and percent filterers (A: 54% vs B: 1.5% respectively). Pollution-tolerant taxa, Chironomidae, were collected in greater numbers at South Brushy Creek compared to the San Gabriel River (TABLE 10), which is in contrast to higher numbers of pollution-intolerant *Chimarra* collected at the same site (Chang et al. 2014, TCEQ 2014). In a riverine system, trophic groups are influenced by the status of environmental conditions such as depth, velocity, substrate

composition, riparian vegetation, etc. (Hynes, 1970) and, in addition, are sensitive to both natural and anthropogenic disturbances (Merritt et al. 2019, Vannote et al. 1980). A lower percentage of filterer taxa were collected at site B which could be a result of altered habitat and/or poorer water quality downstream of the city of Georgetown since they are more sensitive to pollution (Wallace et al. 1977). The collector/grazer trophic guild was much higher at this site which is an indicator of higher organic content in the water (Camargo et al. 2004).

TABLE 10.—Benthic index of biotic integrity scores from both bioassessment sites in the Little River watershed, May 2018.

		Site A: *South Brushy Creek*		**Site B:** *San Gabriel River*	
	Metric Category	**Value**	**Score**	**Value**	**Score**
Taxa Richness and Composition	Total Taxa	32	3	34	5
	Diptera Taxa	4	3	3	1
	Ephemeroptera Taxa	6	5	6	5
Indicator Taxa Composition	Intolerant Taxa	20	5	23	5
	% EPT Taxa	61.72	5	32.01	5
	% Chironomidae	14.49	3	1.10	3
	% Tolerant Taxa	74.57	1	64.71	1
Trophic Composition	% Grazers	7.37	1	32.69	5
	% Gatherers	23.46	5	23.82	5
	% Filterers	53.96	3	1.47	1
Taxa Abundance Condition	% Dominance (3 taxa)	71.74	1	39.35	5
	Total Score	–	**35**	–	**41**
	Aquatic Life Use	–	**High**	–	**Exceptional**

Historical data from both TCEQ monitoring stations in the Little River watershed were similar to our observations during this study. Compared to the past collections, five unique mayfly genera (*Acentrella*, *Caenis*, *Vacupernius*, *Neochoroterpes*, and *Thraulodes*), two unique dragonfly genera (*Erpetogomphus* and *Stylurus*), and one new caddisfly (*Ithytrichia*) genus were collected during this study. Unique taxa collected in the past samples that we did not collect include several mayflies (*Baetodes* and *Leptohyphes*), dragonflies (*Brechmorhoga* and *Erythemis*), a caddisfly (*Nectopsyche*), and a true fly (*Hemerodromia*). Differences in community composition could be due to interannual variation and seasonality.

In conclusion, overall macroinvertebrate community composition at the two sites was quite diverse and stream condition and water quality appear to be in good condition based on HBI and BIBI scores.

TABLE 11.—Benthic macroinvertebrates with their associated abundances and trophic guilds collected with a Hess sampler from both bioassessment sites on the Little River Watershed in May 2018. Taxa collected at each site were summed. Trophic guilds are abbreviated: collector gatherer (CG), filtering collector (FC), predator (P), scraper (SCR), and shredder (SHR). Species collected during TCEQ monitoring events are noted with an 'X'; taxa with an asterix denote unique historic collections that were not collected in this sampling event.

				Site A: *South Brushy Creek*		**Site B:** *San Gabriel River*	
Order	**Family**	**Genus**	**Trophic Guild**	Historical	Current	Historical	Current
Amphipoda	Taltridae	*Hyalella*	CG/SHR		270	X	1,359
Arguloida	Argulidae	*Argulus*	P		1		
Coleoptera	Dryopidae	*Helichus*	SCR/CG			X	2
	Elmidae	*Dubiraphia*	SCR/CG				1
		Hexacylloepus	SCR/CG	X	2	X	8
		Macrelmis	SCR/CG	X	23	X	55
		Microcylloepus	SCR/CG	X	21	X	24
		Neoelmis	SCR/CG	X		X	13
		Stenelmis	SCR/CG	X	164	X	165
	Hydrophilidae	*Berosus*	P			X	3
	Lutrochidae	*Lutrochus*					1
	Psephenidae	*Psephenus*	SCR	X	27		1
Diptera	Chironomidae		P/CG/FC	X	343	X	41
	Empididae	*Hemerodromia**	P/CG			X	
	Simuliidae		FC	X	1	X	7
	Stratiomyidae	*Euparyphus*	SCR/CG		1		
		Odontomyia/Hedriodiscus	CG				2
	Ceratopogonidae		P		1		
Ephemeroptera	Baetidae	*Acentrella*	SCR/CG				2
		*Baetodes**	SCR	X			
		Camelobaetidius	SCR/CG	X		X	3
		Fallceon	SCR/CG	X	4	X	34
	Caenidae	*Caenis*	CG/SCR		2		
	Leptohyphidae	*Vacupernius*	CG		11		4
		*Leptohyphes**	CG			X	
	Leptophlebiidae	*Neochoroterpes*	CG/SCR		1		3
		Thraulodes	CG/SCR		1		
	Tricorythidae	*Tricorythodes*	CG	X	185	X	29
Hemiptera	Naucoridae	*Ambrysus*	P	X	1	X	27

TABLE 11.—Continued.

Order	Family	Genus	Trophic Guild	Site A: *South Brushy Creek*		Site B: *San Gabriel River*	
				Historical	Current	Historical	Current
Hirudinea			P		6		510
Lepidoptera	Pyralidae	*Petrophila*	SCR	X	15		4
Odonata	Calopterygidae	*Hetaerina*	P	X	16		
	Coenagrionidae	*Argia*	P	X	8	X	1
	Gomphidae	*Erpetogomphus*	P				1
		Stylurus	P		1		
	Libellulidae	*Brechmorhoga**	P	X			
		*Erythemis**	P			X	
Planariidae	Dugesiidae	*Dugesia*	P		5		303
Trichoptera	Helicopsychidae	*Helicopsyche*	SCR	X	20		1,044
	Hydropsychidae	*Cheumatopsyche*	FC	X	951	X	22
		Hydropsyche	FC	X	30	X	8
		Smicridea	FC	X	2		
	Hydroptilidae	*Hydroptila*	SCR		3	X	11
		Ithytrichia	SCR				1
	Leptoceridae	*Oecetis*	P/SHR		2	X	9
		*Nectopsyche**	SHR/CG/P	X			
	Odontoceridae	*Marilia*	SHR	X	70		16
	Philopotamidae	*Chimarra*	FC	X	179	X	4
		Number of individuals		–	**2,367**	–	**3,718**
		Number of taxa		–	**32**	–	**34**
		Shannon's Species Diversity		–	**2.02**	–	**1.81**
		Pielou's Species Evenness		–	**0.58**	–	**0.51**

CRAYFISH

Methods: Crayfish were not specifically targeted during this assessment; however, all crayfish collected were photographed and placed on the website iNaturalist (http://www.inaturalist.org/) for species identification and verification.

Results and Discussion: Four species of crayfish were collected from 38 sites during this study (TABLE 12; FIGURE 7). Red Swamp Crayfish *Procambarus clarkii* was the most common species collected and was found at 23 sites. All four crayfish have a NatureServe conservation status of G5, meaning the species are secure due to a large geographic range and common occurrence throughout that range (NatureServe 2019). Virile Crayfish *Faxonius virilis* was reclassified from the cave dwelling genus Oronectes to the genus Faxonius in 2017 (Crandall and De Grave 2017). This species is considered non-native in most parts of Texas aside from several drainages in northeast Texas including the Red River and upper Trinity River (D. Johnson, pers. comm.).

TABLE 12.—Species of crayfish encountered during fish sampling from March-July of 2018 as part of the Little River Basin bioassessment and the site numbers where each species were collected. See TABLE 1 for site information.

Scientific Name	Common Name	Sites	# of Sites
Faxonius virilis	Virile Crayfish	B, 7, 37, 41-44	7
Procambarus acutus	White River Crayfish	2, 62	2
Procambarus clarkii	Red Swamp Crayfish	A, 8, 9, 13, 24, 28-33, 35, 43-45, 52, 55, 56, 58-61, 63	23
Procambarus simulans	Southern Plains Crayfish	1, 2, 11, 16-18, 20, 23, 57, 62	10
Total:	**4 species**	**38 unique sites**	–

FIGURE 7.—Photos documenting each crayfish species collected during the Little River bioassessment from March-July of 2018, from left to right, top to bottom: Virile Crayfish, White River Crayfish, Red Swamp Crayfish, and Southern Plains Crayfish.

IMPERILED SPECIES

Two species of fishes classified as SGCN during the survey period were collected during this study: Silverband Shiner (NatureServe Global Conservation Status: G5 – Secure; NatureServe 2019) and Guadalupe Bass (G3 – Vulnerable; TABLE 5-TABLE 8; FIGURE 8). Silverband Shiner had a limited distribution and was collected at only two sites, Site 54 at the Little River at US 77 and Site 58 at Big Elm Creek at CR 240, which both occur in the lower reaches of the watershed near the confluence with the Brazos River. Guadalupe Bass was more widespread throughout the system and was found at 15 sites including both bioassessment sites. Shoal Chub, which was found at two downstream Little River mainstem sites (sites 53 and 54), was added as a SGCN in 2020 (TPWD 2023; FIGURE 8).

Silverband Shiner and Shoal Chub are broadcast-spawning minnows with similar life history strategies. They inhabit mainstem rivers and large tributaries with extensive stretches of continuous flow, such as the Little River and Big Elm Creek, which they utilize for reproduction (Gilbert and Bailey 1962; Eisenhour 2004). These minnows face current threats including habitat loss, a reduction of natural flow regime, and habitat fragmentation. Both species have shown population declines and local extirpations within their historic ranges (Cohen et al. 2018; Luttrell et al. 1999).

Four additional SGCN fishes previously documented in the basin that were not collected during this study are Smalleye Shiner (G2 – Imperiled), Chub Shiner (G4 – Apparently Secure), Pallid Shiner (G4 – Apparently Secure), and Mountain Mullet (G5 – Secure). All species are known from a single occurrence record (or two for Mountain Mullet) in the Little River watershed with collection dates in 1951 for Smalleye Shiner and 1952 for Chub Shiner and Pallid Shiner (Hendrickson and Cohen 2015).

FIGURE 8.—The three Species of Greatest Conservation Need collected during the Little River Watershed study are Silverband Shiner (top), Guadalupe Bass (bottom-left), and Shoal Chub (bottom-right).

Guadalupe Bass is an Edwards Plateau endemic occurring in portions of the greater Brazos River Basin that make up the most easterly extent of their range. The Little River watershed comprises the bulk of their Brazos range with the vast majority of occurrences in the San Gabriel River tributary. Current threats to Guadalupe Bass include habitat loss and fragmentation, reductions in stream flow, and hybridization with non-native Smallmouth Bass (Bean 2017).

In order to assess the status of Guadalupe Bass in the Little River watershed to support TPWD's Guadalupe Bass Restoration Initiative (Birdsong et al. 2019a), fin clip samples of phenotypic *M. treculii* (GB: Guadalupe Bass; n = 93), *M. punctulatus* (SP: Spotted Bass; n = 19), and *M. salmoides* (LM: Largemouth Bass; n = 98) were collected from multiple sites throughout the study area. For all phenotypic GB and SP, isolated DNA was genotyped at 14 species informative Single Nucleotide Polymorphisms (SNPs; assays BBID1 and BBID2). For a subset of LM (n = 16), the same assays were applied. Multi-locus genotypes were then used to assign taxonomic status based on manual inspection for diagnostic alleles and using the Bayesian inference algorithm implemented within STRUCTURE (Pritchard et al. 2000; burn-in 20000, mcmc 250000, admix model, allele freq corr, update allele freq w pop flag = 1, K = 4).

Mean estimated taxa specific allele frequencies among all samples were 68% (GB), 15% (SP), 1% (SM), and 15% (LM) (APPENDIX 1; FIGURE 9). Among phenotypic GB, alleles frequencies were 86%, 8%, 1%, and 4%, respectively. Among phenotypic SP, alleles frequencies were 38%, 62%, 0%, and 1%, respectively. Among phenotypic LM, alleles frequencies were 0%, 0%, 0%, and 100%, respectively. All phenotypic LM also carried LM genotypes and were not evaluated further.

Genotype frequencies indicated 38% of all samples were GB, 3% were SP, 15% were LM, and 44% were hybrids with 7% of hybrids containing genetic material from three taxa (tribrids). Among phenotypic GB, similar frequencies of non-introgressed GB (52%) and hybrids (45%) were observed, with 3% identified as LM. Among the hybrids, most (79%) were identified as SP x GB, 12% were GB x SM, and 9% were tribrids of GB x SP x SM (FIGURE 10), and most alleles were estimated to be from GB (78%). Among phenotypic SP, 21% were identified as non-introgressed SP, and all of these samples were recovered from two sites (FIGURE 10), but most (79%) were SP x GB hybrids (APPENDIX 1) with a majority of their alleles estimated to be from SP (52%). Non-introgressed GB were most prevalent in samples from Brushy Creek and Salado Creek, with most sites exhibiting substantial introgression with SP (FIGURE 10).

Leaving out phenotypic LM, most fish collected were hybrids. Samples identified to species by phenotype were typically hybrids of the described taxon with a majority of their genome derived from the lineage of the described taxon. Results support previous work indicating that non-introgressed GB could be consistently recovered from Brushy Creek, but GB were more difficult to locate in surrounding drainages (TPWD, unpublished data). Results are also consistent with previous work (Lutz-Carrillo et al. 2018) suggesting that the Brazos River drainage is part of a natural hybrid zone between Spotted and Guadalupe Bass.

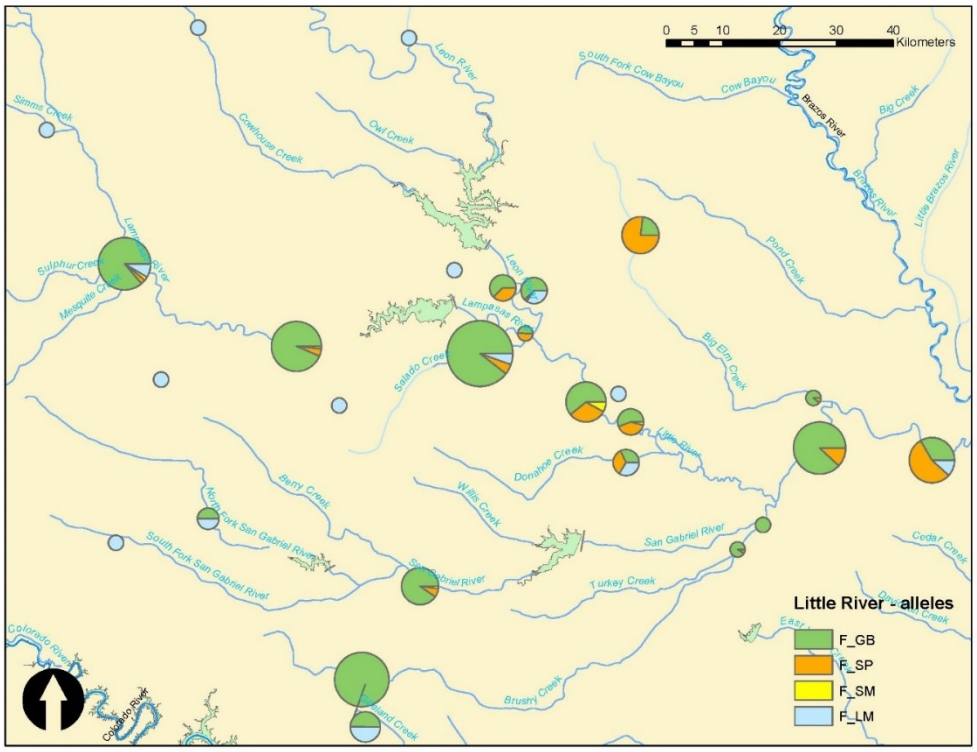

FIGURE 9.—Taxa specific allele frequencies in collections of micropterids from the Little River watershed. Graphs are scaled by sample size.

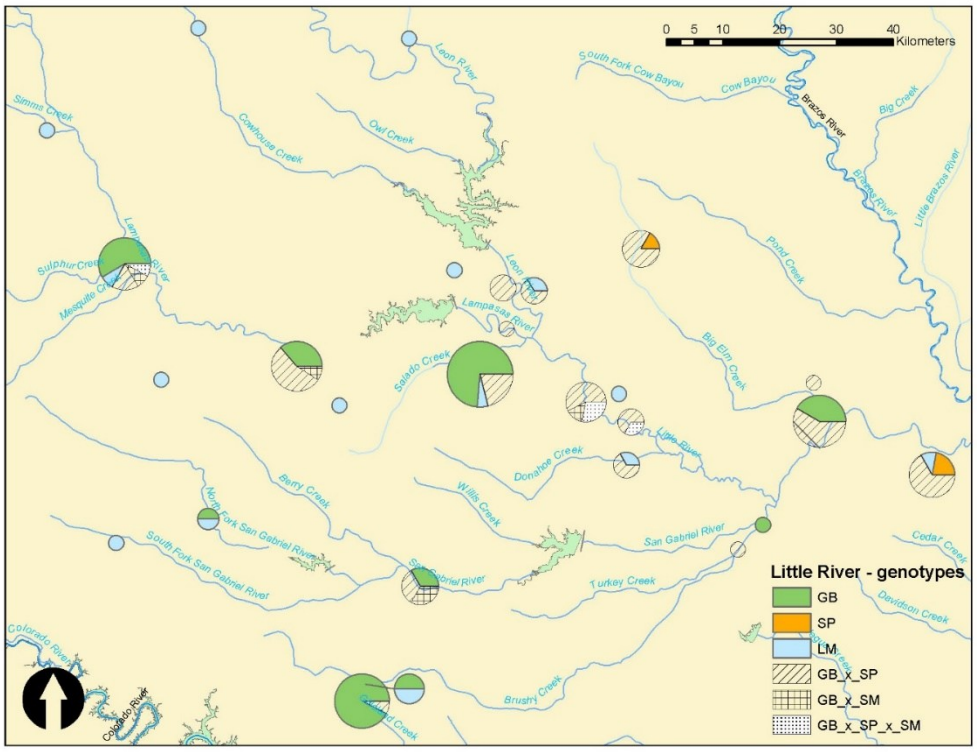

FIGURE 10.—Genotype frequencies in collections of micropterids from the Little River watershed. Graphs are scaled by sample size.

Although they were not collected during this study, two federally listed mussel species (Balcones Spike and Texas Fawnsfoot) and one state listed species (Brazos Heelsplitter) have been documented in the Little River watershed (Randklev et al. 2011; 2017; 2020). Balcones Spike, recently split from False Spike (Smith et al. 2021) is one of the rarest listed mussel species, which was thought to have been extinct up until its recent rediscovery in 2011 (Randklev et al. 2011). Balcones Spike is historically distributed throughout the Colorado and Brazos river basins. The species is currently restricted to the Little River watershed within the Brazos River basin and to the Llano and San Saba Rivers within the Colorado River basin (Randklev et al. 2023). The Little River watershed is the smallest watershed compared to the watersheds of the Colorado River basin populations and may also have the smallest populations of Balcones Spike (Randklev et al. 2013). Balcones Spike has been recently collected live in lower Brushy Creek and the San Gabriel River below Granger Lake (Randklev et al. 2017), as well as in the Little River (TPWD unpublished data). Texas Fawnsfoot are distributed throughout the Colorado, Brazos, and Trinity river watersheds. Texas Fawnsfoot have been recently collected in the Little River watershed, including Brushy Creek, the San Gabriel River, and the Little River (Randklev et al. 2017, TPWD unpublished data). Brazos Heelsplitter, a Brazos River endemic, has recently been collected live in lower Brushy Creek and the Little River (Randklev et al. 2023).

RIPARIAN AND STREAM HEALTH

Properly functioning riparian areas are essential to the health of river ecosystems. They provide shade, which reduces water temperature and helps maintain dissolved oxygen levels for aquatic life use; armor banks and prevent erosion; slow floodwaters; and trap and hold new sediments, which store water in the banks and slowly release water back into the river during times of drought (Nelle 2014).

Methods: An assessment of riparian functional condition was conducted for the study area utilizing the Riparian Bull's-Eye Evaluation described in Your Remarkable Riparian, Third Edition (Nueces River Authority 2016). This evaluation tool utilizes ten metrics that serve as indicators to riparian functional condition: 1. Active Floodplain, 2. Energy Dissipation, 3. New Plant Colonization, 4. Stabilizing Vegetation, 5. Age Diversity, 6. Species Diversity, 7. Plant Vigor, 8. Water Storage, 9. Bank/Channel Erosion, and 10. Sediment Deposition (TABLE 13).

To evaluate the riparian area at Site A on South Brushy Creek and Site B on the San Gabriel River, each respective riparian area was walked and answers to the above indicators were placed in one of three Riparian Bull's-Eye Evaluation zones: Outer Zone (Poor, Dysfunctional Condition); Mid Zone (At-Risk Condition); or Bull's-Eye (High Functional Condition). Given the subjective nature of scoring, two researchers evaluated the study reach in tandem and discussed their observations before a score was assigned. Scores for each riparian indicator for both bioassessment sites are in TABLE 14.

Results and Discussion: The riparian scores for Site A on South Brushy Creek indicated that the riparian area is functioning at a High Functional Condition (Bull's-Eye; TABLE 14). Only two metrics, 'water storage' and 'sediment deposition', scored in the Mid Zone (At-Risk Condition). For the 'Water Storage' metric, there were several obligate (OBL) and facultative wet (FACW) plant species present, but they did

not extend far out into the floodplain in places, indicating that water is not being stored very far from the edge of the water. As they expand further back on the floodplain, it will indicate more water being stored and this metric could trend to the Bull's-Eye condition. The 'Sediment Deposition' metric scored in the Mid Zone due to the presence of some mid-channel bars. Otherwise, sediment was deposited where it should be, on point-bars. Additionally, the 'Stabilizing Vegetation' metric scored in the Bull's-Eye condition due to the presence of vegetation covering the banks. However, in some open areas, plants with higher stability ratings will need to colonize the banks to keep this metric from trending to the Mid Zone (At-Risk) condition. One other metric that could trend from Bull's-Eye to At-Risk is the 'Species Diversity' metric. While there were more than five different species of native riparian woody and herbaceous plants present, if the larger invasive woody plants growing within this reach (e.g., Chinese Tallow Tree *Sapium sebiferum* and Chinaberry *Melia azedarach*) are given the opportunity to take over, species diversity could be reduced.

Overall, the riparian area of South Brushy Creek as it flowed through Champion Park was functioning well. There was an abundance of age classes of riparian plants, and plants appeared healthy. The lack of mowing, weed eating, and foot traffic in the riparian area should be commended as it has allowed a thick, diversely vegetated understory to develop, increasing the stability and function of the system. The presence of large rock, roots, and woody debris is enhancing stream habitat complexity and stream stability as the wood becomes embedded in the banks and streambed.

The riparian scores for Site B on the San Gabriel River indicated that the riparian area along this study reach is functioning at a Mid Zone (At-Risk condition; TABLE 14). One metric, 'Plant Vigor', scored in the Bull's-Eye due to the abundance of healthy, vigorous riparian plants. There was little to no sign of browsing, weed-eating, mowing, or trampling, allowing for robust, healthy plant growth of both woody and herbaceous species. The other metrics all scored in the Mid Zone (At-Risk) due to the lack of access of floodwaters to the floodplain; a lack of energy dissipating features; only some new plant colonization on fresh sediment, many of which were invasive species; there were some gaps of vegetation present along the banks, some of which lacked sufficient stability ratings; a modest, rather than high, species diversity (only 3-4 species of native riparian woody and/or grass and sedge species were present); only a few obligate (OBL) and facultative wet (FACW) species were present, and only along the water's edge; there was widespread bank erosion not balanced by point bar deposition; and there was some excessive sediment deposition, i.e. the presence of some mid-channel bars, but otherwise sediment was deposited where it should be, on point bars.

Overall, the riparian area of the San Gabriel River at CR 100 is providing for some function but is At-Risk. Over time, if riparian vegetation is permitted to continue to grow and colonize freshly deposited sediment, more sediment will be trapped by that vegetation, and the riparian area will gradually widen. This will in turn allow for the streambed to narrow, and the water stored in the sediment along the banks will return water to the stream over a longer period of time, potentially improving base flow. As the streambed narrows, the width to depth ratio of the stream will improve, allowing for a better ability of the stream to move sediment through the system rather than piling up in mid-channel bars.

TABLE 13.—Riparian Indicators used in scoring the Riparian Bull's Eye Evaluation Assessment Tool, derived from the "Your Remarkable Riparian Field Guide" (Nueces River Authority, 2016).

RIPARIAN INDICATORS	**OUTER ZONE** Poor, Dysfunctional Condition	**MID ZONE** At-Risk Condition	**BULL'S EYE** High Functional Condition
1. Active Floodplain *Does floodwater have access to a floodplain?*	**Limited or no apparent floodplain** where floodwater can spread out and slow down.	**Floodplain too far above channel** to be very effective.	**Floodplain clearly defined**, allowing for floodwater to overflow channel, spread out, and slow down.
2. Energy Dissipation *Is there enough "stuff" in channels, on banks and in the floodplain to dissipate flood energy?*	**Not many energy dissipating features** in the channel, on the banks, or in the floodplain.	**Only some** energy dissipating features present.	**Abundance** of energy dissipaters present in the channel, on the banks, and in the floodplain.
3. New Plant Colonization *Are new plants successfully colonizing on fresh sediment?*	**Not much colonization**; sediment deposits and point bars are bare.	**Only some** new plant colonization are on fresh sediment.	**Abundance** of new plants colonizing on fresh sediment.
4. Stabilizing Vegetation *Are banks covered with strong stabilizing plants- those with a stability rating (SR) of 6 or greater?*	**Not much** of bank is covered with stabilizing vegetation and tree roots.	**Some gaps present** and/or some vegetation lacks sufficient stability rating.	**Banks covered** with stabilizing vegetation.
5. Age Diversity *Are young, middle-aged and mature riparian plants present?*	**Few to no** young and middle-age trees, shrubs, riparian grasses, or sedges.	**Only a few** young and/or middle-aged riparian plants present.	In addition to older riparian plants, **young and middle-aged plants are abundant**.
6. Species Diversity *Are several key, native riparian plant species present?*	**No or low diversity**; Only 1-2 native species of riparian trees, shrubs, and/or only 1-2 grasses and sedges.	**Modest diversity**; 3-4 species of native riparian trees, shrubs, and/or 3-4 grasses and sedges.	**More than** 5 different species of native riparian trees, shrubs, and/or more than 5 species of grasses and sedges.
7. Plant Vigor *Are riparian plants vigorous and healthy?*	**Unhealthy riparian plants**. Woody plants and sedges show signs of heavy or chronic browsing; a severe browse line can be noted. Riparian grasses and sedges compromised by grazing, mowing, or trampling.	**Low vigor**: Woody plants show signs of heavy browsing or hedging; a browse line may be present. Grasses and sedges show signs of heavy use, grazing, mowing, or trampling, only in places.	**Healthy, vigorous riparian plants**. Wood plants show little or no sign of heavy browsing or hedging. Grasses and sedges show little or no sign of heavy grazing, mowing, trampling, or other impairments.
8. Water Storage *Are the banks and floodplain storing water?*	**No OBL or FACW** species are present, indicating a lack of water being stored in the riparian area.	**Only a few** OBL and FACW plant species present- and only along the stream's edge.	**Several** wetland plant species present- at water's edge and out in the floodplain, too.
9. Bank/Channel Erosion *Are bank and channel erosion balanced with deposition on point bars?*	**Continuous, active and extreme bank erosion** with no apparent balancing by point bar deposition. Channel may appear either too wide or too deep.	**Widespread bank erosion**, beyond meander bends and not balanced by point bar deposition. Channel looks out of balance.	**Light and balanced bank erosion** on meander bends being compensated by deposition on point bars downstream. Channel appears to be of size and depth to manage sediment.
10. Sediment Deposition Is sediment being deposited in a balanced way-on point bars downstream from eroded banks?	**Clearly excessive** amounts of sediment, often in the middle of the channel.	**Some excessive sediment deposition**, some mid-channel bars, but otherwise sediment is where it should be, on point-bars.	**Normal and balanced** sediment deposition.

TABLE 14.—Scores from the South Brushy Creek and San Gabriel River Riparian Bull's Eye Evaluation are marked with an 'X' for each riparian indicator.

	Site A: *South Brushy Creek*			**Site B:** *San Gabriel River*		
RIPARIAN INDICATORS	**OUTER ZONE** Poor, Dysfunctional	**MID ZONE** At-Risk	**BULL'S EYE** High	**OUTER ZONE** Poor, Dysfunctional	**MID ZONE** At-Risk	**BULL'S EYE** High
1. Active Floodplain			X		X	
2. Energy Dissipation			X		X	
3. New Plant Colonization			X		X	
4. Stabilizing Vegetation			X		X	
5. Age Diversity			X		X	
6. Species Diversity			X		X	
7. Plant Vigor			X			X
8. Water Storage		X			X	
9. Bank/Channel Erosion			X		X	
10. Sediment Deposition		X			X	

RECREATIONAL ACCESS

The Little River watershed contains a wide variety of public recreational access opportunities to rivers and streams across the five sub-watersheds within this region (FIGURE 11; FIGURE 12; TABLE 15). Given the size of this watershed and the degree of urbanization, there are many options for access that include public parks and hike & bike trails with easy access points and more developed infrastructure to road crossings and remote public parks with more logistically and physically challenging access that offer more rural options for users. Site conditions within the watershed also vary widely with most wadeable sites occurring in the Lampasas and San Gabriel sub-watersheds and non-wadeable sites occurring in the Leon and Little River sub-watersheds.

Locations highlighted in FIGURE 11, FIGURE 12, and TABLE 15 provide public access for bank and wade fishing; access information specific to fishing opportunities can be found in Reed 2020 along with additional site recommendations. Several of the access points offer additional opportunities for launching canoes, kayaks, and/or small motorized watercraft and some of the sites occur at parks where day use and overnight camping is available. Access points within parks are managed by federal, county, and/or city entities that often provide additional information about the park on their websites. Please verify amenities with the controlling authority before making plans to visit (TABLE 15).

In addition to public parks and road crossings that offer single access points, the Little River watershed is home to multiple hike and bike trails that offer approximately 24 miles of linear access along portions of Nolan Creek, the San Gabriel River, and Brushy Creek as well as several tributaries within these systems (FIGURE 12; TABLE 15). These trails include public parks where users can park to access hike and bike trails. Longitudinal access is a great way to explore these waterways and find additional places to fish and recreate. Please be mindful of private property and make sure access is within public reaches of these systems.

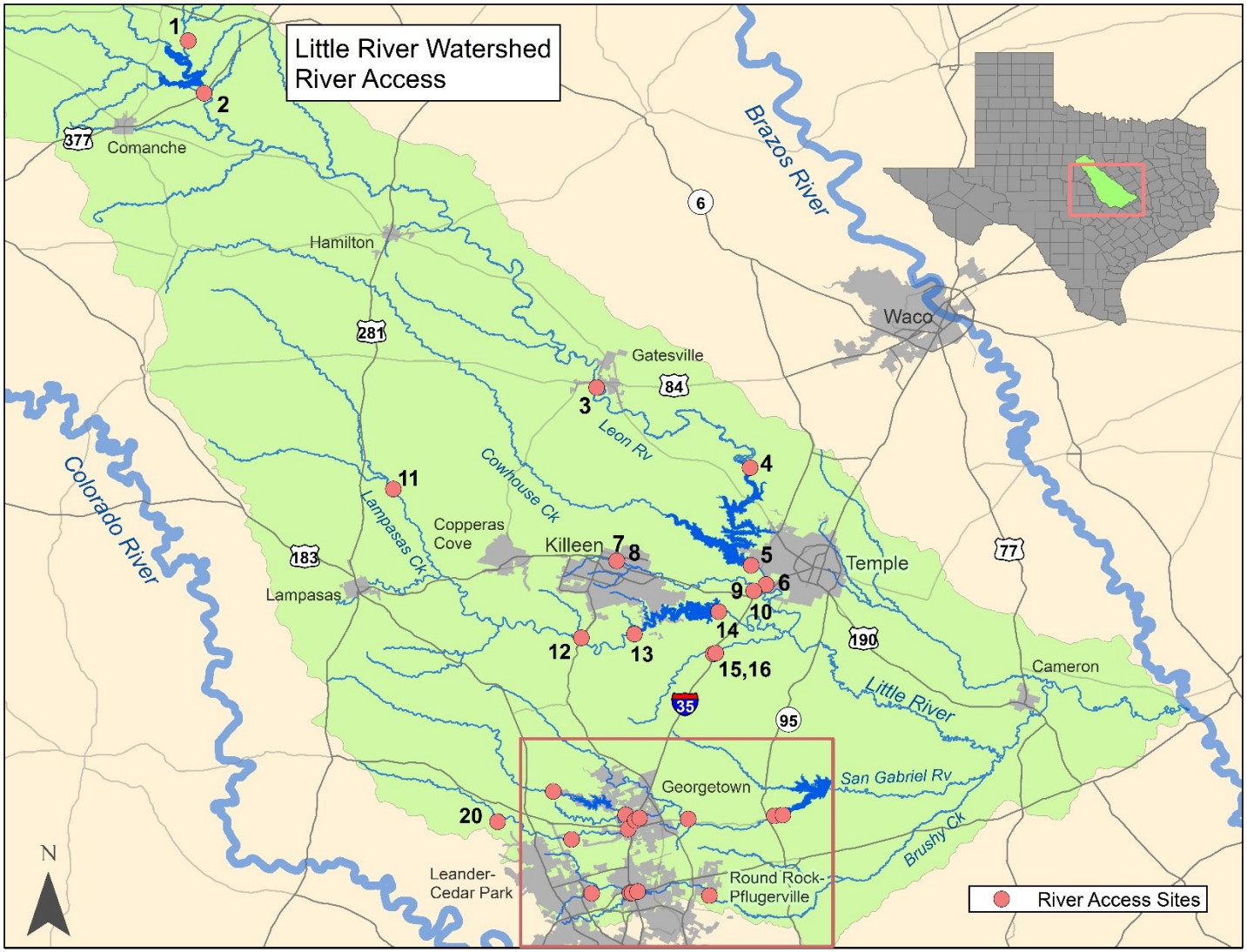

FIGURE 11.—River access locations for public recreational use in the Little River watershed; see FIGURE 12 for Greater Austin Area access locations. Additional information can be found in TABLE 15.

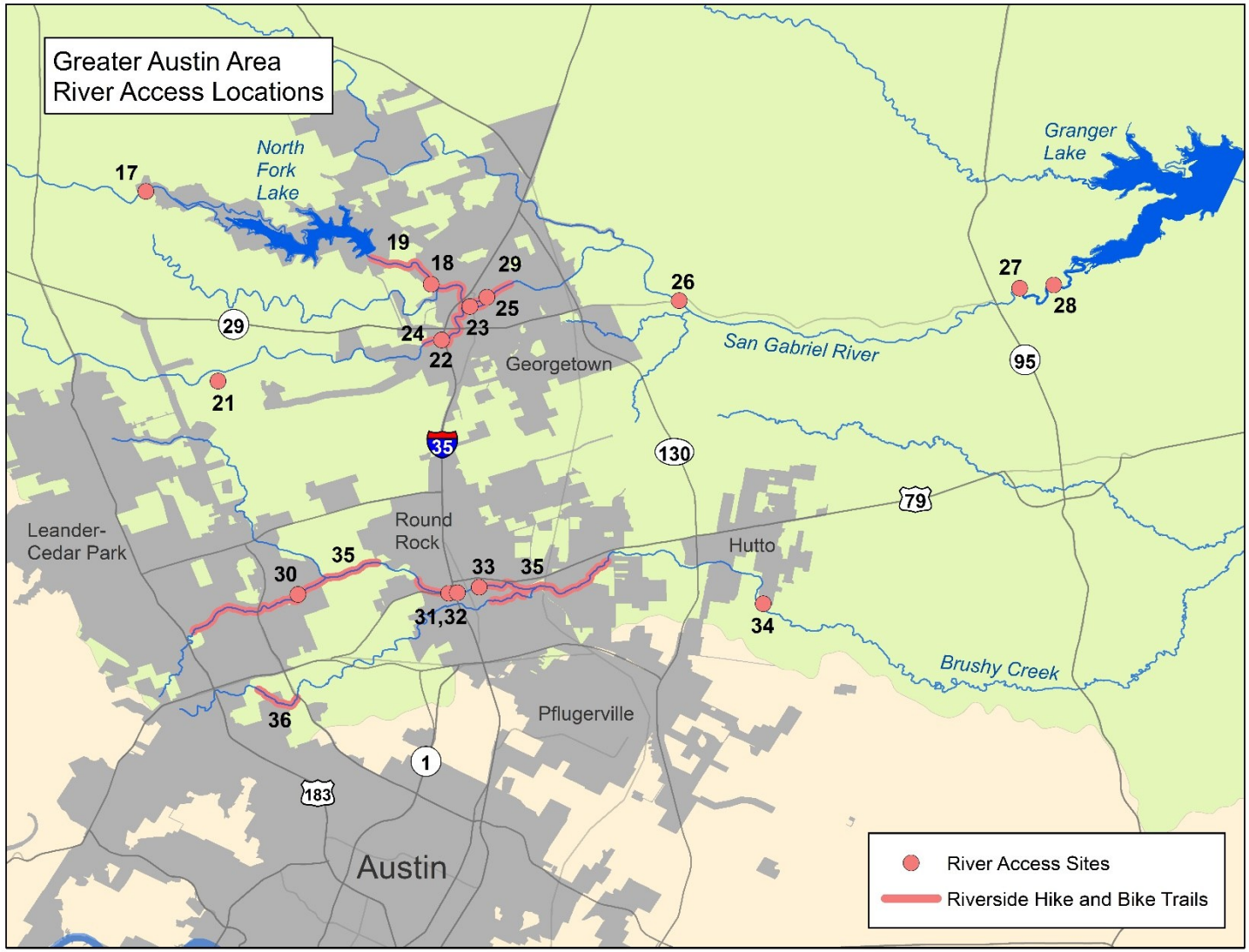

FIGURE 12.—River access locations for public recreational use in the Greater Austin Area; highlighted rivers and streams note riverside hike and bike trails. See TABLE 15 for additional information.

TABLE 15. —List of Little River watershed public river access locations.

Site #	Site Name	Location	Access Fee	Use	Controlling Authority	Comments
			Leon River			
1	Jones Crossing (CR 446)	32.0529, -98.4882	free		Comanche County	dry during periods of no rain; wade only
2	US 377/67	31.9580, -98.4594	free		TxDOT	no ramp; primitive access; bank only
3	Faunt Le Roy Park	31.4256, -97.7497	free		City of Gatesville	steep banks; difficult access; wade only
4	Iron Bridge Park	31.2808, -97.4723	free		USACE	unimproved dirt ramp; deep channel; bank only
5	Miller Spring Park	31.1043, -97.4703	free		City of Belton/USACE	no ramp; must carry vessels
6	Heritage Park	31.0694, -97.4433	free		City of Belton	fishing dock; bank only
			Nolan Creek			
7	Killeen Community Park	31.1123, -97.7133	free		City of Killeen	fishing might be limited
8	Andy K. Wells Hike & Bike Trail		free		City of Killeen	trail on S. Nolan Ck
9	Yetti Polk Park	31.0580, -97.4657	free		City of Belton	community park; shallow water
10	Nolan Creek Hike & Bike Trail		free		City of Belton	trail on Nolan Ck
			Lampasas River			
11	FM 1690	31.2423, -98.1174	free		Lampasas County	primitive access; wade only; Reed 2020
12	TX 195	30.9732, -97.7774	free		TxDOT	primitive access; wade only; Reed 2020
13	Gravel Crossing	30.9799, -97.6814	free		USACE	unimproved dirt ramp; deep channel; bank only
14	Chalk Ridge Falls Park	31.0204, -97.5291	$5/vehicle		USACE	access via trail
			Salado Creek			
15	I-35 at the Stagecoach Inn	30.9441, -97.5391	free		TxDOT	Reed 2020
16	Pace Park	30.9455, -97.5343	free		Village of Salado	community park; shallow water
			North Fork San Gabriel River			
17	Tejas Camp	30.6958, -97.8280	free		USACE	no ramp; Reed 2020
18	Chandler Park	30.6533, -97.6975	free		City of Georgetown	no ramp; Reed 2020
19	Randy Morrow Trail		free		City of Georgetown	trail on NF San Gabriel River
			South Fork San Gabriel River			

Site #	Site Name	Location	Access Fee	Use	Controlling Authority	Comments
20	River Ranch County Park	30.6410, -97.9287	$2-4/per person		Williamson County	1.5 mile hike to river; wade only
21	Garey Park	30.6090, -97.7950	$2-4/per person		City of Georgetown	0.3 mile hike to river; wade only; Reed 2020
22	Wolf Ranch Park	30.6279, -97.6928	free		City of Georgetown	short hike to river; wade only; Reed 2020
23	Blue Hole Park	30.6432, -97.6799	free		City of Georgetown	no ramp; Reed 2020
24	South San Gabriel River Trail		free		City of Georgetown	trail on SF San Gabriel River
			San Gabriel River			
25	San Gabriel Park	30.6474, -97.6721	free		City of Georgetown	must carry vessels; Reed 2020
26	Mankin's Crossing (CR 100)	30.6458, -97.5842	free		Williamson County	no ramp; Reed 2020
27	Dickerson's River Bottom (a.k.a. The Steps)	30.6516, -97.4284	free		USACE	primitive access
28	San Gabriel WMA - Granger Lake	30.6530, -97.4129	free		USACE	kayak/canoe launch; deep channel; bank only
29	San Gabriel River Trail		free		City of Georgetown	trail on San Gabriel River
			Brushy Creek			
30	Champion Park	30.5115, -97.7585	free		Williamson County	short hike to river; wade only; Reed 2020
31	Chisholm Trail Park	30.5121, -97.6895	free		City of Round Rock	short hike to river; Reed 2020
32	Memorial Park	30.5123, -97.6856	free		City of Round Rock	community park; shallow water; Reed 2020
33	Veterans Park	30.5148, -97.6756	free		City of Round Rock	fishing pier; bank only; Reed 2020
34	Adam Orgain Park	30.5072, -97.5457	free		City of Hutto	moderately steep bank
35	Brushy Creek Regional Trail System		free		Williamson County, City of Cedar Park, City of Round Rock	trail along Brushy Creek
36	Lake Creek Trail		free		Williamson County, City of Round Rock	trail along Lake Creek

 Camping  Bank and/or wade fishing access  Kayak/Canoe launch  Small motorized boat

SPORT FISHING OPPORTUNITIES

Multiple species supporting recreational sport fisheries were present at both sites and included Guadalupe and Largemouth bass, Common Carp, Channel Catfish, Rio Grande Cichlid, and multiple sunfish species (FIGURE 13).

FIGURE 13.—Some of the fish species that offer angling potential within South Brushy Creek and San Gabriel River include from left to right, top to bottom Guadalupe Bass, Largemouth Bass, Rio Grande Cichlid, and Longear Sunfish.

Both Site A on South Brushy Creek and Site B on the San Gabriel River are popular recreational fisheries access sites, particularly among fly anglers. A roving creel survey of Brushy Creek in 2018 and 2019 indicated that approximately 10% of all anglers intercepted were fly anglers (Ireland and De Jesus 2019). This survey also noted that the highest directed angler effort was toward Largemouth Bass at 35.6%, Common Carp at 17.8%, and catfishes (Channel, Blue, and Flathead) at 9.9%. No known angler creel data exists for the San Gabriel River.

Guadalupe Bass were present in low numbers at Site A on South Brushy Creek but are reportedly more abundant downstream of the bioassessment site and in the San Gabriel River where local outfitters guide recreational fly-fishing trips targeting this species. The creel survey conducted on Brushy Creek in 2018 and 2019 indicated that 2.3% of angler effort was specifically directed toward this species. Largemouth Bass collected during this bioassessment were predominantly less than 6 inches, but one individual measuring 22 inches was collected at Site B on the San Gabriel River. Backpack electrofishing surveys conducted by TPWD Fisheries Management staff in the Brushy Creek watershed (including Site A on South Brushy Creek at Champion Park) in the fall of 2018 and spring of 2019 documented a wide

distribution of lengths for Largemouth Bass; however, most fish collected were below the minimum length limit of 14 inches. Largemouth Bass Catch-Per-Unit-Effort for these surveys were 51.0 fish/hour for fall 2018 and 38.4 fish/hour for spring 2019.

Sunfish were less abundant at Site B on the San Gabriel River; however, they were generally larger than individuals from Site A on South Brushy Creek. Relative to the other sunfish species collected, Redbreast Sunfish were the most abundant and had the largest sizes at both bioassessment sites. Other sunfish collected during the survey that would provide additional panfish angling opportunities included Bluegill, Green Sunfish *Lepomis cyanellus*, and Longear Sunfish. Though not collected during this survey, Redear Sunfish and Warmouth *Lepomis gulosus* were documented in small numbers during the fall 2018 and spring 2019 backpack electrofishing survey of Brushy Creek. Overall, the wide, shallow habitats at Site B on the San Gabriel River do not provide suitable habitat for many large fish, however small pockets of suitable habitat are available for a few larger fish to persist. Likewise, the deeper areas of Brushy Creek, mainly absent at Site A on South Brushy Creek, generally hold larger fish that anglers seek.

Only three catfish were collected during this survey which may be a result of gear bias. Two Flathead Catfish were collected from Site B on the San Gabriel River with total lengths of 4.6 and 18.9 inches, the latter was of harvestable size (minimum length limit of 18 inches; TPWD 2019). Although catfish numbers were low, the roving creek survey on Brushy Creek in fall 2018 and spring 2019 indicated that anglers were consistently catching and harvesting legal-sized catfish (≥12 inches) in the deeper portions of Brushy Creek.

SUMMARY AND RECOMMENDATIONS

Little River Watershed

Fish assemblage sampling occurred at 65 sites throughout the Little River watershed in Texas yielding a total of 50 fish species. These collections included three fish species currently of SGCN status (Silverband Shiner, Shoal Chub, and Guadalupe Bass), with Silverband Shiner and Shoal Chub only occurring at two sites while Guadalupe Bass were broadly distributed. Federal and state-listed species historically found within this range were not encountered (Smalleye Shiner and Chub Shiner). One species of freshwater mussel, 42 benthic macroinvertebrate taxa, and four species of crayfish were documented throughout the watershed.

There are many public recreational access opportunities within the study area especially in the mid-lower watershed where water availability is greater. Users can access river reaches and small riverine impoundments at multiple city and county parks as well as through several well-developed trail systems that run alongside a couple of these waterbodies. Given the shallow nature of much of this watershed, paddling opportunities are scarcer and more limited to lower reaches such as the Little River mainstem.

Bioassessment Study Site A on South Brushy Creek at Champion Park

Sixteen species of fish, one mussel species, 32 benthic macroinvertebrate taxa, and one species of crayfish were documented at Site A on South Brushy Creek in Champion Park. The fish assemblage was assigned an aquatic life use of high. Several fish species were collected that offer angling opportunities such as Guadalupe and Largemouth bass, Common Carp, Channel Catfish, Rio Grande Cichlid, and multiple species of sunfish.

Point water quality measurements at Site A on South Brushy Creek all fell within established water quality standards except for dissolved oxygen. Given the diverse fish assemblage identified at Site A on South Brushy Creek during this study, it appears these low dissolved oxygen levels were likely an anomaly rather than a regular occurrence. The riparian area received an overall score in the Bull's Eye for a High Functional Condition.

Bioassessment Study Site B on the San Gabriel River at CR 100

Seventeen species of fish, 34 benthic macroinvertebrate taxa, and one species of crayfish were documented at Site B on the San Gabriel River at County Road 100. The fish assemblage was assigned an aquatic life use of exceptional. Several fish species were collected that offer angling opportunities such as Guadalupe and Largemouth bass, Common Carp, Flathead Catfish, and multiple species of sunfish.

Point water quality measurements at Site B on the San Gabriel River all fell within established water quality standards. The riparian area received an overall score in the Mid Zone for At-Risk Condition.

Conclusions & Recommendations

The Little River watershed is one of the largest sub-basins in the state, encompassing almost 3% of the total land mass of Texas. Given the size of this subwatershed, it boasts a diverse array of aquatic habitats and biological communities but is also home to a wide variety of challenges that can affect these systems. Natural resource managers should continue to monitor biological communities to evaluate conditions through time and work towards maintaining healthy instream and riparian habitats. These habitats support healthy biological communities that in turn provide opportunities for outdoor recreation including fishing, swimming, and other aquatic-oriented activities that are common within the basin.

Recreational Access: The Little River watershed provides many options for recreational access across rural and urban settings that offer opportunities for recreation based on the user's level of comfort. Access sites in rural locations often require users to navigate unimproved dirt roads within medians and right-of-ways along roads and highways. State and county controlling authorities should continue to monitor popular access points within these settings to ensure public access remains unimpeded and to encourage the responsible use of the resource. Within urban environments, city and county governments should continue to maintain, provide, and encourage responsible access via local parks and hike-and-bike trails. Sustainable and inclusive access should be encouraged by incorporating family-friendly and accessible design features such as gently sloped and/or paved pathways, benches, and shade from native trees. Fully contained trash receptacles should also be considered to reduce litter and waste that often

enter waterways at these locations. It is important for municipalities to guide public access by creating pocket access points to reduce impact to riparian areas and streamside habitat (HCA 2021).

Furthermore, controlling authorities in this region should consider applying for funding from the TPWD Boating Access Grant Program and Habitat and Angler Access Program (HAAP) to improve access (TPWD 2024a and 2024b). Funds awarded through the Boating Access Grants are eligible for various kinds of improvements including access roads, parking areas, restrooms, land acquisition, etc. for the purpose of improving or creating access sites for boating. The HAAP offers funding for improving angler access by adding features such as a kayak launch or fishing pier and/or implementing habitat improvement projects in public waters. Such improvements at existing public access points would reduce the difficulty of launching vessels and likely lead to increased recreational utilization.

It is also recommended that additional access sites between current public access points be considered to reduce the long stream distance between existing access points that provide paddling opportunities. Municipalities and private landowners can explore options with the TPWD Texas Paddling Trails Program (TPWD 2024d) and the River Access and Conservation Areas Program (RACA; TPWD 2024e) to increase paddling access throughout the watershed. The RACA Program uses federal grant funding to lease private streamside properties for public river access. The establishment of several RACA sites along the mid-upper reaches of the Little River would provide better paddling connectivity within long stream reaches and further enhance stream-based recreational opportunities such as kayak fishing.

Sportfish Opportunities & Angling: Given the high level of recreational use throughout the Little River watershed, TPWD should consider expanding creel survey efforts within lotic systems to further assess angling pressure, harvest, and species preference. This would allow managers to better understand the priorities and economic contribution of anglers that utilize this watershed. Expanded creel surveys would provide an opportunity to assess whether current CFL regulations should be extended to other reaches within the Brushy Creek/San Gabriel system to reduce take given high angling pressure. Furthermore, fisheries management surveys in angler-targeted reaches should incorporate multiple gear types to assess the full assemblage and quantify instream habitat to assess potential differences in angling quality based on habitat and forage availability (TCEQ 2014). As recommended by Ireland and DeJesus (2019), controlling authorities should continue to work with TPWD to post signage at popular angling access points to clearly communicate fishing regulations and educate the public about the importance of limiting the spread of invasive species.

Water Quality and Quantity: Watershed-scale conservation actions for river health should be coordinated among stakeholders to reduce localized impacts from land use, development, and other water management activities that are common within the basin. Water quality and quantity issues should be evaluated with a focus on urban areas as well as in river reaches downstream of reservoirs to reduce impacts to rivers ecosystems. Cities and municipalities should incorporate solutions such as bioswales and other green infrastructure that are designed to slow and filter runoff which will improve water quality and help reduce the flashiness of stream systems that are caused by excessive impervious cover. It is also recommended that cities and municipalities plan for increased volumes of wastewater effluent due to population growth and explore alternative options for application that reduce the amount of effluent discharged into waterways. Furthermore, cities and municipalities should ensure all effluent meets and/or exceeds water quality standards to mitigate impacts from increasing volumes of wastewater discharge.

Controlling authorities of reservoirs should participate in voluntary conservation actions like the U.S. Army Corps of Engineer's Sustainable Rivers Program to provide regulated river reaches with natural flow regimes that are beneficial to native aquatic species.

Riparian Areas: It is important for riparian and instream habitats to be properly managed and conserved within the watershed. Cities and municipalities should work to maintain and conserve healthy riparian zones along waterways and identify areas for restoration where native planting and invasive species removal can occur. Healthy riparian areas offer multiple benefits and services by providing instream habitat, dissipating flood energy, reducing erosion and buffering stream temperatures. Furthermore, wise development around our waterways that preserve riparian areas can help prevent future damages caused by flooding.

Connectivity: Stream fragmentation from dams and improperly sized culverts is common in the watershed. It is recommended that cities, municipalities, and natural resource organizations identify opportunities to improve aquatic connectivity within the watershed by removing obsolete dams and renovating road crossings with passage-friendly designs (GACT 2021). These restoration actions will provide better aquatic organism passage allowing for native species and sport fish resiliency throughout the watershed, improve instream habitat by allowing sediment and woody debris movement, and create more resilient infrastructure to withstand large flood events and improve human health and safety.

Monitoring: Water quality and biological monitoring should be conducted on a routine basis throughout the watershed to provide data that can be used to develop science-based recommendations to mitigate many of the challenges mentioned above. Water quality monitoring through TCEQ's Clean Rivers Program should continue quarterly and biological monitoring should be conducted annually at select sites to assess long-term trends in biological communities. As the population and water demand continues to grow and impacts from drought become increasingly more common (Nielsen-Gammon et al. 2020), it is imperative that stakeholders come together across jurisdictional boundaries to plan for future water needs that will both support human needs and conserve aquatic ecosystems within this unique watershed.

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APPENDIX

APPENDIX 1.—Estimated genotype (gID), and taxa specific allele frequency estimates (GB, SP, SM, LM) for all evaluated samples of phenotypic GB, SP, and LM from the Little River watershed; GB = Guadalupe Bass, SP = Spotted Bass, SM = Smallmouth Bass, and LM = Largemouth Bass. Lab ID is equivalent to the submitted TNHC-FT#.

Lab ID	Phenotypic Description	gID	GB	SP	SM	LM	Locality Name
TNH-1683	*punctulatus*	SP x GB	0.66	0.34	0	0	Donahoe Creek at FM437
TNH-1684	*punctulatus*	SP x GB	0.3	0.68	0	0.01	Donahoe Creek at FM437
TNH-1703	*punctulatus*	SP x GB	0.48	0.51	0	0	Little River @ FM437 (~300m reach above and below bridge)
TNH-1704	*punctulatus*	SP x GB	0.45	0.54	0	0	Little River @ FM437 (~300m reach above and below bridge)
TNH-1711	*punctulatus*	SP x GB	0.17	0.81	0	0.01	Big Elm Creek at FM438
TNH-1712	*punctulatus*	SP x GB	0.24	0.75	0	0.01	Big Elm Creek at FM438
TNH-1713	*punctulatus*	SP	0.01	0.98	0	0	Big Elm Creek at FM438
TNH-1714	*punctulatus*	SP x GB	0.66	0.34	0	0	Big Elm Creek at FM438
TNH-1715	*punctulatus*	SP x GB	0.24	0.75	0	0.01	Big Elm Creek at FM438
TNH-1716	*punctulatus*	SP	0.05	0.95	0	0	Big Elm Creek at FM438
TNH-1729	*punctulatus*	SP	0.01	0.99	0	0	Pin Oak Creek at FM2095
TNH-1730	*punctulatus*	SP	0.05	0.95	0	0	Pin Oak Creek at FM2095
TNH-1731	*punctulatus*	SP x GB	0.24	0.75	0	0.01	Pin Oak Creek at FM2095
TNH-1732	*punctulatus*	SP x GB	0.31	0.66	0.01	0.02	Pin Oak Creek at FM2095
TNH-1733	*punctulatus*	SP x GB	0.75	0.24	0	0.01	Pin Oak Creek at FM2095
TNH-1734	*punctulatus*	SP x GB	0.48	0.51	0	0	Pin Oak Creek at FM2095
TNH-1735	*punctulatus*	SP x GB	0.49	0.51	0	0	Pin Oak Creek at FM2095
TNH-1737	*punctulatus*	SP x GB	0.66	0.34	0	0	Pin Oak Creek at FM2095
TNH-1793	*punctulatus*	SP x GB	0.89	0.11	0	0	Nolan Creek at E Ave A
TNH-1556	*salmoides*	LM	0	0	0	0.99	North Fork Leon River at SH112 (~100m reach)
TNH-1576	*salmoides*	LM	0	0	0	0.99	Sabana River at CR435
TNH-1687	*salmoides*	LM	0	0	0	0.99	Donahoe Creek at FM437
TNH-1728	*salmoides*	LM	0	0	0	0.99	Pin Oak Creek at FM2095
TNH-1744	*salmoides*	LM	0	0	0	0.99	Buttermilk Creek at Gault Site
TNH-1748	*salmoides*	LM	0	0	0	0.99	Bear Creek on Collins Ranch
TNH-1783	*salmoides*	LM	0	0	0	0.99	Knob Creek at Reed Cemetery Rd.
TNH-1798	*salmoides*	LM	0	0	0	0.99	South Nolan Creek at Backstroms Crossing
TNH-1817	*salmoides*	LM	0	0	0	0.99	Salado Creek at E. Amity Rd
TNH-1854	*salmoides*	LM	0	0	0	0.99	Oatmeal Creek at FM1174
TNH-1861	*salmoides*	LM	0	0	0	0.99	Little Rocky Creek at US183 (into S. Rocky Creek)
TNH-1866	*salmoides*	LM	0	0	0	0.99	Sulphur Creek at FM1715
TNH-1887	*salmoides*	LM	0	0	0	0.99	Simms Creek at US281
TNH-1890	*salmoides*	LM	0	0	0	0.99	Cowhouse Creek at CR505 (Schoolerville Rd)
TNH-1895	*salmoides*	LM	0	0	0	0.99	Cowhouse Creek at CR137
TNH-1896	*salmoides*	LM	0	0	0	0.99	Coryell Creek at FM107
TNH-1698	*treculii*	GB x SP	0.89	0.11	0	0	Big Elm Creek at CR240
TNH-1702	*treculii*	GB x SP x SM	0.74	0.14	0.12	0	Little River @ FM437 (~300m reach above and below bridge)
TNH-1717	*treculii*	GB x SP	0.95	0.02	0.01	0.02	Leon River at Taylors Valley Rd (~250m reach)
TNH-1723	*treculii*	LM	0	0	0	0.99	Leon River at Taylors Valley Rd (~250m reach)

Lab ID	Phenotypic Description	gID	GB	SP	SM	LM	Locality Name
TNH-1726	*treculii*	GB x SP	0.91	0.07	0.01	0.01	Leon River at Taylors Valley Rd (~250m reach)
TNH-1746	*treculii*	GB	0.99	0.01	0	0	Bear Creek on Collins Ranch
TNH-1764	*treculii*	GB	0.99	0.01	0	0	San Gabriel River at CR100
TNH-1766	*treculii*	GB	0.99	0.01	0	0	San Gabriel River at CR100
TNH-1769	*treculii*	GB x SP	0.66	0.34	0	0	San Gabriel River at CR100
TNH-1770	*treculii*	GB x SP	0.89	0.11	0	0	San Gabriel River at CR100
TNH-1773	*treculii*	GB x SM	0.92	0	0.05	0.02	San Gabriel River at CR100
TNH-1775	*treculii*	GB x SM	0.92	0.01	0.06	0.01	San Gabriel River at CR100
TNH-1776	*treculii*	GB x SP	0.42	0.56	0.01	0.01	Little River at Sunshine Rd.
TNH-1777	*treculii*	GB x SM	0.85	0.02	0.11	0.02	Little River at Sunshine Rd.
TNH-1778	*treculii*	GB x SP x SM	0.65	0.12	0.23	0	Little River at Sunshine Rd.
TNH-1779	*treculii*	GB x SP	0.67	0.32	0	0	Little River at Sunshine Rd.
TNH-1780	*treculii*	GB x SP	0.57	0.41	0	0.01	Little River at Sunshine Rd.
TNH-1781	*treculii*	GB x SP	0.65	0.31	0.03	0.01	Little River at Sunshine Rd.
TNH-1782	*treculii*	GB x SP x SM	0.41	0.4	0.18	0.01	Little River at Sunshine Rd.
TNH-1788	*treculii*	GB x SP	0.48	0.51	0	0	Lampasas River at FM1123
TNH-1791	*treculii*	GB x SP	0.66	0.34	0	0	Nolan Creek at E Ave A
TNH-1792	*treculii*	GB x SP	0.3	0.68	0	0.01	Nolan Creek at E Ave A
TNH-1802	*treculii*	GB x SP	0.89	0.11	0	0	Salado Creek at E. Amity Rd
TNH-1803	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1804	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1805	*treculii*	GB x SP	0.66	0.34	0	0	Salado Creek at E. Amity Rd
TNH-1806	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1807	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1808	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1809	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1810	*treculii*	GB x SP	0.89	0.11	0	0	Salado Creek at E. Amity Rd
TNH-1811	*treculii*	GB x SP	0.66	0.34	0	0	Salado Creek at E. Amity Rd
TNH-1812	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1813	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1814	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1815	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1816	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1821	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1823	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1824	*treculii*	GB	0.99	0.01	0	0	Salado Creek at E. Amity Rd
TNH-1830	*treculii*	GB	0.99	0.01	0	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1831	*treculii*	GB x SP	0.89	0.11	0	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1832	*treculii*	GB x SM	0.85	0.02	0.13	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1833	*treculii*	GB x SP	0.91	0.07	0.01	0.02	Lampasas River at SH195 (Ding Dong, TX)
TNH-1835	*treculii*	GB	0.98	0.01	0.02	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1836	*treculii*	GB x SP	0.89	0.11	0	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1837	*treculii*	GB x SP	0.95	0.02	0.01	0.02	Lampasas River at SH195 (Ding Dong, TX)
TNH-1838	*treculii*	GB x SP	0.89	0.11	0	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1840	*treculii*	GB x SP	0.91	0.07	0.01	0.02	Lampasas River at SH195 (Ding Dong, TX)

Lab ID	Phenotypic Description	gID	GB	SP	SM	LM	Locality Name
TNH-1841	*treculii*	GB	0.99	0.01	0	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1842	*treculii*	GB	0.99	0.01	0	0	Lampasas River at SH195 (Ding Dong, TX)
TNH-1867	*treculii*	GB x SP	0.89	0.11	0	0	Sulphur Creek at FM1715
TNH-1868	*treculii*	GB	0.99	0.01	0	0	Sulphur Creek at FM1715
TNH-1869	*treculii*	GB	0.99	0.01	0	0	Sulphur Creek at FM1715
TNH-1870	*treculii*	GB x SM	0.86	0.01	0.13	0	Sulphur Creek at FM1715
TNH-1871	*treculii*	GB x SP	0.89	0.11	0	0	Sulphur Creek at FM1715
TNH-1872	*treculii*	GB	0.99	0.01	0	0	Sulphur Creek at FM1715
TNH-1873	*treculii*	GB	0.99	0.01	0	0	Sulphur Creek at FM1715
TNH-1874	*treculii*	GB	0.99	0.01	0	0	Sulphur Creek at FM1715
TNH-1875	*treculii*	GB	0.99	0.01	0	0	Sulphur Creek at FM1715
TNH-1876	*treculii*	GB	0.99	0.01	0	0	Sulphur Creek at FM1715
TNH-1877	*treculii*	GB x SP x SM	0.77	0.1	0.13	0	Sulphur Creek at FM1715
TNH-1950	*treculii*	GB	0.99	0.01	0	0	Little River at US77 (S. of Cameron)
TNH-1951	*treculii*	GB	0.99	0.01	0	0	Little River at US77 (S. of Cameron)
TNH-1952	*treculii*	GB	0.99	0.01	0	0	Little River at US77 (S. of Cameron)
TNH-1953	*treculii*	GB	0.99	0.01	0	0	Little River at US77 (S. of Cameron)
TNH-1954	*treculii*	GB x SP	0.67	0.32	0	0	Little River at US77 (S. of Cameron)
TNH-1955	*treculii*	GB x SP	0.89	0.11	0	0	Little River at US77 (S. of Cameron)
TNH-1957	*treculii*	GB x SP	0.66	0.34	0	0	Little River at US77 (S. of Cameron)
TNH-1958	*treculii*	GB	0.99	0.01	0	0	Little River at US77 (S. of Cameron)
TNH-1959	*treculii*	GB x SP	0.66	0.34	0	0	Little River at US77 (S. of Cameron)
TNH-1960	*treculii*	GB x SP	0.91	0.07	0.01	0.01	Little River at US77 (S. of Cameron)
TNH-1962	*treculii*	GB x SP	0.89	0.11	0	0	Little River at US77 (S. of Cameron)
TNH-1963	*treculii*	GB x SP	0.82	0.11	0.02	0.06	Little River at US77 (S. of Cameron)
TNH-1964	*treculii*	GB	0.99	0.01	0	0	San Gabriel River at FM487
TNH-1968	*treculii*	GB x SP	0.91	0.07	0.01	0.02	Brushy Creek at FM908
TNH-1976	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1977	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1980	*treculii*	GB x SP	0.93	0.03	0.01	0.03	Brushy Creek at Veterans Park
TNH-1982	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1983	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1984	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1985	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1986	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1987	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1989	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1992	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1994	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-1995	*treculii*	GB	0.99	0	0	0	Brushy Creek at Veterans Park
TNH-2001	*treculii*	GB	0.99	0	0	0	Lake Creek at Lake Creek Park, Round Rock
TNH-2002	*treculii*	LM	0	0	0	0.99	Lake Creek at Lake Creek Park, Round Rock
TNH-2003	*treculii*	GB	0.99	0	0	0	Lake Creek at Lake Creek Park, Round Rock
TNH-2004	*treculii*	LM	0	0	0	0.99	Lake Creek at Lake Creek Park, Round Rock

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