LOUISIANA DEPARTMENT OF WILDLIFE & FISHERIES

OFFICE OF FISHERIES
INLAND FISHERIES SECTION

TANGIPAHOA RIVER WATERSHED, LOUISIANA

WATERBODY MANAGEMENT PLAN – PART B

EVALUATION & RECOMMENDATIONS

CHRONOLOGY

DOCUMENT SCHEDULED TO BE UPDATED ANNUALLY

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WATERBODY EVALUATION

STRATEGY STATEMENT

Recreational

Largemouth Bass (*Micropterus nigricans*) are managed to maintain a sustainable population while providing anglers the opportunity to catch or harvest numbers of fish to maintain angler interest and efforts.

Commercial

Commercial species are managed with statewide regulations to provide a maximum sustainable yield that does not contribute to declines in future population strength.

Species of Special Concern

Species of special concern are managed to protect the current population and to provide an opportunity for recovery to a sustainable population. In Louisiana, management of Threatened and Endangered (T & E) species is the purview of the United States Fish and Wildlife Service (USFWS).

EXISTING HARVEST REGULATIONS

Recreational

There are no special recreational regulations for the Tangipahoa River, Statewide regulations for all fish species, the Louisiana Department of Wildlife and Fisheries (LDWF) recreational fishing regulations may be viewed at the link below:
https://www.wlf.louisiana.gov/subhome/recreational-fishing

Commercial

There are no special commercial regulations for the Tangipahoa River. Statewide species and gear specific regulations apply. The LDWF commercial fishing regulations may be viewed at the link below: https://www.wlf.louisiana.gov/subhome/commercial-fishing

Species of Special Concern

Louisiana prohibited the take of all sturgeon in 1991. It is also illegal in Louisiana to possess a threatened or endangered species. The daily possession limit for Paddlefish is two per person with a maximum lower jaw fork length of 30 inches.

SPECIES EVALUATION

Recreational/Sportfish

Largemouth Bass Relative Abundance, and Structural Indices

Largemouth Bass occur throughout the Tangipahoa River and its tributaries. However, Largemouth Bass habitat and angler accessibility is limited in the upper reaches of the river. Therefore, LDWF standardized electrofishing samples for Largemouth Bass have concentrated on the lower reach of the river. Prior to 2015, four fixed stations (APPENDIX) were sampled

for 15 minutes each in the spring and fall. From 2015 onward, five stations have been sampled in the summer to evaluate Largemouth Bass populations. Relative abundance or catch per unit effort (CPUE), length frequency, the structural indices of proportional stock density (PSD), relative stock density (RSD-p), and relative weight (Wr) are calculated for each sample. Inconsistent environmental factors have influenced spring electrofishing results in the past. Therefore, the following analyses were derived from only fall samples taken prior to 2015, and summer samples taken post 2015. A summary of fall electrofishing results from 1996-2011 (Table 1) suggests the population was negatively affected by Hurricane Katrina, but quickly recovered.

The most recent length distributions for Largemouth Bass collected in the summer of 2021 in the Tangipahoa River are presented in Figure 1. The Largemouth Bass ranged from 2 to 19 inches total length (TL).

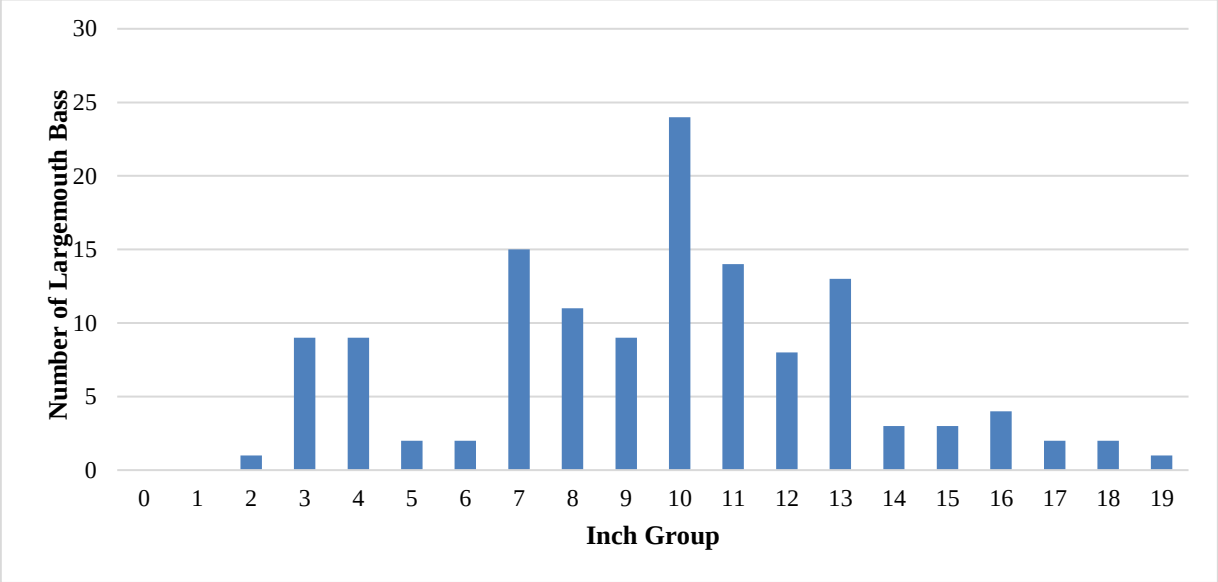

Figure 1. Size distribution by inch group of Largemouth Bass collected from the Tangipahoa River, Louisiana, in the summer of 2021, n=132.

Proportional stock density (PSD) and relative stock density (RSD) are indices used to numerically describe size distribution (length-frequency) of the population data (Anderson and Neumann 1996). Proportional stock density compares the number of quality size bass (greater than 12 inches for Largemouth Bass) to the number of stock-size bass ($\geq$8 inches in length). The PSD is expressed as a percent. A fish population with a high PSD consists mainly of larger individuals. A population with a low PSD consists mainly of smaller fish.

$$PSD = \frac{\text{Number of bass} \geq 12 \text{ inches}}{\text{Number of bass} \geq 8 \text{ inches}} \text{ x100}$$

Relative stock density of preferred fish (RSD_P) is the proportion of Largemouth Bass in a stock (fish over 8 inches) that are 15 inches or longer.

$$RSD_P = \frac{\text{Number of bass>15 inches}}{\text{Number of bass>8 inches}} \times 100$$

The desirable range for PSD is between 40 and 80, and the desirable range for RSD_P is between 10 and 40. In the years following Hurricane Katrina proportional stock densities (PSD) increased until reaching a peak in 2009, suggesting a steady increase in number of spawning class fish. In 2010, an upward spike in mean CPUE with a corresponding decline in PSD suggests a successful spawn and strong recruitment of the 2009 year class (Figures 2 and 3). Results from 2011 show the 2009 cohorts' progress by the increase in PSD value. Furthermore, mean sample CPUE in 2011 remained above the long-term average suggesting another successful spawn and strong year class from the 2010 brooders. Results from the 2015 and 2021 updated Ricers and Streams Protocol samples indicate a balanced Largemouth Bass population (Table 1 and Figure 4).

Table 1. Summary of electrofishing results for the lower Tangipahoa River from 1996-2021.

Year	Mean Catch per Unit Effort	PSD	RSD-P
1996	20	50	38
1997	55	38	5
2006	26	0	0
2007	112	15	4
2008	128	25	8
2009	90	55	9
2010	208	3	3
2011	115	20	8
2015	44	47	15
2021	53	38	12

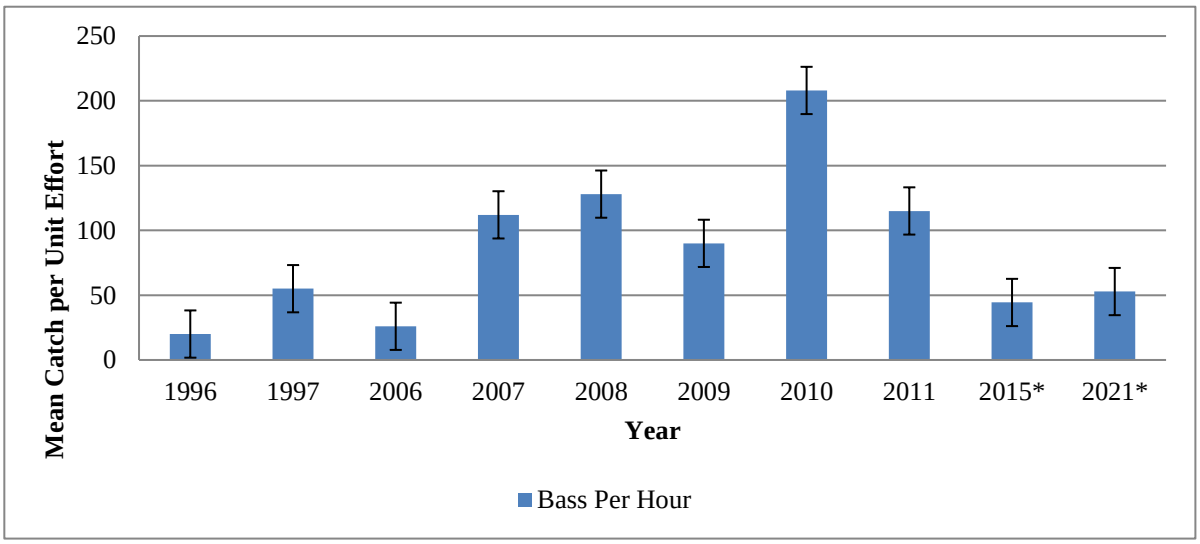

Figure 2. The catch per unit effort (CPUE ± SE) for Largemouth Bass from the Tangipahoa River, Louisiana, 1996 -2021 (* denotes Rivers and Streams Protocol).

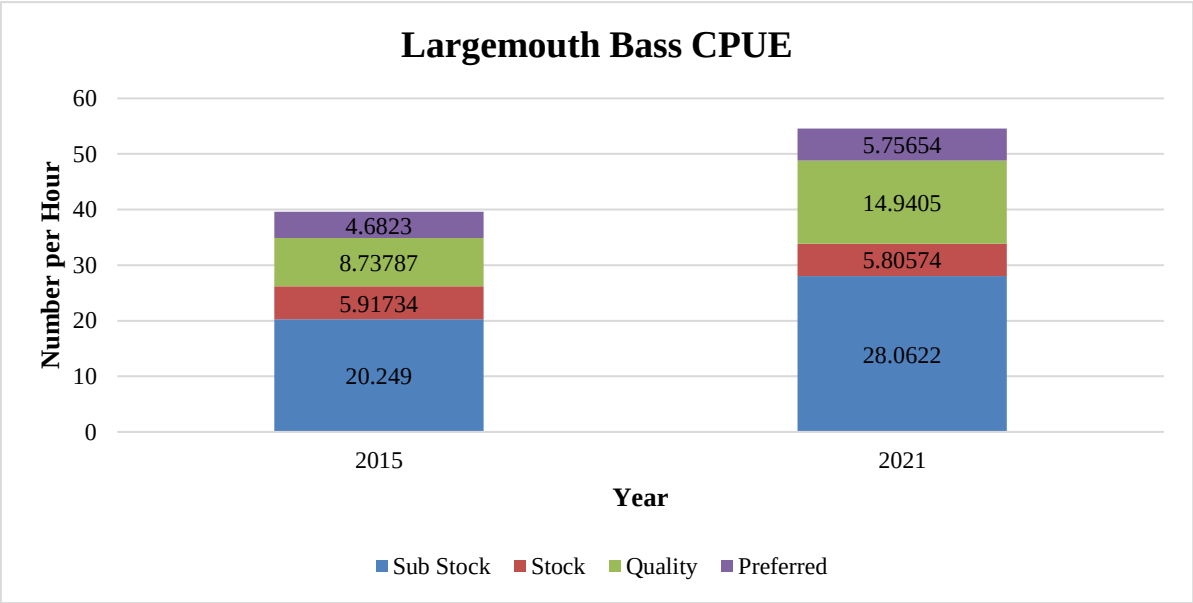

Figure 3. The mean relative abundance (CPUE ± SE) by size structure for Largemouth Bass from the Tangipahoa River, Louisiana, 2015 and 2021. Rivers and Streams Protocol.

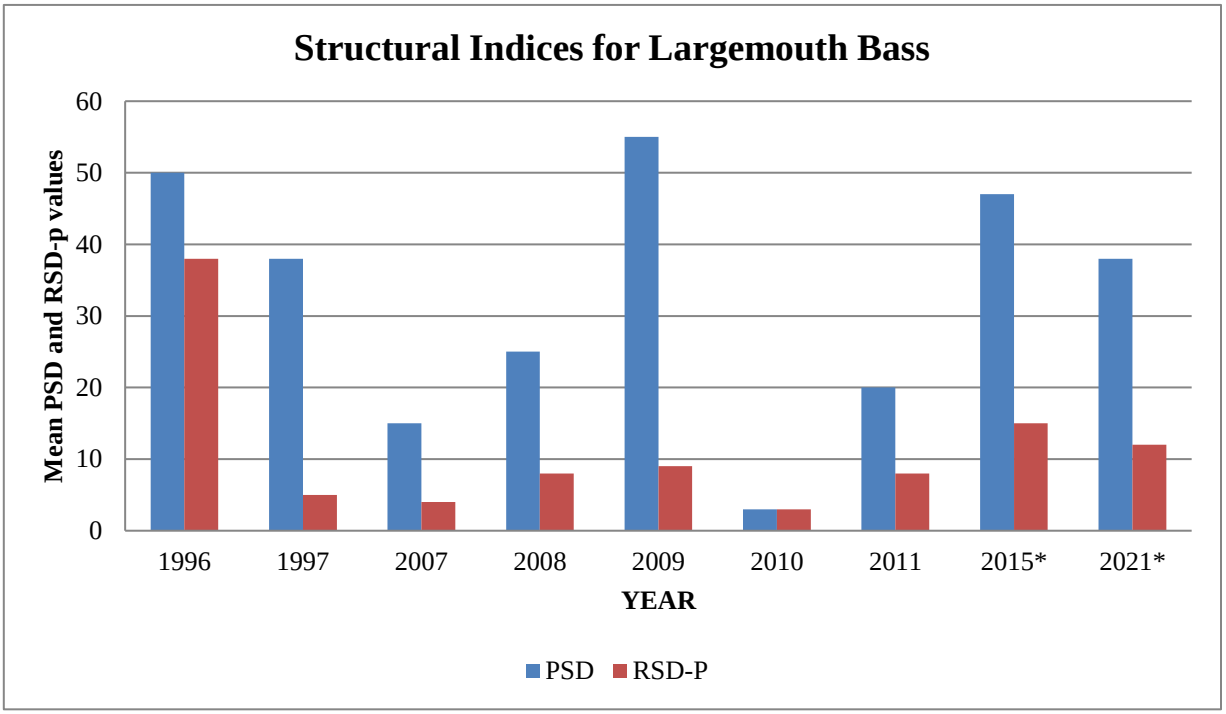

Figure 4. The mean PSD's and RSD-p for Largemouth Bass from the Tangipahoa River, Louisiana from 1996-2021 (* denotes Rivers and Streams Protocol).

Forage Availability and Mean Relative Weight

Forage availability can be measured indirectly by calculating bass body condition or relative weight. Relative weight (Wr) is a measure of fishes "plumpness" and is the ratio of a fish's weight to the weight of a ''standard'' fish of the same length.. Largemouth Bass Wr below 80

may indicate a potential problem with forage availability, while Wr near or above 100 indicates a healthy bass population. Mean relative weight (Wr) of Largemouth Bass sampled in the summer of 2021 is within the acceptable range (i.e., above 80). Mean relative weight (Wr) of all size classes of Largemouth Bass was 103.89 and stock size Largemouth Bass was 104 (Figures 5 & 6). This indicates that Largemouth Bass of stock-size class are in good condition and forage does not appear to be a limiting factor. Crawfish, crabs, river shrimp, grass shrimp and other invertebrates in addition to common fish species are available as forage to Largemouth Bass in the Tangipahoa River.

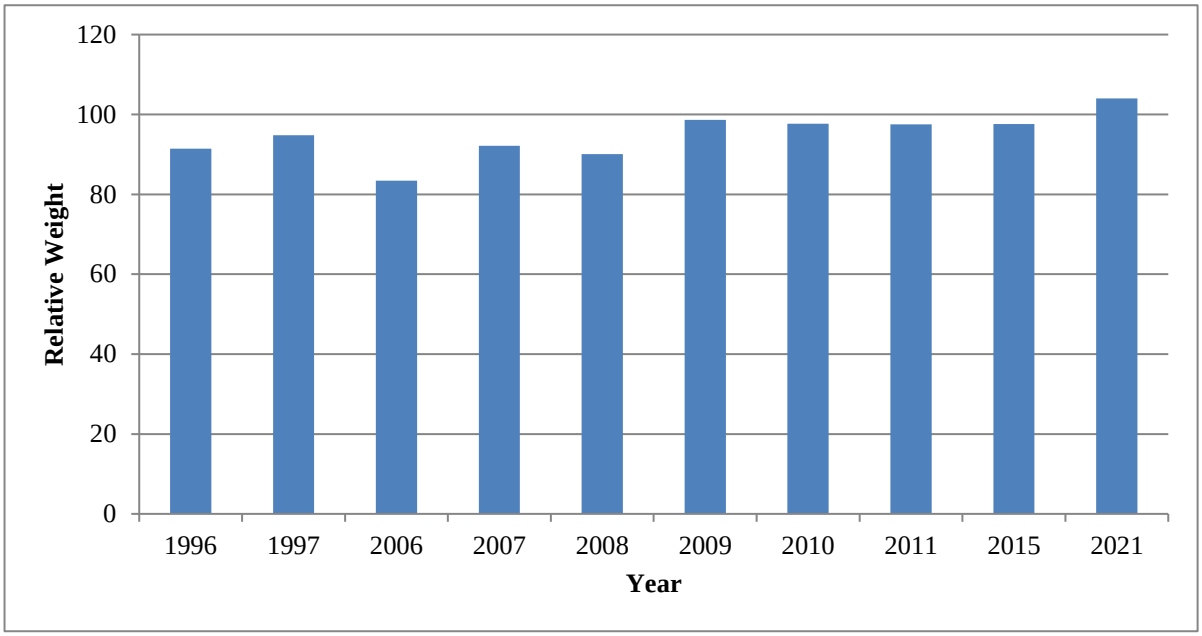

Figure 5. Mean relative weight of stock-size Largemouth Bass from the Tangipahoa River, Louisiana for fall electrofishing samples in 1996, 1997, 2006-2011, 2015 and 2021.

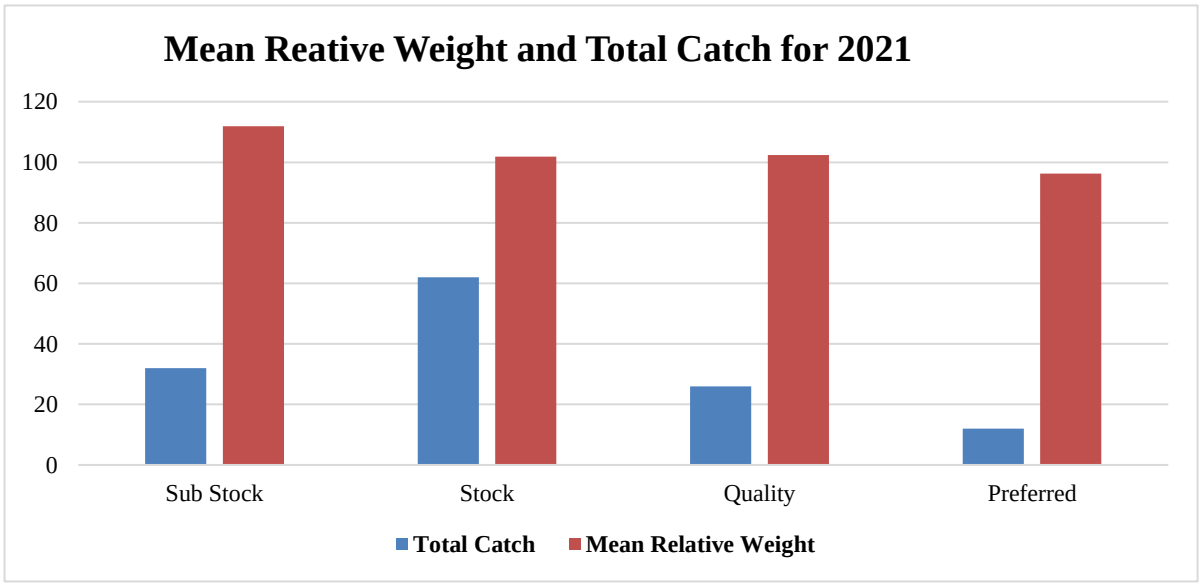

Figure 6. Mean relative weight and total catch of Largemouth Bass from the Tangipahoa River, Louisiana for summer electrofishing samples in 2021.

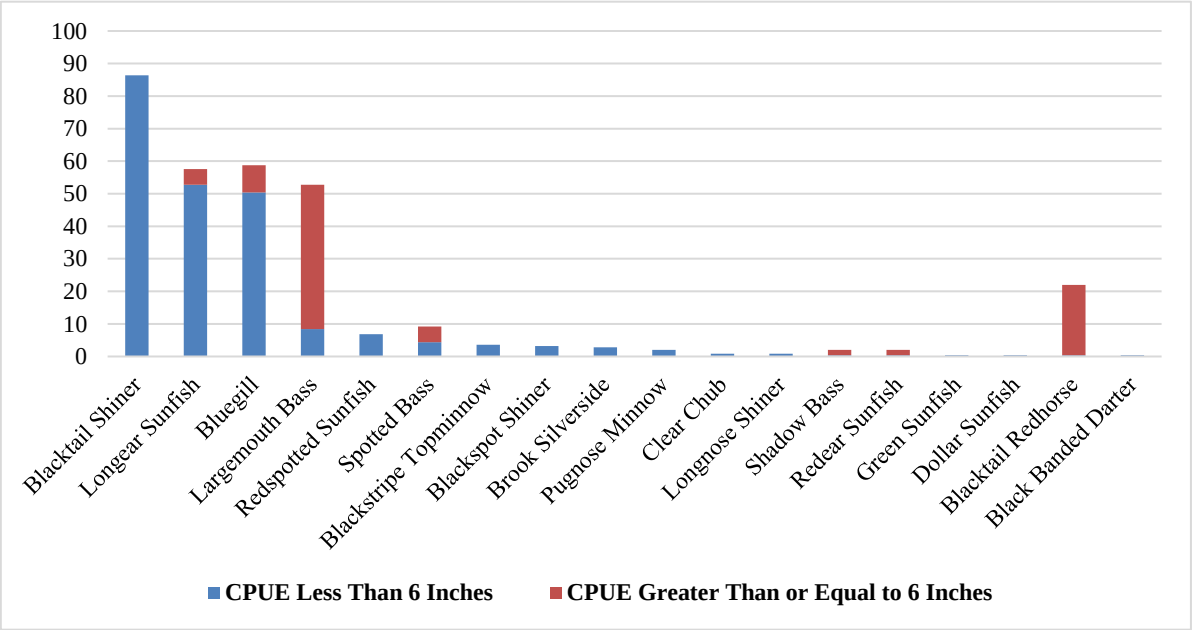

Figure 7. Available forage from the Tangipahoa River, Louisiana for summer electrofishing samples in 2021.

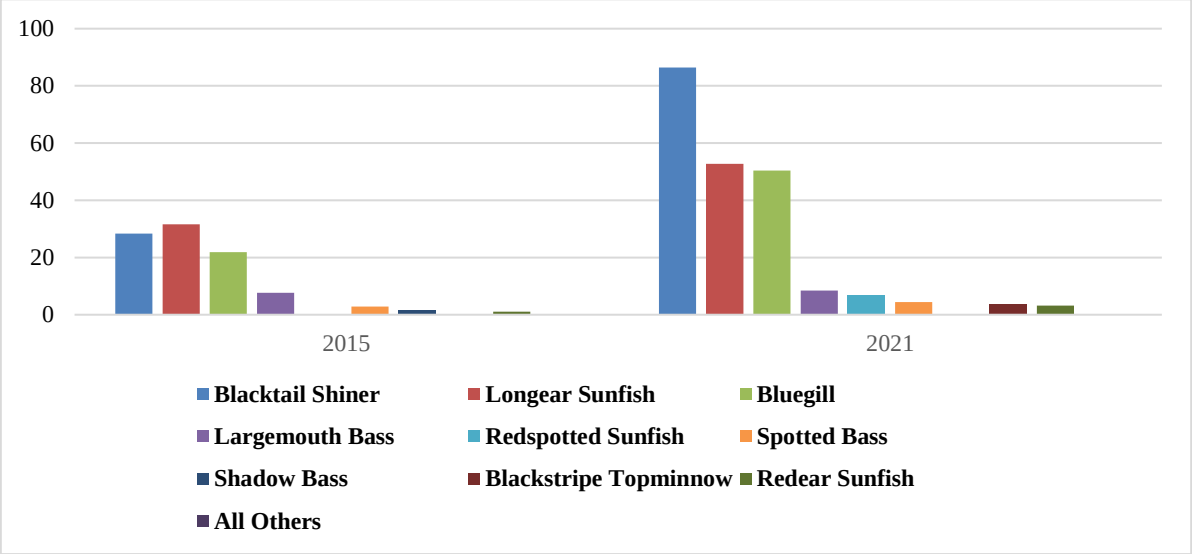

Figure 8. Available forage of most abundant species from the Tangipahoa River, Louisiana for summer electrofishing samples in 2015 and 2021.

Crappie

Only 41 crappie have been collected by LDWF standardized electrofishing samples in the Tangipahoa River from 1996-1997, 2006-2011, 2015 and 2021. Black Crappie continue to be a small proportion of the total fish composition of the watershed.

Species Assemblages

Fish Assemblage in the Main Stem of the River
A total of 2,041 fish were collected from the fall 2021 main stem electrofishing samples of the Tangipahoa River (Table 2). Theses samples represent 40 distinct species.

Table 2. Species collected on the main stem of the Tangipahoa River by boat electrofishing in 2021.

Scientific Name	**Common Name**	**CPUE**
Cyprinella venusta	Blacktail Shiner	86.4
Lepomis macrochirus	Bluegill	58.8
Lepomis megalotis	Longear Sunfish	57.6
Micropterus nigricans	Largemouth Bass	52.8
Moxostoma poecilurum	Blacktail Redhorse	22
Micropterus punctulatus	Spotted Bass	9.2
Lepomis miniatus	Redspotted Sunfish	6.8
Lepisosteus oculatus	Spotted Gar	4.4
Lepisosteus osseus	Longnose Gar	4
Fundulus notatus	Blackstripe Topminnow	3.6
Mugil cephalus	Striped Mullet	3.6
Pomoxis nigromaculatus	Black Crappie	3.2
Notropis atrocaudalis	Blackspot Shiner	3.2
Ictalurus punctatus	Channel Catfish	3.2
Minytrema melanops	Spotted Sucker	3.2
Labidesthes sicculus	Brook Silverside	2.8
Dorosoma cepedianum	Gizzard Shad	2.8
Opsopoeodus emiliae	Pugnose Minnow	2
Lepomis microlophus	Redear Sunfish	2
Ambloplites ariommus	Shadow Bass	2
Amia ocellicauda	Bowfin	1.6
Lepomis gulosus	Warmouth	1.6
Ictiobus bubalus	Smallmouth Buffalo	1.2
Anguilla rostrata	American Eel	0.8
Hybopsis winchelli	Clear Chub	0.8
Notropis longirostris	Longnose Shiner	0.8
Hypentelium nigricans	Northern Hog Sucker	0.8
Alosa chrysochloris	Skipjack Herring	0.8
Morone saxatilis	Striped Bass	0.8
Percina nigrofasciata	Black Banded Darter	0.4
Ictalurus furcatus	Blue Catfish	0.4
Lepomis marginatus	Dollar Sunfish	0.4
Pylodictis olivaris	Flathead Catfish	0.4

Scientific Name	Common Name	CPUE
Aplodinotus grunniens	Freshwater Drum	0.4
Esox americanus vermiculatus	Grass Pickerel	0.4
Lepomis cyanellus	Green Sunfish	0.4
Carpiodes velifer	Highfin Carpsucker	0.4
Pomoxis annularis	White Crappie	0.4
Shannon's (H') Diversity Index		1.79478
Simpson's (1-D) Diversity Index		0.7399
Species Richness		38

Table 3. Species collected on the main stem of the Tangipahoa River by bag seine in 2021.

Scientific Name	Common Name	Number of individuals	CPUE (Catch per seine sample 50 FT.)
Cyprinella venusta	Blacktail Shiner	581	36.3125
Notropis longirostris	Longnose Shiner	361	22.5625
Ammocrypta beani	Naked Sand Darter	42	2.625
Percina sciera	Dusky Darter	32	2
Lepomis macrochirus	Blue Gill	29	1.8125
Hybopsis winchelli	Clear Chub	22	1.375
Labidesthes sicculus	Brook Silverside	20	1.25
Fundulus notatus	Blackstripe Topminnow	18	1.125
Gambusia affinis	Western Mosquito Fish	16	1
Micropterus punctulatus	Spotted Bass	12	0.75
Trinectes maculatus	Hogchoker	11	0.6875
Ictaluras punctatus	Channel Catfish	7	0.4375
Percina nigrofasciata	Black Banded Darter	5	0.3125
Lepomis megalotis	Longear Sunfish	4	0.25
Lepomis cyanellus	Green Sunfish	4	0.25
Etheostoma stigmaeum	Speckled Darter	3	0.1875
Ambloplites ariommus	Shadow Bass	2	0.125
Etheostoma swaini	Gulf Darter	2	0.125
Notropis volucellus	Mimic Shiner	2	0.125
Moxostoma poecilurum	Blacktail Redhorse	1	0.0625
Pimephales vigilax	Bullhead Minnow	1	0.0625
Shannon's (H') Diversity Index			1.368138896
Simpson's (1-D) Diversity Index			0.62278053
Species Richness			21

Fish Assemblage in Wadeable Tributaries and Headwaters

A total of 883 fish were collected from 1st, 2nd, 3rd and 4th order streams representing the headwaters through the middle reaches of the watershed (Table 4). Theses samples represent 13 different families and 38 distinct species.

Table 4. Fish species collected during tributary sampling in 2021 in the Tangipahoa River watershed.

Scientific Name	Common Name	Number	CPUE
Gambusia affinis	Western Mosquito Fish	82	19.5417
Cyprinella venusta	Blacktail Shiner	109	9.75
Notropis longirostris	Longnose Shiner	94	8
Lepomis megalotis	Longear Sunfish	63	6.5417
Percina nigrofasciata	Black Banded Darter	71	6.5
Hybopsis winchelli	Clear Chub	39	6.2083
Hypentelium nigricans	Northern Hog Sucker	55	5.0833
Lepomis macrochirus	Bluegill	52	4.3333
Fundulus notatus	Blackstripe Topminnow	35	3.375
Luxilus chrysocephalus	Southern Striped Shiner	34	3.25
Micropterus punctulatus	Spotted Bass	26	2.1667
Noturus leptacanthus	Speckled Madtom	18	1.75
Ambloplites ariommus	Shadow Bass	19	1.6667
Lythrurus roseipinnis	Cherryfin Shiner	18	1.625
Etheostoma swaini	Gulf Darter	17	1.5
Ichthyomyzon gagei	Southern Brook Lamprey	16	1.3333
Percina sciera	Dusky Darter	15	1.25
Etheostoma histrio	Harlequin Darter	15	1.25
Percina maculata	Blackside Darter	14	1.1667
Lepomis cyanellus	Green Sunfish	13	1.125
Notropis texanus	Weed Shiner	13	1.0833
Nocomis leptocephalus	Bluehead Chub	6	0.6667
Erimyzon oblongus	Creek Chubsucker	8	0.6667
Lepomis gulosus	Warmouth	6	0.6667
Moxostoma poecilurum	Blacktail Redhorse	7	0.625
Aphredoderus sayanus	Pirate Perch	7	0.625
Etheostoma stigmaeum	Speckled Darter	6	0.5
Ameiurus natalis	Yellow Bullhead	4	0.5
Lepomis humilis	Orangespotted Sunfish	4	0.3333
Lepomis miniatus	Redspotted Sunfish	4	0.3333
Elassoma zonatum	Banded Pygmy Sunfish	1	0.25
Pomoxis nigromaculatus	Black Crappie	2	0.25
Micropterus nigricans	Largemouth Bass	1	0.25
Labidesthes sicculus	Brook Silverside	2	0.1667
Noturus nocturnus	Freckled Madtom	2	0.1667

Scientific Name	Common Name	Number	CPUE
Opsopoeodus emiliae	Pugnose Minnow	2	0.1667
Minytrema melanops	Spotted Sucker	2	0.1667
Noturus miurus	Brindled Madtom	1	0.0833
Shannon's (H') Diversity Index		2.27008	
Simpson's (1-D) Diversity Index		0.82438	
Species Richness		38	

Freshwater Mussel Assemblages

Freshwater mussel samples were conducted at fifteen stations throughout the Tangipahoa River watershed in 2021. Each sample was conducted in the littoral zone in waters less than one meter in depth. A total of 1,206 individual mussels were collected. *Cyclonaias refulgens* was the most common species, representing 54% by total number, while *Lampsilis hydiana, Quadrula nobilis* and *Plectomerus dombeyanus* were the least abundant species (Table 5).

Table 5. Freshwater Mussel Species collected in 2021 in the Tangipahoa River watershed.

Species	Count	Relative Composition	CPUE (90 min.)
Cyclonaias refulgens	656	0.543946932	10.9944
Villosa lienosa	200	0.165837479	3.352
Lampsilis straminea	125	0.103648425	2.095
Lampsilis teres	73	0.06053068	1.2235
Pyganodon grandis	50	0.04145937	0.838
Fusconaia cerina	25	0.020729685	0.419
Toxolasma parvum	14	0.011608624	0.2346
Potamilus purpuratus	12	0.009950249	0.2011
Tritogonia verrucosa	12	0.009950249	0.2011
Amblema plicata	8	0.006633499	0.1341
Villosa Vibex	8	0.006633499	0.1341
Utterbackia imbecillis	7	0.005804312	0.1173
Utterbackiana hartfieldorum	5	0.004145937	0.0838
Lampsilis ornata	4	0.00331675	0.067
Lampsilis hydiana	3	0.002487562	0.0503
Quadrula nobilis	3	0.002487562	0.0503
Plectomerus dombeyanus	1	0.000829187	0.0168
Total Individuals			1206
Species Richness			17
Shannon Weiner H'			1.57317
Simpson Diversity			0.66069

Commercial

LDWF has not conducted a formal survey of the commercial fisheries of the Tangipahoa River.

Species of Special Concern

Gulf Sturgeon

Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) occurrences in the Tangipahoa River are known from historic studies (Davis et al. 1970) but were not found by Rogillio et al. (2001). The current status of the Gulf Sturgeon population in the Tangipahoa River is unknown (Reed 2015).

On April 26, 2024 a local fisherman, sighted a large "7-8ft long and 250-300 lb" sturgeon travelling upstream in the Tangipahoa River. Exact location was within a mile south of the hwy 16 bridge. There is video evidence to confirm it's a Gulf Sturgeon although the actual size is likely much smaller, more like 5-6ft and 100+/- pounds. BRFWCO biologist, Kayla Kimmel, spoke with him and confirmed his sighting.

Paddlefish

LDWF does not specifically monitor Paddlefish (*Polyodon spathula*) populations in the Tangipahoa River. However, there is a statewide concern to conserve this species.

River Redhorse

R.E. Jenkins (1980) noted nationwide population declines of the River Redhorse (*Moxostoma carinatum*). Researchers believe the decline in this species may have resulted from a decline in the population of native mussels, the primary diet of the River Redhorse. In addition, siltation of spawning grounds may have caused a decrease in the number of River Redhorse (Ross 2001).

Gulf Logperch

Although no Gulf Logperch (*Percina suttkusi*) have been observed in the Tangipahoa River watershed in recent years, two specimens were observed within the Pearl River watershed in Louisiana during 2010, and they have been collected in the Amite River and Tchefuncte River watersheds (Alford 2012). The current status of the Gulf Logperch in Louisiana is unknown.

Broadstripe Topminnow

Broadstripe Topminnow (*Fundulus euryzonus*) is found only in the Tangipahoa and Amite River drainages. In these systems, it prefers smaller tributaries with relatively large amounts of canopy cover that shades the channel, good water quality, and very good physical habitat conditions that reflect natural, relatively undisturbed ecosystems (Alford 2012).

HABITAT EVALUATION

Habitat Evaluation of Tributaries and Headwaters

Habitat evaluations have been conducted on the tributaries and the headwater portion of the watershed in 2015 and 2021. A visual-based habitat assessment defined in the United States Environmental Protection Agency's (EPA) Rapid Habitat Assessment (RHA) protocol was

used to rate the quality of the habitat. Most habitats rated in the optimal range (Table 5.). Canopy cover parameters and physical parameters including turbidity (NTU), water temperature (c°), dissolved oxygen (ppt), conductivity (u mhos/cm), pH (in tenths) and velocity (feet/minutes) were collected (Table 6).

Table 6. Habitat data collected during the tributaries sampled at backpack electrofish sample sites in 2015 and 2021 in the Tangipahoa River watershed (* indicates 2015 data collection).

Station	1 - 4258	2	3 - 4261	4 - 4260	5 - 4255	6 - 4256	7 - 4257	8- 4360	9 - 43601
Latitude	30.5249°	30.5567°	30.6824°	30.7929°	30.7955°	30.8825°	30.9963°	30.9558	30.87898
Longitude	-90.3786°	-90.3483°	-90.3166°	-90.4178°	-90.4522°	-90.5118°	-90.5497°	-90.5039	-90.4873
Temp.	20.98	N/A	23.83	22.68	24.02	25.91	20.93	22.44	22.6
Conductivity	0.11	N/A	0.03	0.03	0.04	0.05	0.06	0.04	0.05
Salinity	0.05	N/A	0.01	0.01	0.02	0.02	0.3	0.02	0.02
pH	7.41	N/A	6.59	6.44	7.18	7.18	6.49	7.81	6.7
Turbidity/NTU	N/A	N/A	74.86	N/A	N/A	32.04	23.42	16.41	32.01
D. O.	3.82	N/A	5.56	5.01	6.12	6.95	6.37	6.78	6.8
Flow	0.1	N/A	1.8	1.4	1.2	0.6	1.4	1.2	0.8
Canopy cover *	95	100	95	95	30	75	100	75	100
Velocity *	Slow	Moderate	Fast	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Total score (RHA) *	120	172	173	177	164	156	164	156	164
Rating (RHA) *	12	17.2	17.3	17.7	16.4	15.6	16.4	15.6	16.4

Nuisance Aquatic Vegetation

There are minor problems associated with water hyacinth and common salvinia inhibiting navigation in man-made canals in the lower reach of the river. It is treated on an as needed basis.

Substrate

The substrate consists of sand, silt, clay, gravel, and organic material.

Artificial Structure

Boat docks associated with hunting and fishing camps provide some artificial structure.

CONDITION IMBALANCE / PROBLEM

Direct habitat alterations such as shoreline development, siltation, and canal dredging for logging and petroleum exploration may be responsible for the decline of several fish and mussel species in the Tangipahoa River. A fish consumption advisory for mercury is posted for the Tangipahoa River by LDEQ (http://new.dhh.louisiana.gov/index.cfm/page/564). The river remains on LDEQ's list of impaired waterbodies for not fully supporting fish and wildlife propagation due to mercury, chloride, dissolved oxygen, sulfates and total dissolved solids. However, twenty years of watershed improvement practices have resulted in significant water quality improvements. LDEQ has removed both the upper and lower segments of the river from their list of fecal coliform impaired waterbodies. The EPA provides full details in the following link http://water.epa.gov/polwaste/nps/success319/la_tang.cfm. Sand and gravel

mining in the watershed continues to contribute to increased sediment. Mossa and Coley (2004) reported 19 sand and gravel mines in the Tangipahoa River floodplain.

CORRECTIVE ACTION NEEDED

Increased coordination between appropriate agencies, non-governmental organizations, and other interested parties are needed to identify and remediate habitat alterations within the watershed.

RECOMMENDATIONS

1. Continue scheduled expanded sampling of fish, invertebrates, habitat quality and aquatic vegetation.

2. Continue treatments as necessary to control nuisance aquatic vegetation. Herbicide applications will be made in accordance with the LDWF approved Aquatic Herbicide Application Procedures (Table 7).

3. Continue the use of existing recreational harvest regulations until LDWF sampling results indicate that change is necessary from a biological perspective, or such time as a change in management strategy is indicated by the collective opinion of area anglers.

Table 7. LDWF Aquatic Herbicide Application Procedures.

Plant Species	Herbicide	Surfactant
Common/Giant Salvinia (April 1 to October 31)	Glyphosate (0.75 gal/acre) + Diquat (0.25 gal/acre) or Clipper (2 oz./acre)	Turbulence (or approved equivalent, 0.25 gal/acre)
Common/Giant Salvinia (November 1 to March 31)	Diquat (0.75 gal/acre)	Nonionic surfactant (0.25 gal/acre)
Water Hyacinth	2, 4-D (0.5 gal/acre)	Nonionic surfactant (1 pint/acre)
Water Hyacinth in waiver areas (March 15 to September 15)	Glyphosate (0.75 gal/acre)	Nonionic surfactant (0.25 gal/acre)
Alligator Weed (undeveloped areas)	Imazapyr (0.5 gal/acre)	Turbulence (or approved equivalent, 0.25 gal/acre)
Alligator Weed (developed areas)	Imazamox (0.5 gal/acre)	Turbulence (or approved equivalent, 0.25 gal/acre)
American Lotus	2, 4-D (0.5 gal/acre)	Nonionic surfactant (1 pint/acre)
American Lotus in waiver areas (March 15 to September 15)	Glyphosate (0.5 gal/acre)	Nonionic surfactant (0.25 gal/acre)
American Lotus in waiver areas with potable water intakes (March 15 to September 15)	Triclopyr (0.5gal/acre)	Turbulence (or approved equivalent, 0.25 gal/acre)
Duckweed	Diquat (1.0 gal/acre)	Nonionic surfactant (0.25 gal/acre)
Cuban Bulrush (*Oxycaryum cubense*)(sedge)	2, 4-D (0.5 gal/acre)	Nonionic surfactant (1 pint/acre)
Cuban Bulrush (sedge) in waiver areas (March 15 to September 15)	Glyphosate (0.75 gal/acre)	Nonionic surfactant (0.25 gal/acre)
Water Lettuce (*Pistia stratiotes*)	Diquat (1.0 gal/acre)	Nonionic surfactant (0.25 gal/acre)

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APPENDIX

(return to document)

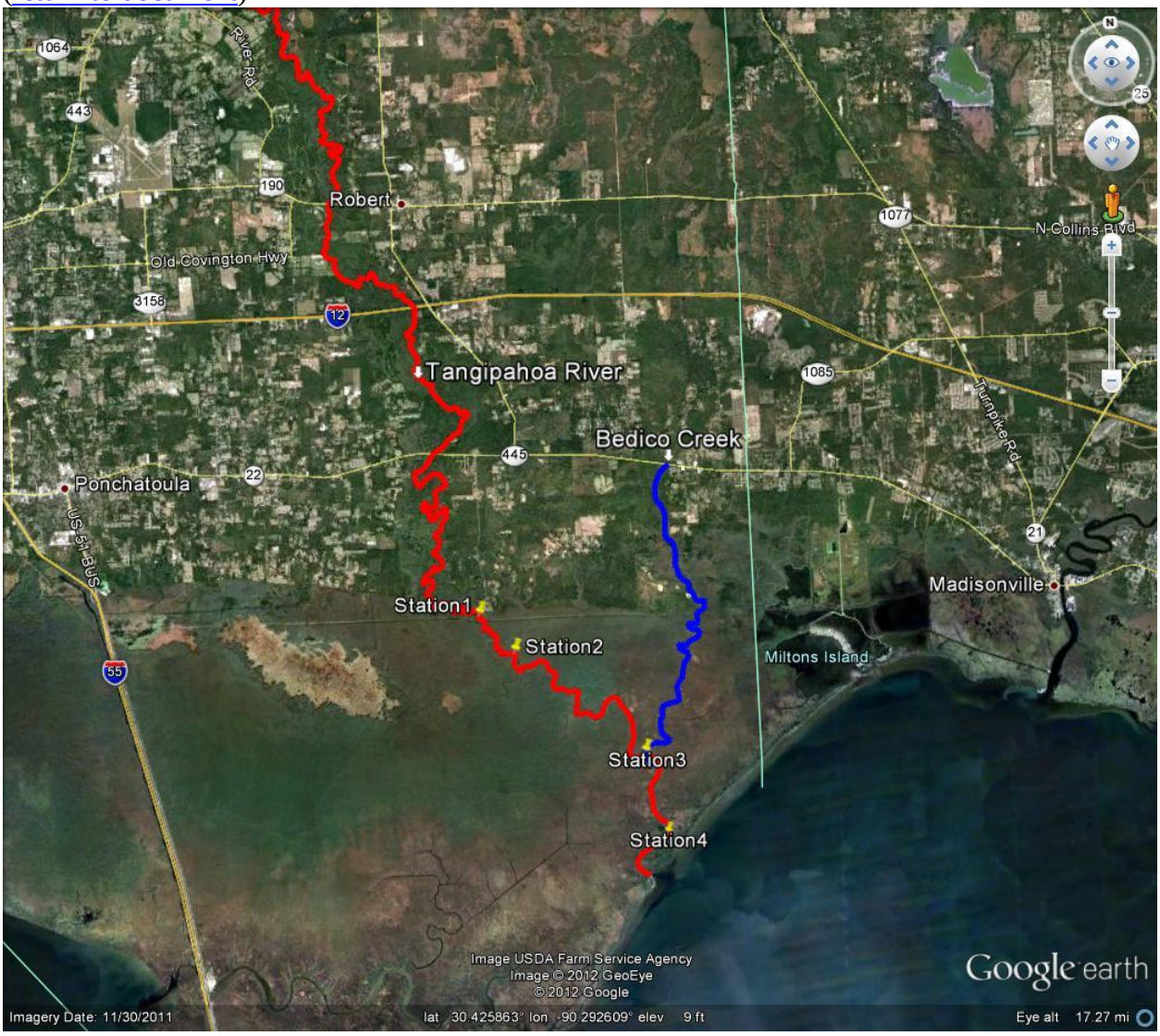

Figure 1. Google earth image 11/30/2011 depicting LDWF standardized electrofishing sample sites on the Tangipahoa River, Louisiana