APPLICATION OF

A FRAMEWORK FOR MONITORING, REPORTING AND MANAGING DAM OPERATIONS FOR ENVIRONMENTAL FLOWS AT SUSTAINABLE RIVERS PROJECT SITES

AT LAKE O' THE PINES ON BIG CYPRESS CREEK

TRUNGALE ENGINEERING & SCIENCE

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Environmental Flows Project

The Caddo Lake Institute (CLI) initiated the environmental flow project ("Project") to restore and protect healthy flows in the Caddo Lake watershed and larger Cypress Basin in 2004 as part of the Sustainable River Project (SRP) (a cooperative program between the U.S. Army Corps of Engineers (USACE) and the Nature Conservancy (TNC)). The initial goal was to seek changes to reservoir operations at Lake O' the Pines (LOTP) to meet a recommended flow regime to restore and maintain the ecological health of Big Cypress Creek and Caddo Lake while also meeting the water needs of people. The Project has since expanded its scope to include recommendations for flow regimes to other major tributaries to Caddo Lake and within the Cypress Basin.

The overall objective is assuring a sound ecological environment, which is defined as

> *"A resilient, functioning ecosystem characterized by intact, natural processes, and a balanced, integrated, and adaptive community of organisms comparable to that of the natural habitat of a region." (TIFP 2008)*

Monitoring is necessary to determine if the recommended flow regimes, and any steps to obtain them, such as changes to reservoir operations at LOPT, are having their intended results and to adjust the recommendations for environmental flows, if necessary. In this report, *A Framework for Monitoring, Reporting and Managing Dam Operations for Environmental Flows at Sustainable Rivers Project Sites* (Higgins et al 2011) is applied to the recommendations for Big Cypress downstream of LOTP.

The purposes of this report are three fold.

1. Document monitoring that has been conducted and has already been used to validate and refine the flow recommendations into a consistent and orderly framework and aid in the evaluation priorities as we move forward,
2. Direct the on-going monitoring program especially work leading up to the next (2016) flows workshop to ensure that critical issues are addressed,
3. Provide a plan that can be evaluated by the larger science team and to which this broader group of scientists and stakeholders can provide input.

Finally, this report is focused primarily on monitoring in Big Cypress Creek downstream of Lake 'O the Pines. Monitoring has also been conducted on the two major tributaries to Big Cypress—Black and Little Cypress. The results of the monitoring on Big Cypress are expected to help evaluate the flow regimes for the other tributaries. The proposed long-term monitoring plans either currently include these tributaries or may be expanded to include them at a future date.

1 The Environmental Flow Prescription: Foundation for Monitoring and Adaptive Management

Science-based environmental flow prescriptions for Big Cypress Creek have been developed in the form of recommendations for how LOTP should be operated to maintain processes important to the condition of the Big Cypress Creek and associated floodplain and the Caddo Lake wetland ecosystem. Individual components of environmental flow prescriptions are based on flow/environmental expert opinion, targeted monitoring and in some cases response models. These components provide the foundation for developing a monitoring plan. The environmental flow prescription for the Big Cypress Creek below Lake O' the Pines Dam includes of a set of hypotheses relating components of river flow to specific geomorphic processes and ecological responses. (Figure 1)

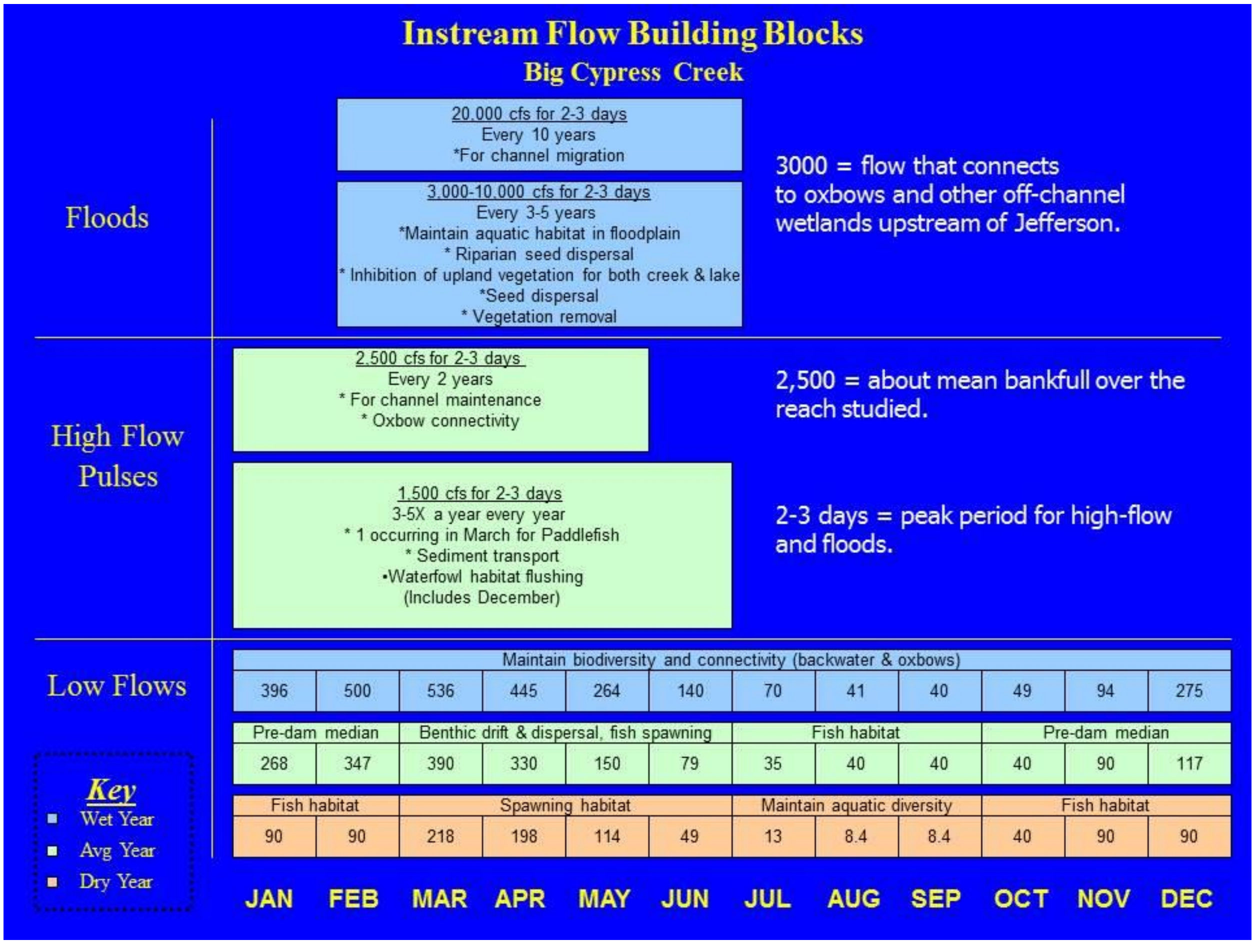

Figure 1 Recommended flow prescription for the Lake O' the Pines Dam on the Big Cypress Creek.

The individual components of the flow prescription (Floods, High-Flow Pulses, Low-Flows) have specific quantitative attributes defined for magnitude, duration, seasonality and frequency that serve as measureable objectives for achieving environmental flows. The expected responses that result from environmental flow components are used to define indicators to inform short-term monitoring and adaptive management needs. (Higgins et al 2011). The overall goal of maintaining and/or restoring the structure and function of a sound ecological environment directs the long-term monitoring.

2 Monitoring to Assess Environmental Flow Implementation

The overall environmental flow prescription for a controlled stream such as Big Cypress Creek consists of components that generally include low flows, periodic high flow pulses, and controlled floods that are possible within authorized dam operations. Each component has a quantitative objective for magnitude, duration, seasonality and frequency. At the conclusion of the 4th Project workshop, participants, including the Northeast Texas Municipal Water District (NETWMD) and the USACE, the two entities with primary responsibility for the management of water in LOTP, agreed to implement a strategy that would provide for much of the flow recommendations for the Big Cypress Creek that had been developed by the Project. The agreed upon implementation plan was intended to include the flow components below and including the 1,500 cfs high flow pulse events and below. The 2,500 cfs pulse occurs, at times, under normal operations necessary to evacuate the flood pool, but is not officially included in the adopted implementation plan. Releases are constrained at this site to 3,000 cfs so the flood events are not implemented in the reservoir operations plans. Dry, Average and Wet conditions are defined by a combination of the Palmer Drought Severity Index values and reservoir elevations (CLI 2014).

The implementation plan was initiated in January 2012. In November 2013, the implementation plan was suspended to due to concerns that lowering lake levels could impact the ability to divert water from the upper end of LOTP. The implementation plan was reinstituted in November 2013. Table 1 below provides tracking implementation of individual components of the flow prescription from Big Cypress Creek.

Table 1 A record of the extent to which environmental flow components were implemented at the Lake O' the Pines Dam on the Big Cypress Creek.

Environmental Flow Component	Prescription (Objectives)			Year 2012	2013	2014
Floods	20,000 cfs for 2-3 days Every 10 years (Wet condtions only) Feb - Jun			Not Implemented		
	3,000-10,000 cfs for 2-3 days Every 3-5 years (Wet condtions only) Feb - Jun			Not Implemented		
High flow pulses	2,500 cfs for 2-3 days Every 2 years (Wet or Avg) Jan - May			Not Implemented		
	1,500 cfs for 2-3 days 3-5X a year every year (Wet or Avg) Dec - Jun			1	0	2
Low flows	Dry	Avg	Wet			
Jan	90 cfs	268 cfs	396 cfs	Dry	No	Avg
Feb	90 cfs	347 cfs	500 cfs	Dry	No	Avg
Mar	218 cfs	390 cfs	536 cfs	Dry	No	Avg
Apr	198 cfs	330 cfs	445 cfs	Dry	No	Avg
May	114 cfs	150 cfs	264 cfs	Dry	No	
Jun	49 cfs	79 cfs	140 cfs	Dry	No	
Jul	13 cfs	35 cfs	70 cfs	Dry	No	
Aug	8.4 cfs	40 cfs	41 cfs	Dry	No	
Sep	8.4 cfs	40 cfs	40 cfs	Dry	No	
Oct	40 cfs	40 cfs	49 cfs	Dry	No	
Nov	90 cfs	90 cfs	94 cfs	No	Dry	
Dec	90 cfs	117 cfs	275 cfs	No	Dry	

The Cypress basin, along with most of the state of Texas, has been experiencing severe drought conditions over the last several years. Thus, implementation of the flow recommendations has largely focused on the dry conditions targets, which only include base flows, and even these were suspended for much of 2013. Conditions have returned to average in 2014 and thus the implementation plan in currently on track to meet some of the high flow pulse recommendations prescribed for average and wet conditions.

3 Monitoring Short-Term Responses to Implementing Flow Prescription Components and to Support Adaptive Management

Short-term monitoring is designed to assess whether or not the implemented components of the flow prescription are resulting in the expected immediate and short-term geomorphic and biotic responses to specific components of flow, and if managing for environmental flows is having any impact on other designated dam operations.

Examples of immediate or short-term geomorphic and biotic responses might include a high flow event that scours substrate (geomorphic) and displaces plants and animals (biotic) or a low flow event that disconnects backwaters (geomorphic) and strands fish (biotic). Indicators of these responses that could be monitored in the short term might include the area of inundated bottomland or available instream habitat. The community response in terms of recruitment rates of juvenile Cypress trees or trends toward riverine dependent fish is considered as part of the long-term monitoring program (see Section 4 below).

The responses to specific components of flow as hypothesized in the Building Blocks are given in Table 2. In general, the priority efforts for the Project in recent years have been monitoring short term responses to high flow pulse events and, in particular, the area of inundation of select riparian and wetland habitats that these events produce. Observations of short-term responses have led to a recalculation of the bank full flow and revisions to the building blocks. Direct measurement and mapping of instream habitat at dry low flows provided a level of validation that the low flow recommendations produced some habitat diversity. Revisions or validation based on short term monitoring, were incorporated into the building blocks that are currently being implemented at LOTP. Soil moisture probes currently installed and collecting data will be used to further validate or refine recommendations related to frequency and duration of high flow pulse events.

If there exists a high degree of uncertainty about the quantification of the flow needed to produce a particular response or there are other reasons for which refining flows values is deemed a priority, it may be helpful to develop a predictive model. In this situation, short-term monitoring could be used to validate and, if necessary, recalibrate models to improve their predictive accuracy. Predictive models of instream flow habitat in response to low flows were developed in this basin as part of earlier studies (USACE 1994). These models were reviewed and discussed at several science meetings and flows workshops. They are now quite dated and the consensus of the biological science subcommittee has been that rather than attempt to modify them to make them suitable to address the questions posed by the SRP project, it would be preferable to develop new models. Participating scientist have been comfortable with the level of certainty associated with the general principle that providing a range of base flows consistent with flows that occurred naturally will provide a suitable range of habitat conditions. The priority, to date, on the low flow / instream habitat component of the SRP project has been to collect baseline biological data to be able to assess long-term ecosystem status and trends in fish communities in response to restoration of low flows (see Section 4) rather than the development or refinement of the predictive flow to habitat models.

Little progress has been made to develop more refined predictive models related to channel maintenance and sediment transport. The literature survey and summary report produced at the beginning of the SRP project (Winemiller et al 2005) predicted the flow required to move significant sediments and these rates were significantly higher than the 3,000 cfs that is currently the upper limit for release from Lake O' the Pines. As a result, there is probably no opportunity to observe short-term channel maintenance or significant sediment transport responses. Monitoring of the response of unplanned dam releases has resulted in attempts to collect data in opportunistic "flow experiments" including pebble count sampling.

A June 2014 implementation report (CLI 2014) explained some of the challenges to implementation of the flow recommendations with respect to other designated dam operations.

Table 2 Predictive models and short term responses to specific components of flow recommendations for the Lake O' the Pines Dam on the Big Cypress Creek.

Environmental Flow Component	Building Blocks (2007) Ecological Response	Predictive Models	Short Term Monitoring
Floods (High)	Channel migration		
Floods (Low)	Maintain aquatic habitat in floodplain		
	Riparian seed dispersal	No predictive modeling	Established vegetation plots for direct observation
	Inhibition of upland vegetation for both creek & lake	Regression models based on GIS Analysis of historical aerial Imagery (SRP 2011)	Validation of predicted inundation via direct observation from boat following flood event (SRP 2012), considering areal imagery collection.
	Vegetation removal	Literature survey saturation tolerance limits (SRP 2011)	Monitoring of established vegetation plots - ongoing in SRP 2014.
High Flow Pulse (High)	Channel maintenance	Considered development of SAM analysis based on existing HEC-RAS models, but not highest priority given available resources	Attempted to perform pebble count pre and post pulse event, however river levels were too high will need to lower releases to closer to 50 cfs to sample. Braun and Moring (2013) includes data comparing based line conditions in big, Black and Little.
	Oxbow connectivity	Bankfull predicted based on 1.5 year recurrence interval (Leopold, Wolman and Miller 1964)	Pressure transducers installed on Big Cypress by USGS lead to revision of bankfull estimate in upper segment (above Jefferson)
High flow pulse (Low)	Paddlefish (Spawning cue)	No model - prediction based on Kilgore memo in Appendix K from COE 1995 Reconnaissance Report	Paddlefish have been reintroduced are being tracked but will be several year before reaching maturity for spawning. Expect spawning study will be developed in future phase of work with USFWS.
	Sediment transport	Similar to channel maintenance issue above	Similar to channel maintenance issue above
	Waterfowl habitat flushing	No predictive modeling	
Low flows (Wet)	Maintain biodiversity and connectivity (backwater & oxbows)		
Low flows (Average)	Benthic drift & dispersal, fish spawning	No predictive modeling	
	Fish habitat	Existing PHAB SIM Models from 1990s predict available habitat at low flows for select species, results presented	
Low flows (Dry)	Fish habitat		Mesohabitat mapping (Braun and Moring 2013)
	Spawning habitat		
	Maintain aquatic diversity	No predictive modeling, assume diversity of habitat provided by range of flows will support population diversity.	

4 Monitoring to Assess Long-Term Ecosystem Status and Trends

Since the initiation of the Project, the state of Texas has passed legislation and provided extensive guidance on the topic of environmental flows analysis including selection of indicators for response to implementation for environmental flow recommendations (TIFP 2008). In an effort to maintain consistency with this program, the Project reviewed indicators selected in other regions of Texas and, at the 2011 flows workshop, proposed a list of indicators, in Table 3, organized by the five TIFP disciplines. Although not necessarily verbatim, this list encompasses most of the items originally identified as Building Blocks. Of this list most items either assess environmental flow implementation (Hydrology) or indicate short-term responses to implementing flow prescription components to support adaptive management (Biology (Habitat), Water Quality and Connectivity). Indicators designed to track the status and trends (direction of change) in the condition of river, floodplain and lake ecosystems in response to flow management are those in the Biology (except Habitat), Geomorphology and Lake categories. Items identified in the Building Blocks that are not encompassed in this list include paddlefish spawning and water fowl habitat. Paddlefish spawning is being addressed as part of a long-term cooperative study with the US Fish and Wildlife Service (USFWS) (See Section 5.4 below). To date there has been no progress on the waterfowl habitat analysis.

It is not feasible given available resources to maintain long-term monitoring of all potential indicators. The long-term monitoring efforts that the Project is currently focused on are the *Fish Community Indices* and *Riparian Vegetation Community* evaluations. Significant efforts have been made to determine baseline conditions and projects are currently under way to develop metrics and initiate long-term sampling programs. The items in the Lake category might be impacted by future water development projects on either Black or Little Cypress or changes to the release structure at Caddo Lake, however the lower imminence of these developments makes these items slightly lower priorities at the current time. The items within the Geomorphology category have continued to be lowest priority issues primarily due to limitations on releases that might reasonably be expected to alter the existing status.

Table 3 Potential indicators of ecosystem health for streams of the Cypress Basin for use in flow monitoring.

Category	Indicator	Description	Monitoring*
Biology	Fish community indices	Fish community metrics (e.g., species richness, percent intolerant species), multi-metric index (e.g., Index of Biotic Integrity) or relative abundance or index of flow-sensitive focal species or guilds.	Long
	Macroinvertebrate community indices	Benthic macroinvertebrate community metrics (e.g., species richness, percent EPT) or multi-metric index.	Long
	Mussel community indices	Indices of mussel community health and /or abundance, recruitment or other measure of focal mussel species.	Long
	Instream habitat quantity, quality	Amount of usable instream habitat for focal fish species using modeled relationships of instream habitats to flow from PHabSim.	Short
	Instream mesohabitat area and diversity	Area and diversity of mesohabitat types (riffle, pool, run). Using modeled relationships of instream mesohabitats to flow from PHabSim or other methods.	Short
	Riparian vegetation communities	Inundated area of flow-dependent vegetation communities (cypress swamp, bottomland hardwoods). Using modeled relationships of inundated area to flow.	Long
	Riparian vegetation communities	Measures of vegetation community structure such as species composition, density, canopy cover and age class distribution (i.e., regeneration).	Long
Hydrology	High Flow Pulses, Controlled Floods	Natural variability and attainment frequency of prescribed High Flow Pulses and Floods (magnitude, frequency, timing, duration, and rate of change) by month/season and hydrologic conditions.	Implementation
	Low, subsistence flows	Natural variability and attainment frequency of prescribed Low and Subsistence flows (magnitude) by month and hydrologic conditions.	Implementation
Water quality	Nutrients, dissolved oxygen, temperature	Primary water quality parameters of nitrogen, chlorophyll-a or other measures of nutrient levels, DO and temperature. Using Clean Rivers Program monitoring and TCEQ standards.	Short
	Turbidity, Conductivity, Bacteria, pH, mercury	Secondary water quality variables. Using Clean Rivers Program monitoring and TCEQ standards.	Short
Geomorphology	Rate of lateral migration, channel avulsion or bank erosion	Rate of lateral movement of stream channel across valley, channel avulsion (creation of channel cut-offs and oxbow lakes) and/or rate at which flows erode the side of the stream channel.	Long
	In-channel bars	Area, configuration, sediment size characteristics of in-channel bars.	Long
	Meander pools	Depth of in-channel meander pools during no or low flows.	Long
	Woody debris volume	Volume, rate of transport and/or recruitment rate of woody debris.	Long
Connectivity	Total floodplain area inundated	Area or percent of total floodplain area inundated by high flow events.	Short
	Habitat area inundated	Area or percent of area of specific habitats (e.g., floodplain features) inundated by high flow events.	Short
	Stage (USGS gages)	Frequency of occurrence of flow stages at which backwater and floodplain connections begin.	Short
	Connection to river	Frequency of connection of the river to oxbow lakes, backwaters and other floodplain habitats.	Short
	Longitudinal connectivity	Longitudinal connections between instream habitats during low flows.	Short
Caddo Lake	Invasive plants	Aerial cover, density or other measure of invasive species in Caddo Lake.	Long
	Bald cypress swamp	Measures of bald cypress community health.	Long

*Implementation - Monitoring to Assess Environmental Flow Implementation, Short - Short-Term Responses to Implementing Flow Prescription Components and to Support Adaptive Management and Long - Assess Long-Term Ecosystem Status and Trends

5 Monitoring Plans

The Caddo Lake and Big Cypress Holistic Monitoring Plan includes monitoring to access

1. Environmental Flow Implementation
2. Short Term Responses for Adaptive Management
3. Long-Term Ecosystem Status and Trends

5.1 Assess Environmental Flow Implementation

The monitoring plan to access the implementation of the environmental flow recommendations is a reasonably straightforward process to calculate the long-term attainment frequencies at which the recommended flow prescriptions are maintained. The exercise has been conducted in near real time since 2012. LOTP has been operated to make releases according to a consensus implementation plan. The effectiveness of this implementation plan to meet the long-term target attainment frequencies has been investigated using reservoir simulation models to predict releases. The results of this analysis are provided in a separate report (CLI 2014).

5.2 Short Term Responses for Adaptive Management

Monitoring of short term responses for adaptive management will continue to address the following questions

1. Are the recommended Low Flows during dry conditions in the summer sufficient to meet water quality standards?
2. Do the recommended Low Flows during dry and average conditions provide diverse suitable habitat supportive of the native fish, invertebrate and mussel communities?
3. Do the recommended Low Flows during wet conditions provide for connections to floodplain oxbow and lakess?
4. Do the recommended High Flow Pulses connect the river to the watershed at sufficient frequencies and durations to inundate riparian wetland areas?

Answers to questions number 1 (water quality) and 4 (riparian oxbow connectivity) were provided through direct observation prior to the last flows workshop and served to validate and refine the recommendations, though continued routine or opportunistic monitoring may continue. Questions number 2 (instream habitat) and 4 (riparian habitat) might be addressed with improved predictive models, and short term response monitoring can be used to validate or refine these models. Question 4 is the one for which a predictive model was most used to evaluate the flow recommendations. The regression model used to estimate area of inundation in response to high flow events would benefit in terms of being refined or validated by target monitoring, ideally with real time aerial photography to determine the accuracy of the model predictions. Question 2, related to the relationship between low flow and instream habitat, would benefit most significantly from an updated (or new) physical habitat model. This is because there is such a wide range of flow rates that it would be difficult to empirically sample and quantify habitat areas at each. Once a better predictive habitat model was developed, short-term response monitoring would be beneficial to ensure that the model made accurate predictions at flow rates for which it was not specifically calibrated.

5.3 Long-Term Ecosystem Status and Trends

The Project continues to develop and implement a program to monitor long-term status and trends of the aquatic and riparian plant and animal communities indicative of a sound ecological environment. These long-term monitoring programs include *Fish Community Indices* and *Riparian Vegetation Community* evaluations. Figure 2 shows a map of candidate monitoring sites for both the fish and vegetation community monitoring. These sites are either currently being monitored or are where baseline data has recently been collected.

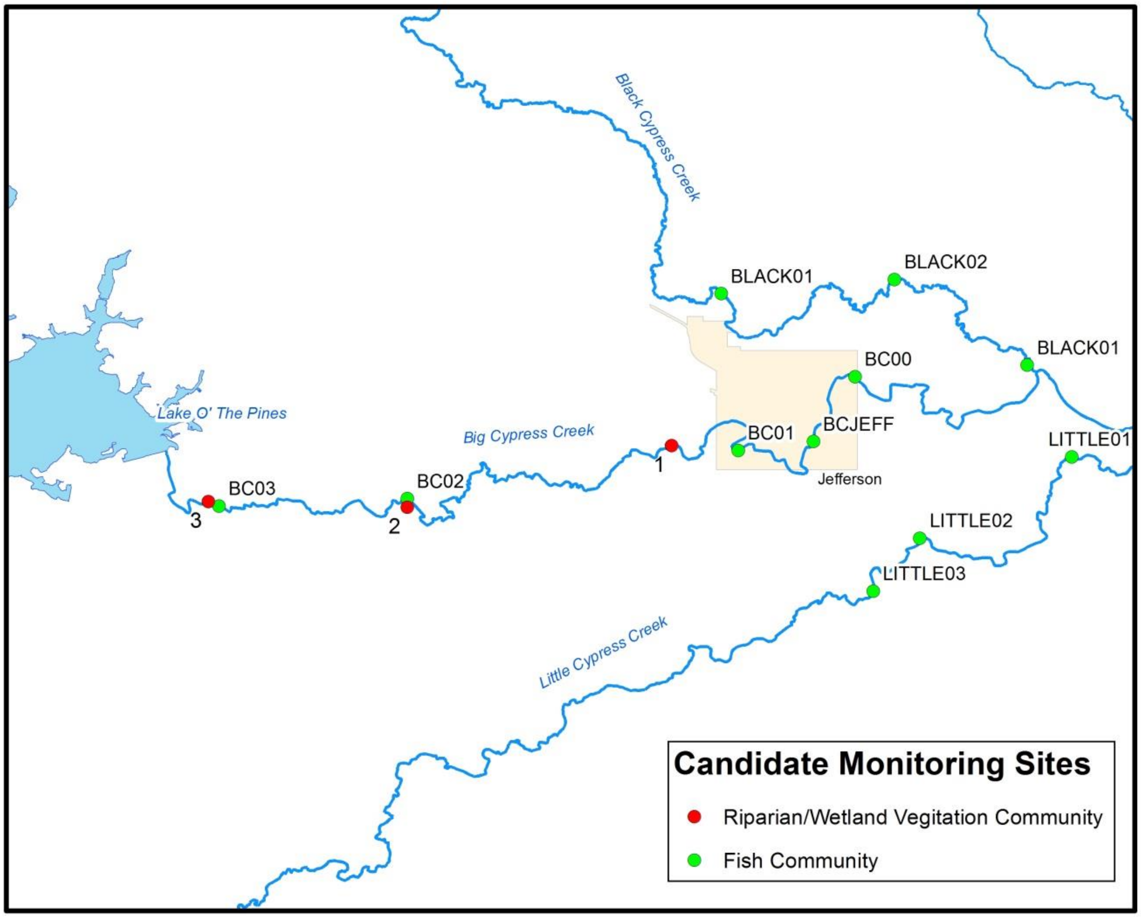

Figure 2 Map of monitoring site candidate.

5.3.1 Fish Community Indices

The Project has received some of the funding needed to develop indicators and initiate the sampling program for status and long-term trends in fish communities. The indicators will consist of a suite of metrics to evaluate the response of flow-sensitive species to restoration of natural flow regimes. The development of indicators will begin with review of the IBI (Index of Biotic Integrity). An IBI combines several metrics within three broad categories (species richness and composition, trophic composition and fish abundance and condition) to produce an IBI score and, based on that score, classify the integrity of the stream (limited, intermediate, high or exceptional). In Texas, the IBI has been used primarily for receiving water assessments and the metrics and scores that have been developed are considered sensitive to changes in water quality.

The biological subcommittee will consider expansion and refinement of select metrics within the IBI that may be more sensitive to restoration of the natural flow regime. A similar approach has been initiated in the Sabine Basin, which may serve as a model for the development of metrics specific to the Cypress Basin.

The biological subcommittee will begin by addressing the following questions.

1. Which species or guilds have responded (increasing or decreasing) in response to altered flow regimes in Big Cypress?

2. What species, within families included above, would expect to show a response to a restoration of a more natural flow regime? Are particular guilds (habitat, reproductive, feeding) important indicators?
3. What specific metrics need to be calculated (richness, diversity, etc.) and would these need to be tied to specific life stages? This would be used to inform the next question.
4. Is the current clean rivers program protocol able to capture the data that is needed? If not, what modifications are needed?
5. Can a natural range of variability (NRV) or something analogous to an IBI score be developed to define expected results? What is good and what is bad based on sampling results and how can that be communicated in way that would validate, refute or suggest modification to the flow recommendations? What is the expected time frame for seeing a response? Are there any means to control for or consider confounding variables?

Sampling is being planned with Texas Parks & Wildlife Department (TPWD) for the fall of 2014. The sampling program with be based on TPWD guidelines that have been used by the SB2 Texas Instream Flow Program. The goal in fish sampling is to collect a representative sample of the species present in their relative abundances. All available habitats and combinations of habitats should be sampled. Beyond the minimum efforts, sampling should always continue until no additional species are collected. In most streams, fish will be collected using multiple gear types—seines and electrofishers. Hoop and gill nets may be used to augment seine and electrofishing samples. A habitat team will work with the sampling team and record habitat data for each seine haul and electrofishing effort.

Initially, thresholds will be defined based on application of metrics developed above to historical fish collections. Synoptic sampling efforts have been conducted during at least three time periods (in the 1950s, 1990s and 2000s) which will be used to construct baseline references for range of natural variability in biotic assemblages. Although the specific indicator indices have not yet been finalized, the biological sub-committee has been assembling and analyzing historical collections and made preliminary evaluations of long-term trends (Figure 3 and 4). Primary findings are consistent with previous hypotheses, namely that "The ichthyofauna of the Cypress Bayou basin appears to have shifted from assemblages dominated by cyprinids, percids, and cyprinidontids in the 1950s to assemblages dominated by centrachids, other cyprinids, clupeids, and atherinids in the 1980s." This analysis may help to inform indicator selection, provide initial estimates of threshold targets and may direct short term monitoring efforts aimed at developing better understanding between flow and habitat.

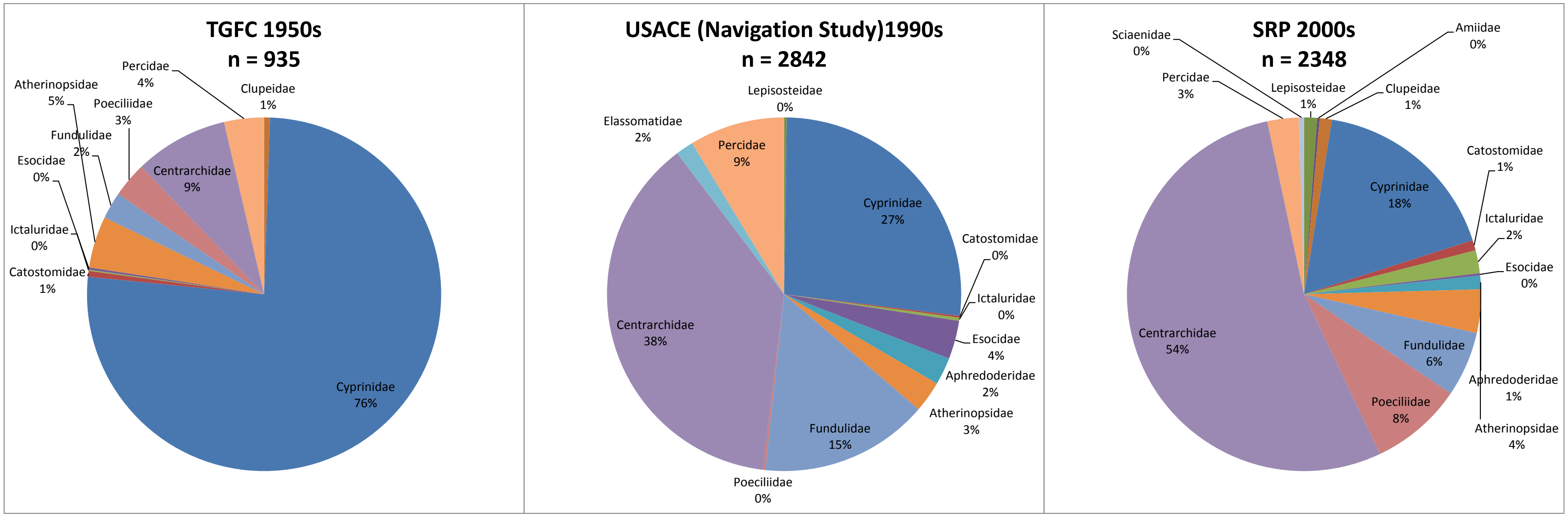

Figure 3 Change in fish communities (Families) in Big Cypress Creek from 1950s to present.

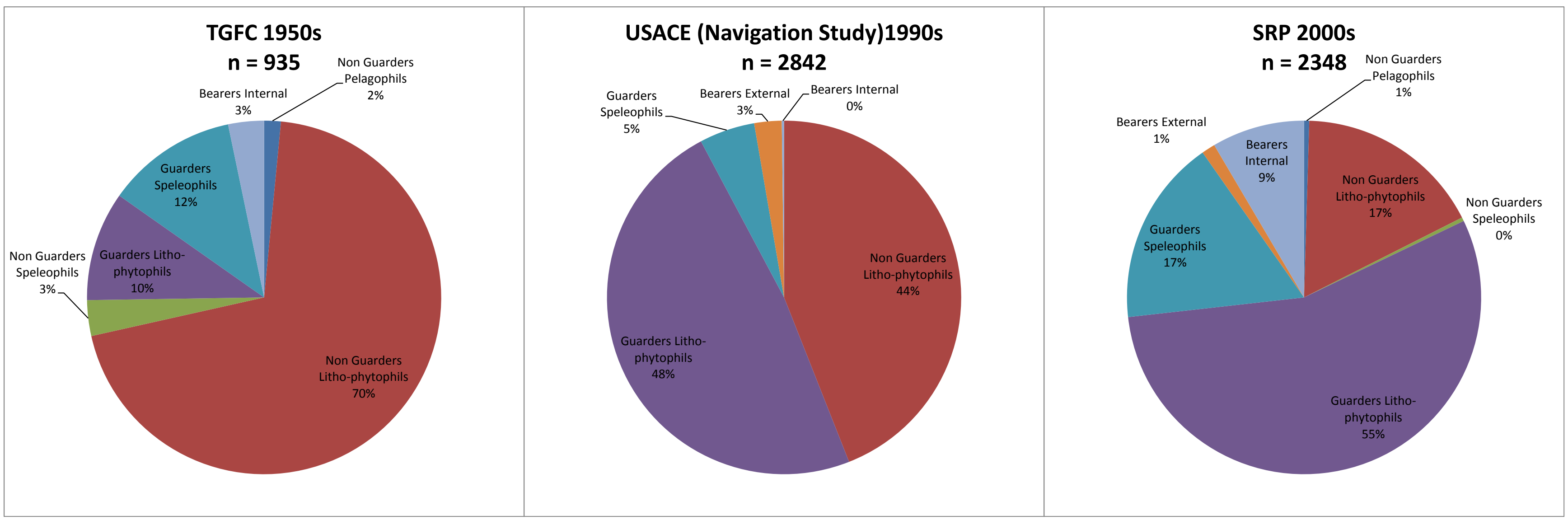

Figure 4 Change in fish communities (Reproductive Guilds) in Big Cypress Creek from 1950s to present.

5.3.2 Riparian Vegetation Community

Long-term monitoring plots have been established at three sites. Indicators will include

1. tree seedling and sapling establishment,
2. species diversity within each forest strata (tree, shrub, herbaceous), and
3. encroachment by upland and exotic plant species.

An initial baseline survey is populating data sets for comparison to subsequent data collections (SRP 2012). The proposed riparian methodologies quantitatively assess plant communities to establish a baseline by which the functional status of river-floodplain connectivity may be determined now and in the future. Vegetation variables, calculated for each community type and each component species, include size class distribution, species richness and diversity, stem density, basal area, and percent canopy cover.

5.4 Special Study - High Flow Pulse Relationship to Paddlefish and Other Fish Spawning Cues

An experimental reintroduction of paddlefish is currently underway to determine if changes to operations of an upstream reservoir can provide the conditions needed for the long-term return of this fish and other endangered fish and mussels to Caddo Lake and the larger watershed. This project includes aspects of both short term and long-term monitoring plans.

Currently the project is focused on a short-term question to determine if, after being reintroduced, the fish will remain in the system. After successful surgery to implant radio transmitters in 47, two-foot long paddlefish and release of those fish into the watershed in March 2014, CLI is now tracking the fish to learn more about their use of the watershed. The first measure will be based on the data collected on movement of the paddlefish and conditions of the habitat used. USFWS, CLI and others will determine if the experiment supports a large-scale reintroduction of the paddlefish and if changes to the dam release patterns are needed to do that. (A report on the project will include an evaluation of the tracking systems to guide future projects at Caddo Lake and elsewhere.)

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