Project 8
Development of a Statewide Stream and River Assessment Program for Aquatic Species of Conservation Concern

Final Report

State: Alabama **SWG Grant Number: T-4-P-1**

Period: October 1, 2005 to September 30, 2009

Need:

This project will initiate a statewide stream and river assessment program to gather new information on the distribution, abundance, species composition, and habitat requirements of aquatic species in Alabama. Species designated as Greatest Conservation Need (GCN) in the Alabama Comprehensive Wildlife Conservation Strategy will be targeted. In addition, this biomonitoring program will provide information evaluating stream and river health. Standardized stream sampling methods (i.e., Index of Biotic Integrity) developed by the Geological Survey of Alabama (GSA) will be employed. The GSA has developed and applied the Index of Biotic Integrity (IBI) to the Cahaba River, streams in the Black Warrior River system, and the Locust Fork system. However, no statewide standardized stream and river assessment program for aquatic species exists in Alabama and Division of Wildlife and Freshwater Fisheries (DWFF) personnel have not been trained to perform such assessments.

Objective(s):

The objectives of this project are to create a bioassesment tool for the State of Alabama using the Index of Biotic Integrity (IBI) methodology and to train DWFF biologists in stream and river assessments.

Expected Results:

These valuable tools will allow DWFF to assess Alabama waters resulting in more effective management of aquatic species, assist agencies in evaluating instream flow issues as related to aquatic species, understand aquatic resources and aquatic species more broadly and in greater depth, and better manage aquatic habitat.

Approach:

Although the IBI is routinely used for water-quality regulation in other states and has been successfully applied in selected drainages in Alabama, it is underutilized in Alabama as an assessment tool. Several obstacles remain if a biomonitoring method is to be applied statewide for assessing streams and stream habitat.

- A standardized wadeable stream sampling protocol must be created and adopted for use. Research is needed to explore lake, reservoir, and non-wadeable river sampling protocols.
- The IBI has not been calibrated statewide to Alabama's high fish biodiversity and variable ecological and physiographic regions. Ecoregional and/or drainage-specific scoring criteria still need to be determined for most of Alabama's waters.
- Application of the IBI requires accurate species identifications by well-trained individuals. Any organization applying the IBI in Alabama should seriously consider this, particularly in light of Alabama's high fish biodiversity. The benefits of "green" sampling (i.e. non-destructive sampling), which means identifications are made on site and individuals are returned to the stream, should also be given a priority. A QA/QC system for fish identification within agencies should be established.
- Ecoregional and (or) drainage reference sites will be established and sampled systematically over time.

Target Date for Achievement: September 30, 2009
Completion Date: September 30, 2009

Activities: Three separate projects were completed in FY09 and their respective reports are attached.

- Project 1 – Henderson, A. 2009. Application of the Index of Biotic Integrity for Assessing Biological Conditions of Wadeable Streams. Alabama Division of Wildlife and Freshwater Fisheries, Montgomery, 23 p.
- Project 2 – O'Neil, P. E. and T. E. Shepard. 2009. Calibration of the Index of Biotic Integrity for the Southern Plains Ichthyoregion in Alabama. Geological Survey of Alabama Open-File Report 0908, Tuscaloosa, 122 p.
- Maceina, M. J. and R. W. Hunter. 2009. Protocol for Fish Data Collection to Develop a Tailwater Fish Index on the Coosa River, Alabama. Alabama Division of Wildlife and Freshwater Fisheries, Montgomery, 21 p.

Significant Problems Encountered: None.

Significant Deviations: None.

Costs: See Grant Agreement, annual cost reflected on SF 269.

Project 1

Application of the Index of Biotic Integrity for Assessing Biological Condition of Wadeable Streams in Alabama

by

Andrew Henderson
Alabama Division of Wildlife and Freshwater Fisheries
3608 Fairground Road
Montgomery, AL 36110

Montgomery, Alabama
2009

Abstract

The Wildlife and Freshwater Fisheries Division of the Alabama Department of Conservation and Natural Resources initiated stream sampling within the Fisheries section in 2009. Seventy stream sites across various watershed sizes were targeted in six management districts across the state. A total of 20,540 fishes representing 136 species were collected, identified, and returned to their capture location. Sites were distributed across 21 counties. Fisheries biologists sampled a minimum of 10 stream sites in their district using Alabama's Index of Biotic Integrity (IBI) 30 + 2 method. Stream IBI scores were calculated from wadeable stream sites in the following major river drainages: Black Warrior, Cahaba, Coosa, Tallapoosa, Chattahoochee, Alabama, Conecuh, Escambia, and Choctawhatchee. Extensive sampling was done in 2009 in the Tennessee River drainage, but IBI scores were not calculated for streams in the basin since development of metrics and criteria has not yet been completed.

Introduction

In 2009 wadeable stream sampling in Alabama was conducted by the Wildlife and Freshwater Fisheries Division (WFFD) of the Alabama Department of Conservation and Natural Resources (ADCNR). These efforts were led by the Aquatic Resources office of WFFD in association with the Geologic Survey of Alabama (GSA) and the Alabama Department of Environmental Management (ADEM). Sampling protocol and methods developed by O'Neil and Shepard (2000; 2004; 2009), and O'Neil et al. (2006), were used as part of development and implementation of a comprehensive fish community bioassessment tool in a multi-year research effort initiated by ADCNR. A standardized

30 + 2 Index of Biotic Integrity (IBI) technique has been developed by GSA for ichthyoregions in Alabama, with existing technical support (Karr et al., 1986; Barbour et al., 1999; O'Neil and Shepard, 2007). The IBI has metrics designed to include a range of attributes of fish assemblages. Data were obtained and evaluated in comparison to what might be expected at a relatively unimpacted site on a stream of comparable size in a similar geographical region. Ratings for each metric are applied and the overall sum yields a site score, a true measure of the quality of a water resource (Karr et al., 1986).

A primary goal is to apply Alabama's calibrated IBI to wadeable streams as a biomonitoring tool. Biological assessments directly measure the biological performance of a water body, and biological monitoring is linked closely with fishes because of their value as a food source and as a recreational resource (O'Neil and Shepard, 2007). Assessment of the biological condition of streams using the fish community has advantages over the use of other aquatic groups, including: fishes occupy the full range of positions throughout the food chain, fishes are generally present in all waters, population numbers of fishes are relatively more stable over longer periods of time, species identification is possible for all individuals collected, and environmental requirements of fishes are well known for a majority of species (Karr et al., 1986).

Assessment and monitoring of Alabama's stream fish communities will achieve multiple goals, including: annual detection of species of greatest conservation need and prioritization of habitat for their conservation, determination of quantity and abundances of stream fish species, provide data on sport fish and commercially important fish species, survey fish communities in ADEM 303d listed streams, and give valuable fish

species information needed for recovery in streams listed as critical habitat units for threatened and endangered mussels in the Mobile River basin (O'Neil et al., 2009).

Acknowledgements

The following individuals from WFFD conducted fieldwork and assisted with data collection: Keith Floyd, Jeff Garner, Phil Ekema, Glenn Selby, Dan Catchings, Michael Holley, Kevin Baswell, Jerry Moss, Jay Haffner, Jim Piper, Chris Greene, Graves Lovell, Rodney McVay, Dave Armstrong, Ben Ricks, Matt Marshall, Jason Thomas, Ken Weathers, Rob Andress, Rob McCarter, Stan Cook, Maurice Jackson, Brenda Morrison, Steve Rider, Travis Powell, Tom Ringenberg. Individuals from GSA that conducted field work included Pat O'Neil, Tom Shepard, Stuart McGregor, Brett Smith, Cal Johnson, and Anne Wynn provided materials. Pat O'Neil, Steve Rider, Stan Cook, and Tom Shepard provided data and were instrumental in logistical planning and discussions on data collection and project implementation. Fred Leslie and Dusty Miller from ADEM provided materials and discussed sampling considerations.

Methods

The 30 + 2 standardized sampling protocol completed in earlier phases of the cooperative IBI project has proved acceptable for collection of a representative fish community sample for the purpose of calculating an IBI score (O'Neil et al., 2006). Stream sampling at all sites was stratified over four habitat types (riffles, runs, pools, and shorelines), with a minimum of 10 sampling efforts dedicated to riffles, runs, and pools, and two 150 feet long shoreline efforts. Fisheries biologists sampled a minimum of 10 sites in their district using the 30 + 2 IBI method (Fig. 1). Districts I, II, and VI sampled more than 10 sites (Table 1). Thirty-two efforts were completed at all sites, and for sites missing certain habitat components the effort potentially expended in the missing habitat was proportioned to habitat types that were present. A small-mesh minnow seine (3/16 weave, 10 feet wide, 6 feet tall), and a Smith-Root backpack electroshocker were used to collect fishes at all sites, often in combination with one another as sets with shocking in riffles, runs, and glides. Shoreline efforts were conducted by electrofishing with crew members following closely behind the shocker netting stunned fishes with dip nets.

Results and Discussion

District I

Fifteen stream IBI sites were sampled in District I. A total of 8,568 fishes representing 66 species were collected in 13 streams. All sites sampled were in the Tennessee River drainage, and sampling efforts were coordinated with GSA in order to gather data for calibration of the IBI in the Tennessee Valley ichthyoregion (O'Neil and

Shepard, 2007). Sites were distributed across Lauderdale, Colbert, Franklin, Lawrence, and Madison counties.

District I had the largest number of Alabama priority species of conservation concern collected of all districts (Mirarchi et al., 2004) (Appendix A). Two priority 2 species of high conservation concern were collected in the Bear Creek system, *Noturus miurus,* (brindled madtom), and *Percina evides,* (gilt darter). These species were collected in Little Bear Creek at County Road 23 and Cedar Creek at Pogo. Three priority 3 species of moderate conservation concern were collected; *Erymistax insignis* (blotched chub), *Notropis microptryx* (highland shiner), and *Notropis photogenis* (silver minnow). Blotched chubs and silver minnows were collected in the Flint River, and highlands shiners were collected in Bear Creek at County Highway 57. Little Cypress Creek at Old Jackson Road and Cedar Creek at Pogo each had 3 Alabama species of conservation concern, and will require continued monitoring in the future. District I also had the site with the highest species diversity in the state, Flint River, with 30 species and 2 moderate concern species. Flint River, Bear Creek, and Little Bear Creek are all 303d listed, and since these streams overall had high diversity, additional sampling in these streams in the future is needed.

District II

Thirteen stream IBI sites were sampled in District II in 2009. A total of 2,247 fishes representing 43 species were collected in 10 streams. Eleven sites were in the Tennessee River drainage, and sampling efforts were coordinated with GSA in order to gather data for calibration of the Index of Biotic Integrity in the Tennessee Valley

ichthyoregion. Sites were distributed across Dekalb, Marshall, Jackson, and Blount counties. There was an IBI score calculated for two sites, Locust Fork of the Black Warrior (site 21) and Big Mud Creek (site 23), a tributary to Locust Fork. Locust Fork scored fair (40), and Big Mud scored poor (30), using methods developed by O'Neil and Shepard (2000) (Table 2). Sites sampled in District II did not have any Alabama priority species of conservation concern collected.

District III

Ten stream IBI sites were sampled in District III in 2009. There were a total of 2,069 fishes representing 54 species collected in 8 streams. All sites were in Tuscaloosa County. Nine sites were in tributaries to the North River, Black Warrior drainage. IBI scores were calculated for those sites using O'Neil and Shepard (2000) (Table 3a). One site was sampled in the Cahaba River drainage, Mud Creek at Tannehill State Park (site 37). Ridge and Valley/Piedmont ichthyoregion IBI metrics were used for this site (O'Neil et al., 2006), and the stream scored fair (40) (Table 3b). Only two stream sites had good IBI scores, Tyro Creek and Hurricane Creek at Hurricane Middle School. Sites sampled in District III did not have any Alabama priority species collected.

District IV

Ten stream IBI sites were sampled in District IV. A total of 2,820 fishes representing 69 species were collected in 9 streams. Five streams were sampled that are designated as Critical Habitat Units for threatened and endangered mussels in the Mobile River Basin. Four of these streams are in the Tallapoosa River drainage: Uphapee,

Choctafaula, Chewacla, and Opintlocco Creeks. One stream is in the Coosa River drainage, Hatchet Creek, which was sampled at two locations. On average there was high diversity and higher IBI scores at these sites compared to other sites in District IV, in particular in Hatchet, Uphapee, and Opintlocco Creeks (Table 4a). Methods and criteria developed for the Coosa & Tallapoosa River systems were used for IBI calculations at these sites (O'Neil et al., 2007). In Hatchet Creek at County Road 18 we collected *Percina brevicauda* (coal darter), a priority 2 species of high conservation concern. This site had a good IBI score (50), the highest IBI score in the district, and this stream has a regional reference watershed (O'Neil and Shepard, 2004). Choctafaula Creek yielded 27 species, the site with the highest diversity in the district. Sougahatchee Creek is a 303d listed stream, and scored fair (40), the lowest scoring site in the Tallapoosa drainage.

Little Uchee, Osanippa, and Halawakee Creeks were sampled in the Chattahoochee River basin. Metrics and criteria developed for the Southern Plains ichthyoregion were used to calculate IBI for sites in the Chattahoochee drainage (O'Neil and Shepard, 2009). *Campostoma pauciradii* (bluefin stoneroller), an Alabama species of moderate conservation concern, was collected in each of these streams and was abundant when present. *Cyprinella callatenia* (bluestripe shiner), a species of moderate conservation concern, was collected in Osanippa Creek, a poor site with the lowest IBI score (34) of sites sampled in the Chattahoochee drainage (Table 4b). *Ameiurus serracanthus* (spotted bullhead), also a species of moderate conservation concern, was collected in Halawakee Creek.

District V

A total of 2,152 fishes representing 56 species were collected in District V. Ten sites were sampled across 9 streams in the Alabama, Conecuh, and Escambia river drainages. Sites were located in Conecuh, Clarke, and Escambia Counties. Six of the 10 sites had good IBI scores using methods developed for the Southern Plains ichthyoregion (O'Neil and Shepard, 2009) (Table 5a). *Percina austroperca* (southern logperch), a priority three species of moderate conservation concern, was relatively abundant in Murder Creek at Highway 29. One 2008 ADEM 303d listed stream was sampled in district V, Little Escambia Creek in Escambia County (Table 5b). The stream had a good (44) IBI score.

District VI

Twelve stream IBI sites were sampled in District VI. A total of 2,677 fishes representing 43 species were collected in 11 streams. All sites were in the Choctawhatchee River drainage and were distributed across Dale, Henry, Houston, and Geneva counties. IBI scores were calculated using methods developed for the Southern Plains ichthyoregion (O'Neil and Shepard, 2009). Judy Creek and Hurricane Creek are ADEM 303d listed. Hurricane Creek scored good, the second highest of all sites in District VI, and Judy Creek scored fair, the lowest score in the district (Table 6a). Spring Creek at County Highway 55 had an excellent IBI score (52), the only stream site sampled by WFFD in 2009 with such a high score. *Alosa alabamae* (Alabama shad) are known to migrate into this stream from the Choctawhatchee River (Ken Weathers, WFFD, pers. comm.), and although it was not collected in 2009, we will continue to

monitor this stream for this species in the future. Also, the Little Choctawhatchee River was sampled in two locations (Table 6b).

References

Barbour, M.T., Gerritsen, J., Snyder, B.D., and Stribling, J.B., 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish, second edition: U.S. Environmental Protection Agency, Office of Water, Washington, D.C., EPA 841-B-99-002.

Karr, J.R., Fausch, K.D., Angermeier, P.L., Yant, P.R., and Schlosser, I.J., 1986. Assessing biological integrity in running waters, a method and its rationale: Urbana, Illinois, Illinois Natural History Survey Special Publication 5, 28p.

Mirarchi, R.E., J.T. Garner, M.F. Mettee, P.E. O'Neil, eds. 2004. Alabama wildlife. Volume 2. Imperiled aquatic mollusks and fishes. The University of Alabama Press, Tuscaloosa, AL. 255 pp.

O'Neil, P.E., and Shepard, T.E., 2000. Application of the Index of Biotic Integrity for assessing biological condition of wadeable streams in the Black Warrior River system, Alabama: Alabama Geological Survey Bulletin 169, 71 p.

O'Neil, P.E., and Shepard, T.E., 2004. Hatchet Creek regional reference watershed study: Alabama Geological Survey Open-File Report 0509, 48 p.

O'Neil, P.E., and Shepard, T.E., 2007. Delineation of Ichthyoregions in Alabama for use with the Index of Biotic Integrity: Alabama Geological Survey Open-File Report 0711, 48 p.

O'Neil, P.E., and Shepard, T.E., 2009. Calibration of the Index of Biotic Integrity for the Southern Plains Ichthyoregion in Alabama: Alabama Geological Survey Open-File Report 0908, 117 p.

O'Neil, P.E, McGregor, S.W., Wynn, E.A., and Powell, J.R., 2009. Critical Habitat Units for Threatened and Endangered Mussels in the Mobile River Basin: Alabama Geological Survey Special Map 247.

O'Neil, P.E., Shepard, T.E., and Cook, M.R., 2006. Habitat and biological assessment of the Terrapin Creek watershed and development of the Index of Biotic Integrity for the Coosa and Tallapoosa River systems: Alabama Geological Survey Open-File Report 0601, 210 p.

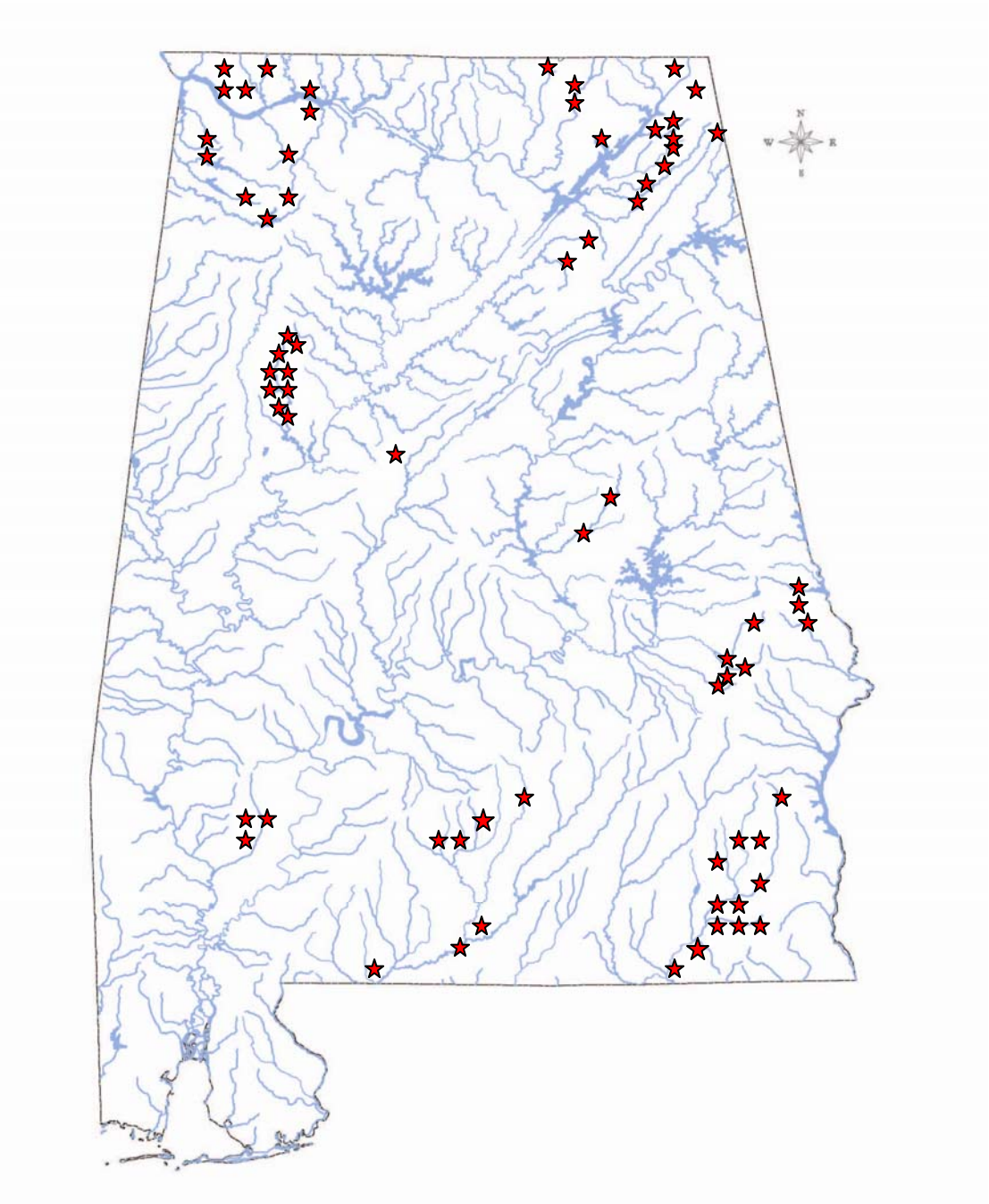


Figure 1. Location of stream sampling stations 2009.

Table 1. Stream sampling stations & IBI scores.

Site	District	Sampling Locality	Drainage	County	Date	Lat (N)	Long (W)	Score	Condition
1	I	Little Cypress Creek at Old Jackson Road	Tennessee	Lauderdale	5/21/2009	34.8428	-87.7219	N/A	N/A
2	I	Bluff Creek at Gravelly Springs	Tennessee	Lauderdale	5/20/2009	34.8858	-87.9077	N/A	N/A
3	I	Brush Creek at Co. Hwy. 33	Tennessee	Lauderdale	5/20/2009	34.9289	-87.9765	N/A	N/A
4	I	Colbert Creek at Colbert Ferry Park	Tennessee	Colbert	5/20/2009	34.838	-87.9554	N/A	N/A
5	I	Cedar Creek at Ala. Hwy. 43	Tennessee	Franklin	5/19/2009	34.4646	-87.753	N/A	N/A
6	I	Bear Creek at Co. Hwy. 57 (Military Bridge)	Tennessee	Franklin	5/27/2009	34.3164	-87.8585	N/A	N/A
7	I	Little Bear Creek at Ala. Hwy. 187	Tennessee	Franklin	5/27/2009	34.4012	-87.8733	N/A	N/A
8	I	Little Bear Creek at Co. Hwy. 23	Tennessee	Franklin	5/28/2009	34.5025	-88.0444	N/A	N/A
9	I	Cedar Creek at Pogo	Tennessee	Franklin	5/28/2009	34.5628	-88.1091	N/A	N/A
10	I	Foxtrap Creek at Co. Hwy 37	Tennessee	Colbert	5/28/2009	34.5758	-87.6339	N/A	N/A
11	I	Muddy Fork Big Nance Creek Co. Hwy. 236	Tennessee	Lawrence	5/29/2009	34.541	-87.3569	N/A	N/A
12	I	Big Nance Creek at Red Bank Co. Hwy. 314	Tennessee	Lawrence	6/5/2009	34.7662	-87.3718	N/A	N/A
13	I	West Fork Flint River at Fisk	Tennessee	Madison	6/4/2009	34.961	-86.5718	N/A	N/A
14	I	Hurricane Creek at U.S. Hwy. 72 Gurley	Tennessee	Madison	6/4/2009	34.7113	-86.3965	N/A	N/A
15	I	Flint River at Oscar Patterson Road	Tennessee	Madison	6/4/2009	34.8804	-86.4806	N/A	N/A
16	II	Scarham Creek at Co. Hwy. 372	Tennessee	Marshall	6/3/2009	34.2985	-86.1165	N/A	N/A
17	II	Town Creek at Ala. Hwy. 117	Tennessee	Dekalb	6/4/2009	34.6487	-85.6477	N/A	N/A
18	II	Flat Rock Creek at Ala. Hwy. 117	Tennessee	Dekalb	6/4/2009	34.7697	-85.7057	N/A	N/A
19	II	Jones Creek at Co. Hwy. 74	Tennessee	Jackson	6/4/2009	34.9718	-85.7442	N/A	N/A
20	II	Town Creek near Guest, Co. Hwy. 50	Tennessee	Dekalb	6/5/2009	34.4274	-85.8761	N/A	N/A
21	II	Locust Fork at Co. Hwy. 26	Black-Warrior	Blount	6/10/2009	34.0678	-86.4942	40	Fair
22	II	Reedy Creek at Co. Hwy. 328	Tennessee	Dekalb	6/10/2009	34.3734	-85.9808	N/A	N/A

Table 1. (continued) Stream sampling stations & IBI scores.

Site	District	Sampling Locality	Drainage	County	Date	Lat (N)	Long (W)	Score	Condition
23	II	Big Mud Creek at Co. Hwy. 21	Black-Warrior	Blount	6/11/2009	34.1354	-86.372	30	Poor
24	II	Slab Creek at Ala. Hwy. 75	Tennessee	Marshall	6/11/2009	34.2128	-86.2798	N/A	N/A
25	II	Browns Creek at Browns Valley Road	Tennessee	Marshall	6/10/2009	34.2843	-86.3884	N/A	N/A
26	II	Short Creek at Co. Hwy. 543	Tennessee	Marshall	6/10/2009	34.2581	-86.1239	N/A	N/A
27	II	South Sauty Creek at Co. Hwy. 47	Tennessee	Dekalb	6/11/2009	34.4991	-85.9289	N/A	N/A
28	II	Town Creek at Co. Hwy. 843 (43)	Tennessee	Dekalb	6/11/2009	34.3933	-85.9584	N/A	N/A
29	III	Tyro Creek at upper Tyro Creek road	Black-Warrior	Tuscaloosa	4/8/2009	33.5662	-87.5762	48	Good
30	III	Cripple Creek at mouth	Black-Warrior	Tuscaloosa	7/14/2009	33.4674	-87.575	44	Fair
31	III	Turkey Creek at Ala. Hwy. 69	Black-Warrior	Tuscaloosa	4/10/2009	33.4097	-87.5111	34	Poor
32	III	Hurricane Creek at Holt-Peterson Road	Black-Warrior	Tuscaloosa	4/30/2009	33.2298	87.4611	34	Poor
33	III	Hurricane Creek at Ala. Hwy. 216	Black-Warrior	Tuscaloosa	4/30/2009	33.2117	-87.4476	38	Fair
34	III	Binion Creek at Kemp Road	Black-Warrior	Tuscaloosa	4/10/2009	33.4791	-87.7037	46	Fair
35	III	Carrolls Creek at Ala. Hwy. 69 Northport	Black-Warrior	Tuscaloosa	4/10/2009	33.2945	-87.5684	42	Fair
36	III	Bear Creek at old USGS gaging site	Black-Warrior	Tuscaloosa	4/9/2009	33.5423	-87.5611	40	Fair
37	III	Mud Creek at Tannehill State Park	Cahaba	Tuscaloosa	4/21/2009	33.2513	-87.0691	40	Fair
38	III	Hurricane Creek at Middle School Road	Black-Warrior	Tuscaloosa	4/8/2009	33.2101	-87.2939	48	Good
39	IV	Hatchet Creek at Co. Hwy.18	Coosa	Coosa	6/30/2009	33.9168	-86.2703	50	Good
40	IV	Hatchet Creek at Ala. Hwy. 280	Coosa	Coosa	6/30/2009	33.0364	-86.1233	46	Fair
41	IV	Choctafaula Creek Forest Service Road 906	Tallapoosa	Macon	7/9/2009	32.4899	-85.6038	40	Fair
42	IV	Opintlocco Creek at Co. Hwy. 26	Tallapoosa	Macon	7/8/2009	32.4123	-85.6165	48	Good
43	IV	Uphapee Creek at Ala. Hwy. 29	Tallapoosa	Macon	7/8/2009	32.4446	-85.6479	48	Good
44	IV	Sougahatchee Creek at Co. Hwy. 172	Tallapoosa	Lee	7/6/2009	32.7281	-85.422	36	Fair

Table 1. (continued) Stream sampling stations & IBI scores.

Site	District	Sampling Locality	Drainage	County	Date	Lat (N)	Long (W)	Score	Condition
45	IV	Chewacla Creek at Co. Hwy. 10	Tallapoosa	Lee	7/7/2009	32.536	-85.4966	38	Fair
46	IV	Halawakee Creek at Ala. Hwy. 29	Chattahoochee	Lee	7/7/2009	32.6976	-85.2669	42	Fair
47	IV	Little Uchee Creek at Ala. Hwy. 160	Chattahoochee	Lee	7/9/2009	32.563	-85.2641	36	Fair
48	IV	Osanippa Creek at Ala. Hwy. 83	Chattahoochee	Chambers	7/6/2009	32.8042	-85.3134	34	Poor
49	V	East Sepulga River at Co. Hwy. 79	Conecuh	Conecuh	7/28/2009	31.6833	-86.971	42	Fair
50	V	West Sepulga River at CCC Trail Road	Conecuh	Conecuh	7/28/2009	31.6168	-86.9872	48	Good
51	V	Murder Creek at Co. Hwy. 30	Conecuh	Conecuh	7/28/2009	31.5627	-87.0631	42	Fair
52	V	Sepulga River at Co. Hwy. 29	Conecuh	Conecuh	7/27/2009	31.5811	-86.9169	46	Good
53	V	Burnt Corn Creek at Ala. Hwy. 31	Conecuh	Escambia	7/27/2009	31.1008	-87.0763	46	Good
54	V	Murder Creek at Ala. Hwy. 29	Conecuh	Escambia	7/27/2009	31.1003	-87.0684	48	Good
55	V	Sizemore Creek at Co. Hwy. 2	Alabama	Clarke	8/19/2009	31.4223	-87.7128	48	Good
56	V	Little Reedy Creek at Co. Hwy. 2	Alabama	Clarke	8/19/2009	31.4319	-87.7452	40	Fair
57	V	Reedy Creek at Co. Hwy. 19	Alabama	Clarke	8/20/2009	31.4025	-87.7457	40	Fair
58	V	Little Escambia Creek at Ala. Hwy. 29	Escambia	Escambia	9/4/2009	31.0207	-87.207	44	Good
59	VI	Spring Creek at Co. Hwy. 55	Choctawhatchee	Geneva	8/5/2009	31.0431	-85.753	52	Excellent
60	VI	Hurricane Creek at Co. Hwy. 41	Choctawhatchee	Geneva	8/5/2009	31.1718	-85.6987	50	Good
61	VI	Panther Creek at Co. Hwy. 40	Choctawhatchee	Henry	8/4/2009	31.5462	-85.3984	46	Good
62	VI	Judy Creek at Co. Hwy. 20	Choctawhatchee	Dale	8/4/2009	31.4446	-85.5652	38	Fair
63	VI	Steephead Creek Ft. Rucker MB Road	Choctawhatchee	Dale	8/4/2009	31.3805	-85.7675	38	Fair
64	VI	Little Choctawhatchee River at Ala. Hwy 84	Choctawhatchee	Dale	7/28/2009	31.2625	-85.6688	42	Fair

Table 1. (continued) Stream sampling stations & IBI scores.

Site	District	Sampling Locality	Drainage	County	Date	Lat (N)	Long (W)	Score	Condition
65	VI	Beaver Creek at Brannon Stand Road	Choctawhatchee	Dale	7/29/2009	31.2178	-85.4865	40	Fair
66	VI	Panther Creek at Panther Road	Choctawhatchee	Dale	7/30/2009	31.2433	-85.5838	42	Fair
67	VI	Rock Creek at Deerpath Road	Choctawhatchee	Houston	7/29/2009	31.2517	-85.4431	40	Fair
68	VI	Little Choctawhatchee River at Ala. Hwy. 231	Choctawhatchee	Houston	7/29/2009	31.26416	-85.4387	42	Fair
69	VI	Mossy Camp Branch at Co. Hwy. 55	Choctawhatchee	Dale	7/28/2009	31.2822	-85.6025	44	Good
70	VI	Little Choctawhatchee trib. at Co. Hwy. 563	Choctawhatchee	Dale	7/30/2009	31.27269	-85.5647	42	Fair

Table 2. DII IBI metrics and calculations

Site Number	21	
Stream	Locust Fork	
Applachian Plateau/Coastal Plain	Value	IBI
1. Total native species	15	5
2. Number of darter species	2	3
3. Number of minnow species	5	5
4. Number of sunfish species	4	5
5. Number of sucker species	2	3
6. Number of intolerant species	0	1
7. Proportion as sunfishes	32%	1
8. Proportion omnivores and herbivores	14%	5
9. Proportion insectivorous cyprinids	5%	1
10. Proportion as top carnivores	1%	3
11. Catch per effort	7	3
12. Proportion with DELT+hybrids	0%	5
IBI Score		40
Condition		Fair

Site Number	23	
Stream	Big Mud	
Applachian Plateau/Coastal Plain	Value	IBI
1. Total native species	13	5
2. Number of darter species	1	1
3. Number of minnow species	5	5
4. Number of sunfish species	4	5
5. Number of sucker species	0	1
6. Number of intolerant species	0	1
7. Proportion as sunfishes	44%	1
8. Proportion omnivores and herbivores	22%	3
9. Proportion insectivorous cyprinids	12%	1
10. Proportion as top carnivores	0%	1
11. Catch per effort	4	1
12. Proportion with DELT+hybrids	0%	5
IBI Score		30
Condition		Poor

Table 3. DIII IBI metrics and calculations (a)

Site Number	29		30		31		32		33		34		35	
Stream	Tyro		Cripple		Turkey		Hurricane Holt		Hurricane 216		Binion		Carrols	
Applachian Plateau/Coastal Plain	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI
1. Total native species	17	5	23	5	13	5	12	5	15	5	13	5	21	5
2. Number of darter species	4	5	4	5	3	5	1	1	2	3	3	5	4	5
3. Number of minnow species	6	5	6	5	4	5	4	5	4	5	4	5	6	5
4. Number of sunfish species	3	3	4	5	2	3	3	3	5	5	2	3	5	5
5. Number of sucker species	2	3	4	5	2	3	0	1	1	3	0	1	0	1
6. Number of intolerant species	0	1	0	1	0	1	0	1	0	1	0	1	0	1
7. Proportion as sunfishes	1%	5	32%	1	27%	3	20%	3	39%	1	3%	5	22%	3
8. Proportion omnivores and herbivores	1%	5	27%	3	54%	1	17%	5	11%	5	7%	5	1%	5
9. Proportion insectivorous cyprinids	52%	5	10%	1	1%	1	0%	1	10%	1	65%	5	10%	1
10. Proportion as top carnivores	3%	5	5%	5	0%	1	1%	3	1%	3	3%	5	1%	3
11. Catch per effort	5	1	8	3	4	1	6	1	5	1	2	1	14	3
12. Proportion with DELT+hybrids	0%	5	0%	5	0%	5	0%	5	0%	5	0%	5	0%	5
IBI Score		48		44		34		34		38		46		42
Condition		Good		Fair		Poor		Poor		Fair		Fair		Fair

(b)

Site Number	36		38	
Stream	Bear		Hurricane MS	
Applachian Plateau/Coastal Plain	Value	IBI	Value	IBI
1. Total native species	23	5	17	5
2. Number of darter species	4	5	3	5
3. Number of minnow species	11	5	4	5
4. Number of sunfish species	3	3	5	5
5. Number of sucker species	2	3	3	5
6. Number of intolerant species	0	1	0	1
7. Proportion as sunfishes	16%	3	10%	3
8. Proportion omnivores and herbivores	11%	3	3%	5
9. Proportion insectivorous cyprinids	36%	3	44%	3
10. Proportion as top carnivores	0	1	2%	3
11. Catch per effort	8	3	5	3
12. Proportion with DELT+hybrids	0%	5	0%	5
IBI Score		40		48
Condition		Fair		Good

Site Number	37	
Stream	Mud Tannehill	
Ridge and Valley/Piedmont	Value	IBI
1. Total native species	22	5
2. Number of darter species	5	5
3. Number of minnow species	7	3
4. Number of sucker species	1	1
5. Number of intolerant species	1	1
6. Proportion of tolerant species	15%	3
7. Proportion as omnivores	9%	5
8. Proportion as invertivores	29%	1
9. Proportion as top carnivores	2%	3
10. Proportion non-lithophilic spawners	47%	5
11. Catch per effort	7	3
12. Proportion with DELT+hybrids	0%	5
IBI Score		40
Condition		Fair

Table 4. D IV IBI metrics and calculations (a)

Site Number	39		40		41		42		43		44		45	
Stream	Hatchet 18		Hatchet 280		Choctafaula		Opintlocco		Uphapee		Sougahatchee		Chewacla	
Ridge and Valley/Piedmont	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI
1. Total native species	23	5	20	5	27	5	23	5	25	5	18	3	20	5
2. Number of darter species	6	5	5	5	3	3	5	5	6	5	1	1	3	3
3. Number of minnow species	9	5	6	3	11	5	7	5	10	5	8	5	4	3
4. Number of sucker species	2	3	2	3	2	3	1	1	1	1	0	1	1	1
5. Number of intolerant species	4	5	2	3	1	1	2	3	2	3	1	1	1	1
6. Proportion of tolerant species	1%	5	0%	5	25%	1	10%	3	3%	5	19%	1	1%	5
7. Proportion omnivores and herbivores	2%	5	3%	5	3%	5	6%	5	6%	5	0%	5	30%	3
8. Proportion as invertivores	15%	1	21%	1	26%	1	19%	1	5%	1	36%	1	22%	1
9. Proportion as top carnivores	2%	3	2%	3	1%	3	4%	5	1%	3	5%	5	38%	5
10. Proportion non-lithophilic spawners	20%	3	40%	5	17%	3	48%	5	41%	5	36%	5	22%	3
11. Catch per effort	12	5	7	3	10	5	10	5	19	5	6	3	10	5
12. Proportion with DELT+hybrids	0%	5	0%	5	0%	5	0%	5	0%	5	0%	5	0%	5
IBI Score		50		46		40		48		48		36		40
Condition		Good		Fair		Fair		Good		Good		Fair		Fair

(b)

Site Number	46		47		48	
Stream	Halawakee		Little Uchee		Osanippa	
Southern Plains	Value	IBI	Value	IBI	Value	IBI
1. Total native species	19	3	15	3	18	3
2. Number of cyprinid species	5	5	5	5	9	5
3. Number of centrarchid species	5	3	7	3	5	3
4. Number of darter + madtom species	4	3	1	1	2	3
5. Proportion of tolerant species	3%	5	24%	1	5%	3
6. Proportion GSF & YBH	0%	5	1%	5	0%	5
7. Proportion as insectivorous cyprinids	18%	1	17%	1	27%	1
8. Proportion as invertivores	30%	3	42%	3	28%	3
9. Proportion as top carnivores	1%	3	4%	5	1%	3
10. Catch per effort	6	3	3	1	3	1
11. Number of lithophilic spawners	10	3	10	3	13	3
12. Proportion with DELT+hybrids	0%	5	0%	5	>1%	1
IBI Score		42		36		34
Condition		Fair		Fair		Poor

Table 5. DV IBI metrics and calculations (a)

Site Number	49		50		51		52		53	
Stream	East Sepulga River		West Sepulga River		Murder 30		Sepulga River		Burnt Corn	
Southern Plains	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI
1. Total native species	19	3	26	5	15	3	19	3	20	3
2. Number of cyprinid species	9	5	7	5	6	5	6	5	5	3
3. Number of centrarchid species	5	3	5	3	1	1	3	3	4	3
4. Number of darter + madtom species	2	3	7	5	6	5	7	5	6	5
5. Proportion of tolerant species	6%	3	4%	5	0%	5	3%	5	2%	5
6. Proportion GSF & YBH	0%	5	1%	3	0%	5	0%	5	0%	5
7. Proportion insectivorous cyprinids	85%	5	40%	3	66%	5	35%	3	49%	3
8. Proportion as invertivores	9%	1	26%	1	17%	1	37%	1	50%	3
9. Proportion as top carnivores	1%	3	3%	3	1%	3	1%	3	3%	3
10. Catch per effort	22	3	8	5	3	1	6	5	6	5
11. Number of lithophilic spawners	11	3	15	5	9	3	11	3	12	3
12. Proportion with DELT+hybrids	0%	5	0%	5	0%	5	0%	5	0%	5
IBI Score		42		48		42		46		46
Condition		Fair		Good		Fair		Good		Good

(b)

Site Number	54		55		56		57		58	
Stream	Murder 29		Sizemore		Little Reedy		Reedy		Little Escambia	
Southern Plains	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI
1. Total native species	25	5	23	5	16	3	22	3	18	3
2. Number of cyprinid species	6	5	7	5	7	5	6	5	6	5
3. Number of centrarchid species	4	3	6	5	2	3	3	3	3	3
4. Number of darter + madtom species	8	5	4	5	3	3	2	3	5	5
5. Proportion of tolerant species	0%	5	22%	1	7%	3	13%	3	3%	5
6. Proportion of GSF & YBH	0%	5	1%	3	0%	5	0%	5	1%	3
7. Proportion insectivorous cyprinids	42%	3	75%	5	54%	3	53%	3	53%	3
8. Proportion as invertivores	38%	1	17%	1	18%	1	34%	1	28%	1
9. Proportion as top carnivores	3%	3	2%	3	1%	3	2%	3	1%	3
10. Catch per effort	10	5	8	5	3	1	4	1	5	5
11. Number of lithophilic spawners	12	3	15	5	14	5	15	5	13	3
12. Proportion with DELT+hybrids	0%	5	0%	5	0%	5	0%	5	0%	5
IBI Score		48		48		40		40		44
Condition		Good		Good		Fair		Fair		Good

Table 6. DVI metrics and calculations (a)

Site Number	59		60		61		62		63	
Stream	Spring		Hurricane		Panther 40		Judy		Steephead	
Southern Plains	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI
1. Total native species	25	5	27	5	19	5	18	3	16	3
2. Number of cyprinid species	5	3	7	5	5	3	5	3	5	3
3. Number of centrarchid species	8	5	10	5	4	3	5	3	3	3
4. Number of darter + madtom species	6	5	7	5	6	5	5	3	6	5
5. Proportion of tolerant species	1%	5	0%	5	1%	5	4%	5	4%	5
6. Proportion of GSF & YBH	0%	5	0%	5	0%	5	0%	5	0%	5
7. Proportion insectivorous cyprinids	65%	5	46%	3	48%	3	20%	1	26%	1
8. Proportion as invertivores	50%	3	13%	1	28%	1	34%	1	33%	1
9. Proportion as top carnivores	1%	3	2%	3	6%	5	1%	3	1%	3
10. Catch per effort	13	3	7	3	5	3	4	3	4	3
11. Number of lithophilic spawners	14	5	15	5	6	3	7	3	7	3
12. Proportion with DELT+hybrids	0%	5	0%	5	0%	5	0%	5	0%	5
IBI Score		52		50		46		38		40
Condition		Excellent		Good		Good		Fair		Fair

(b)

Site Number	64		65		66		67		68		69		70	
Stream	Little Choc 84		Beaver		Panther		Rock		Little Choc 231		Mossy		Unnamed Trib.	
Southern Plains	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI	Value	IBI
1. Total native species	24	5	22	5	21	5	19	5	16	3	15	3	20	5
2. Number of cyprinid species	7	5	5	3	3	3	3	3	4	3	5	3	7	5
3. Number of centrarchid species	9	5	9	5	6	5	9	5	6	5	4	3	4	3
4. Number of darter + madtom species	5	3	2	3	6	5	2	3	4	3	2	3	2	3
5. Proportion of tolerant species	5%	1	4%	5	4%	5	9%	1	2%	5	0%	5	1%	5
6. Proportion of GSF & YBH	5%	1	3%	1	2%	3	2%	3	2%	3	0%	5	1%	3
7. Proportion insectivorous cyprinids	31%	3	28%	1	9%	1	26%	1	60%	5	65%	5	69%	5
8. Proportion as invertivores	55%	3	64%	5	34%	3	60%	5	32%	3	32%	3	26%	1
9. Proportion as top carnivores	1%	3	1%	3	2%	3	1%	3	1%	3	0%	1	0%	1
10. Catch per effort	7	3	4	1	3	1	9	3	4	1	12	5	11	1
11. Number of lithophilic spawners	15	5	13	5	9	3	10	3	10	3	9	3	13	5
12. Proportion with DELT+hybrids	0%	5	1%	3	0%	5	0%	5	0%	5	0%	5	0%	5
IBI Score		42		40		42		40		42		44		42
Condition		Fair		Fair		Fair		Fair		Fair		Good		Fair

Appendix A. Numbers of fishes by species collected from each site.

District I	**Site Number**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tennessee	**Stream Name**	L Cypress	Bluff	Brush	Colbert	Cedar	Bear	L Bear	L Bear	Cedar	Foxtrap	M Fork	B Nance	W Fork	Hurricane	Flint River
Scientific name	**Common name**															
Lepisosteus osseus	longnose gar					1										
Campostoma oligolepis	largescale stoneroller	80	138	60	529	32	17	286	58	10	115		28	423	203	127
Clinostomus funduloides	rosyside dace		40	157	5											
Cyprinella galactura	whitetail shiner							10		2				12		14
Cyprinella spiloptera	spotfin shiner				14	19	23			3			2			1
Erimystax insignis	blotched chub															11
Hemitremia flammea	flame chub													1		
Hybopsis amblops	bigeye chub					12		27					4	45	2	16
Luxilus chrysocephalus	striped shiner	52	10	5	164	28	6	48	19	3	56		12	62	40	32
Luxilus coccogenis	warpaint shiner	3														
Lythrurus bellus	pretty shiner						6									
Lythrurus fasciolaris	scarlet shiner	73	161	25	57	62		1	5		63	76	17	80	14	14
Nocomis leptocephalus	bluehead chub						2									
Notropis baileyi	rough shiner						4									
Notropis boops	bigeye shiner					4										
Notropis micropteryx	highland shiner						3									
Notropis photogenis	silver minnow															3
Notropis telescopus	telescope shiner	50														
Notropis texanus	weed shiner				21											
Pimephales notatus	bluntnose minnow					7	3		1	3	74	42	12	2	1	10
Rhinichthys atratulus	blacknose dace		21													
Semotilus atromaculatus	creek chub		4	8							3					
Erimyzon oblongus	creek chubsucker			1												
Hypentelium nigricans	northern hog sucker	3	5	23	9	8	3	14	2	3				18	7	1
Minytrema melanops	spotted sucker					1										
Moxostoma duquesnei	black redhorse									1						
Moxostoma erythrurum	golden redhorse										2					
Ameiurus natalis	yellow bullhead			4	1			4			1	3				
Ictalurus punctatus	channel catfish															
Noturus exilis	slender madtom		4	14					1	1						
Noturus miurus	brindled madtom								1	3						
Esox niger	chain pickerel	1														

District I	Site Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tennessee	Stream Name	L Cypress	Bluff	Brush	Colbert	Cedar	Bear	L Bear	L Bear	Cedar	Foxtrap	M Fork	B Nance	W Fork	Hurricane	Flint River
Scientific name	Common name															
Labidesthes sicculus	brook silverside											4				
Fundulus catenatus	northern studfish	4				2		1	9	3				6		1
Fundulus notatus	blackstripe topminnow															
Fundulus olivaceus	blackspotted topminnow	1	5	7	9	15		13	6			13	24	8	1	2
Gambusia affinis	western mosquitofish	1			5	4			13			15	4	7	1	
Cottus bairdi	mottled sculpin		92	91												
Cottus carolinae	banded sculpin	24		1	91	1		30	5	2			15	9	78	49
Ambloplites rupestris	rock bass	13	2			2		4	3			2	10	10	1	14
Lepomis auritus	redbreast sunfish	1			9							13	33			9
Lepomis cyanellus	green sunfish	4			3	6	1	1			23	31	9	2	8	15
Lepomis gulosus	warmouth										3	1	1	12	2	1
Lepomis macrochirus	bluegill	1	20		57	9	6	36	1	5	39	16	38	85	22	36
Lepomis megalotis	longear sunfish	10	15	5	146	89	4	20	16	31	22	50	52	34	5	26
Lepomis microlophus	redear sunfish				1	1		1		4			3		1	3
Micropterus dolomieui	smallmouth bass	1			2											
Micropterus punctulatus	spotted bass					1	1	1						4		1
Micropterus salmoides	largemouth bass	3			3		2	2			5	7	1	1	2	3
Etheostoma blennioides	greenside darter	4				13	3		3	5		1	9	8	5	8
Etheostoma blennius	blenny darter	18														
Etheostoma caeruleum	rainbow darter	14	70	79	292	47		11	4		37			28	1	20
Etheostoma duryi	black darter		19	4	35	6		6	6	1	24	8	7	19	26	7
Etheostoma flabellare	fantail darter	24	77	178										12		
Etheostoma jessiae	blueside darter								3	2						
Etheostoma kennicotti	stripetail darter										8	4	2	3		1
Etheostoma nigripinne	blackfin darter		47	7	5	1							4		22	
Etheostoma nigrum	johnny darter										2					
Etheostoma rufilineatum	redline darter	373	4	10		31	179	70	74	101			135	39	23	27
Etheostoma tennesseense	Tennessee darter	15	1			24		14	3	5	1		1	66	11	11
Etheostoma stigmaeum	speckled darter						2									
Etheostoma zonale	banded darter	2													2	
Percina caprodes	logperch	1			41	11	2	8		4			2		5	2
Percina evides	gilt darter								1	5						

District I	Site Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tennessee	**Stream Name**		L Cypress	Bluff	Brush	Colbert	Cedar	Bear	L Bear	L Bear	Cedar	Foxtrap	M Fork	B Nance	W Fork	Hurricane	Flint River
Scientific name	**Common name**																
Percina sciera	dusky darter									1	1						
	hybrid centrarchid																1
Total individuals		8568	778	735	685	1507	447	279	622	251	216	498	308	449	1022	511	496
Total species		66	27	20	20	24	27	20	24	24	24	19	19	26	28	26	32

District II	**Site Number**	16	17	18	19	20	21	22	23	24	25	26	27	28
Tennessee, Black Warrior	**Stream Name**	Scarham	Town	F Rock	Jones	Town	L Fork	Reedy	B Mud	Slab	Browns	Short	S Sauty	Town
Scientific name	**Common name**													
Dorosoma cepedianum	gizzard shad										1			
Campostoma oligolepis	largescale stoneroller	23	46		3	68	16	25	31	24	26	4	112	16
Cyprinella callistia	Alabama shiner						93		12					
Cyprinella galactura	whitetail shiner	3						38					7	115
Cyprinella spiloptera	spotfin shiner					12		4				44	5	28
Cyprinella venusta	blacktail shiner						4		16	29				
Luxilus chrysocephalus	striped shiner	7	7			8		1						3
Notemigonus crysoleucas	golden shiner				3				2		1		3	
Notropis stilbius	silverstripe shiner						11			13				
Pimephales notatus	bluntnose minnow						1							
Pimephales vigilax	bullhead minnow										1			
Semotilus atromaculatus	creek chub		28	20	2				3				1	
Catostomus commersoni	white sucker				1						1			
Hypentelium etowanum	Alabama hog sucker						3							
Hypentelium nigricans	northern hog sucker		13		2	2					1			2
Moxostoma poecilurum	blacktail redhorse						1							
Ameiurus melas	black bullhead								2					
Ameiurus natalis	yellow bullhead	2		7		5	3	1	1	1	1	4	1	3
Labidesthes sicculus	brook silverside												22	
Fundulus olivaceus	blackspotted topminnow				2									
Gambusia affinis	western mosquitofish				2					1	4			
Cottus carolinae	banded sculpin				35									
Ambloplites rupestris	rock bass				8									
Lepomis auritus	redbreast sunfish	33	37		40	65	51	27	17	38	99	28	38	24
Lepomis cyanellus	green sunfish	14	8	46	10		2	22	10	1	2		15	3
Lepomis gulosus	warmouth			2					1			1		
Lepomis macrochirus	bluegill	29	31	80	62	20	11	32	33	12	45	7	15	16
Lepomis megalotis	longear sunfish						7							
Lepomis microlophus	redear sunfish			3	4			1			11			
Lepomis miniatus	redspotted sunfish			3	2									

District II	**Site Number**		16	17	18	19	20	21	22	23	24	25	26	27	28
Tennessee, Black Warrior	**Stream Name**		Scarham	Town	F Rock	Jones	Town	L Fork	Reedy	B Mud	Slab	Browns	Short	S Sauty	Town
Scientific name	**Common name**														
Micropterus dolomieui	smallmouth bass			3											
Micropterus punctulatus	spotted bass							1						2	1
Micropterus salmoides	largemouth bass		2	3	8	2	4		4		2	3	1	1	
Pomoxis nigromaculatus	black crappie									5			1		
Etheostoma caeruleum	rainbow darter					2									
Etheostoma duryi	black darter					43						3			
Etheostoma tennesseense	Tennessee darter											1			
Etheostoma stigmaeum	speckled darter							3							
Perca flavescens	yellow perch					1									
Percina caprodes	logperch											11			
Percina nigrofasciata	blackbanded darter							12		5	8				
	hybrid centrarchid		1	1	1										
Total individuals		2247	115	178	171	224	184	219	155	138	129	211	90	222	211
Total Species		42	9	10	9	19	8	15	10	13	10	16	8	12	10

District III	**Site Number**	29	30	31	32	33	34	35	36	37	38
Black Warrior, Cahaba	**Stream Name**	Tyro	Cripple	Turkey	Hurricane	Hurricane	Binion	Carrolls	Bear	Mud	Hurricane
Scientific name	**Common name**										
Ichthyomyzon gagei	southern brook lamprey						5				
Lampetra aepyptera	least brook lamprey								2		
Campostoma oligolepis	largescale stoneroller	14	70	70	5	15			20	22	4
Cyprinella callistia	Alabama shiner		1	9	16	2				31	
Cyprinella trichroistia	tricolor shiner									24	
Cyprinella venusta	blacktail shiner		15		75	46		2	20		
Luxilus chrysocephalus	striped shiner	7					6	5	32		35
Lythrurus alegnotus	Warrior shiner								42		
Lythrurus bellus	pretty shiner	25					9	28		2	25
Nocomis leptocephalus	bluehead chub		1				5	1	4		
Notropis asperifrons	burrhead shiner	32							10		
Notropis baileyi	rough shiner						29		1		7
Notropis stilbius	silverstripe shiner	18	25			15			5	1	
Notropis texanus	weed shiner			2				10			
Notropis volucellus	mimic shiner	1									
Phenacobius catostomus	riffle minnow									2	
Pimephales notatus	bluntnose minnow							1	2		
Pimephales vigilax	bullhead minnow				26				2		
Semotilus atromaculatus	creek chub		8	4					2	3	
Erimyzon oblongus	creek chubsucker		1	1							
Hypentelium etowanum	Alabama hog sucker		9			1			2	9	1
Minytrema melanops	spotted sucker		2	1							1
Moxostoma erythrurum	golden redhorse	1									
Moxostoma poecilurum	blacktail redhorse	2	3						13		2
Ameiurus natalis	yellow bullhead		1					2			
Ictalurus punctatus	channel catfish				1						
Noturus funebris	black madtom						5				
Noturus gyrinus	tadpole madtom							2			
Noturus leptacanthus	speckled madtom		1	1			1	4			

District III	**Site Number**		29	30	31	32	33	34	35	36	37	38
Black Warrior, Cahaba	**Stream Name**		Tyro	Cripple	Turkey	Hurricane	Hurricane	Binion	Carrolls	Bear	Mud	Hurricane
Scientific name	**Common name**											
Esox niger	chain pickerel											1
Aphredoderus sayanus	pirate perch									2		
Labidesthes sicculus	brook silverside					2						
Fundulus olivaceus	blackspotted topminnow		6	2		6	1		29	5	5	2
Gambusia affinis	western mosquitofish			1	1							
Gambusia holbrooki	eastern mosquitofish										1	
Cottus carolinae	banded sculpin										3	
Lepomis auritus	redbreast sunfish						2					
Lepomis cyanellus	green sunfish		2	10	32	3	7		5	15	8	2
Lepomis gulosus	warmouth								4		1	1
Lepomis macrochirus	bluegill		1	21	3	1	8	1	59		23	5
Lepomis megalotis	longear sunfish		21	51		31	41	1	33	25	7	6
Lepomis microlophus	redear sunfish			2					1		3	
Lepomis miniatus	redspotted sunfish						1			2		2
Micropterus coosae	redeye bass										4	
Micropterus punctulatus	spotted bass		4	4		1	1		1			
Micropterus salmoides	largemouth bass						1	2	1			
Etheostoma artesiae	redspot darter		7	6	1					8	1	26
Etheostoma jordani	greenbreast darter										34	
Etheostoma lachneri	Tombigbee darter							4				
Etheostoma ramseyi	Alabama darter										49	
Etheostoma stigmaeum	speckled darter		12	11			1		90	33	4	28
Etheostoma swaini	gulf darter								59			
Percina kathae	Mobile logperch		1	8	1			4	121	8		
Percina nigrofasciata	blackbanded darter		5	8	6	8	9	2	8	3	2	6
Total individuals		2404	188	291	163	207	184	108	501	294	276	192
Total species		54	18	24	14	13	16	14	22	24	23	18

District IV	**Site Number**	39	40	41	42	43	44	45	46	47	48
Coosa, Tallapoosa, Chattahoochee	**Stream Name**	Hatchet	Hatchet	Choctafaula	Opintlocco	Uphapee	Sougahatchee	Chewacla	Halawakee	L Uchee	Osanippa
Scientific name	**Common name**										
Ichthyomyzon gagei	southern brook lamprey		5	2							
Campostoma oligolepis	largescale stoneroller	7	1	9	1	20		91			
Campostoma pauciradii	bluefin stoneroller								14	19	9
Cyprinella callistia	Alabama shiner	29	40								
Cyprinella callitaenia	bluestripe shiner										2
Cyprinella gibbsi	Tallapoosa shiner				3	16	15	5			
Cyprinella trichroistia	tricolor shiner	8	47								
Cyprinella venusta	blacktail shiner	14	1	29	42	170		37	2	1	
Hybopsis lineapunctata	lined chub	27					2				
Hybopsis winchelli	clear chub			3		7			1		
Luxilus chrysocephalus	striped shiner			33			37				1
Lythrurus atrapiculus	blacktip shiner									1	1
Lythrurus bellus	pretty shiner			14	39		31	6			
Macrhybopsis sp cf aestivalis	undescribed chubs	6									
Notemigonus crysoleucas	golden shiner						3			1	
Notropis ammophilus	orangefin shiner			7		30					
Notropis amplamala	longjaw minnow			12	20	69					2
Notropis baileyi	rough shiner			65		2	58		27		8
Notropis longirostris	longnose shiner										1
Notropis stilbius	silverstripe shiner	125	10				3				
Notropis texanus	weed shiner			1	6	5			4	20	4
Notropis xaenocephalus	Coosa shiner	49	1								
Pimephales notatus	bluntnose minnow				18	8					
Pimephales vigilax	bullhead minnow			2		9					
Semotilus atromaculatus	creek chub	1		17							
Semotilus thoreauianus	Dixie chub						40				3
Erimyzon oblongus	creek chubsucker			2							
Hypentelium etowanum	Alabama hog sucker	2	3	16				7	10	1	
Moxostoma duquesnei	black redhorse	14	1								
Moxostoma erythrurum	golden redhorse					2					
Moxostoma poecilurum	blacktail redhorse				1						

District IV	**Site Number**	39	40	41	42	43	44	45	46	47	48
Coosa, Tallapoosa, Chattahoochee	**Stream Name**	Hatchet	Hatchet	Choctafaula	Opintlocco	Uphapee	Sougahatchee	Chewacla	Halawakee	L Uchee	Osanippa
Scientific name	**Common name**										
Scartomyzon lachneri	greater jumprock								6		
Ameiurus brunneus	snail bullhead									5	
Ameiurus serracanthus	spotted bullhead								1		
Ictalurus punctatus	channel catfish	1			4	16		3			
Noturus leptacanthus	speckled madtom	8	2	5	3	9		23	1		2
Esox americanus	redfin pickerel										6
Aphredoderus sayanus	pirate perch			1	1	1					
Labidesthes sicculus	brook silverside								2		3
Fundulus olivaceus	blackspotted topminnow			7	16			2	3		
Fundulus stellifer	southern studfish	2									
Gambusia affinis	western mosquitofish			3	13	13	2				
Cottus carolinae	banded sculpin		3					56			
Ambloplites ariommus	shadow bass		2	1				1			
Lepomis auritus	redbreast sunfish			1			31	4	38	19	9
Lepomis cyanellus	green sunfish			4			2		1	2	
Lepomis gulosus	warmouth						6			1	
Lepomis macrochirus	bluegill	1		22	14	6	4	5	4	28	3
Lepomis megalotis	longear sunfish	13	4	21	26	9	2	18		1	1
Lepomis microlophus	redear sunfish		1		1		2			3	
Lepomis miniatus	redspotted sunfish							1			
Micropterus coosae	redeye bass		2					2			
Micropterus henshali	Alabama bass				1	4		9	1		
Micropterus punctulatus	spotted bass	6									
Micropterus salmoides	largemouth bass			3	12	2	7	1	1	5	1
Pomoxis nigromaculatus	black crappie								2		
Etheostoma artesiae	redspot darter			5							
Etheostoma coosae	Coosa darter	11	5								
Etheostoma jordani	greenbreast darter	29	64		22	123					
Etheostoma rupestre	rock darter	24	6		9	58		4			
Etheostoma stigmaeum	speckled darter		3	1	5	1	1	12			
Etheostoma swaini	gulf darter					5			7		

District IV	**Site Number**	39	40	41	42	43	44	45	46	47	48
Coosa, Tallapoosa, Chattahoochee	**Stream Name**	Hatchet	Hatchet	Choctafaula	Opintlocco	Uphapee	Sougahatchee	Chewacla	Halawakee	L Uchee	Osanippa
Scientific name	**Common name**										
Percina brevicauda	coal darter	3									
Percina kathae	Mobile logperch	1									
Percina maculata	blackside darter				1						
Percina nigrofasciata	blackbanded darter			34	61	22		29	59	24	26
Percina palmaris	bronze darter	4	25								
Percina vigil	saddleback darter					1					
	hybrid centrarchid			1			1				1
Total individuals	3286	463	306	403	403	694	335	406	276	225	179
Total species	69	23	22	27	25	27	20	20	21	15	20

District V	**Site Number**	49	50	51	52	53	54	55	56	57	58
Alabama, Conecuh, Escambia	**Stream Name**	E Sepulga	W Sepulga	Murder	Sepulga	Burnt Corn	Murder	Sizemore	L Reedy	Reedy	L Escambia
Scientific name	**Common name**										
Ichthyomyzon gagei	southern brook lamprey		2					3	7	2	
Anguilla rostrata	American eel		2				1				
Campostoma oligolepis	largescale stoneroller								1	1	
Cyprinella venusta	blacktail shiner	5	24	4	44	23	90	5			3
Hybopsis sp cf winchelli	coastal clear chub	2	24			1	5				
Luxilus chrysocephalus	striped shiner							11	4	12	
Lythrurus atrapiculus	blacktip shiner	303	48	3	50						
Lythrurus bellus	pretty shiner							13	4		1
Notemigonus crysoleucas	golden shiner	2									
Notropis amplamala	longjaw minnow	11	15	1	6		15			3	
Notropis baileyi	rough shiner							105	17	38	
Notropis longirostris	longnose shiner		15	4	8	10	20				15
Notropis petersoni	coastal shiner					23	6				1
Notropis texanus	weed shiner	53	6	10	5	31	87	9	6	5	67
Opsopoeodus emiliae	pugnose minnow	3									
Pimephales notatus	bluntnose minnow	3			6						
Pimephales vigilax	bullhead minnow							1			
Pteronotropis hypselopterus	sailfin shiner			49					25	14	2
Semotilus atromaculatus	creek chub	3	6					42	6	16	
Carpiodes cyprinus	quillback						9				
Erimyzon oblongus	creek chubsucker									3	
Erimyzon sucetta	lake chubsucker	3									
Hypentelium etowanum	Alabama hog sucker							6	2	7	
Moxostoma poecilurum	blacktail redhorse				2						
Ameiurus melas	black bullhead									1	
Ameiurus natalis	yellow bullhead		2				1	2			
Ictalurus punctatus	channel catfish					2	4				1
Noturus funebris	black madtom		1								
Noturus leptacanthus	speckled madtom		4	2	5	2	2	2	3		5
Esox americanus	redfin pickerel		3	1	2				1	2	2

District V	**Site Number**	49	50	51	52	53	54	55	56	57	58
Alabama, Conecuh, Escambia	**Stream Name**	E Sepulga	W Sepulga	Murder	Sepulga	Burnt Corn	Murder	Sizemore	L Reedy	Reedy	L Escambia
Scientific name	**Common name**										
Aphredoderus sayanus	pirate perch		6					4		4	
Fundulus escambiae	russetfin topminnow						2				
Fundulus nottii	bayou topminnow									1	
Fundulus olivaceus	blackspotted topminnow	2	8	3	9	13	1	3		5	23
Gambusia holbrooki	eastern mosquitofish	4	2			1					4
Cottus carolinae	banded sculpin							2	5	7	
Ambloplites ariommus	shadow bass						2	1			3
Lepomis cyanellus	green sunfish							1			1
Lepomis gulosus	warmouth	3	1							1	
Lepomis macrochirus	bluegill	15			1	2		1	3	1	
Lepomis megalotis	longear sunfish	7	18	9	7	26	5	24	2		16
Lepomis microlophus	redear sunfish		1			17					
Lepomis miniatus	redspotted sunfish	1	8		2		2	4		3	
Micropterus punctulatus	spotted bass	1	1			4	1				
Micropterus salmoides	largemouth bass							1			
Ammocrypta bifascia	Florida sand darter		4	1	2	1	2				8
Etheostoma colorosum	coastal darter	22	29	4	46	3	14				4
Etheostoma edwini	brown darter			2							
Etheostoma ramseyi	Alabama darter							8	6	5	
Etheostoma stigmaeum	speckled darter	2	5	3	1		1	1			
Etheostoma swaini	gulf darter		8		1	1	3				
Percina austroperca	southern logperch						7				
Percina nigrofasciata	blackbanded darter		22	6	1	1	7	2	11	5	5
Percina vigil	saddleback darter				2	12	20				2
Elassoma zonatum	banded pygmy sunfish					1				1	
Trinectes maculatus	hogchoker					4	8				
Total individuals	2260	494	265	102	252	178	315	251	103	137	163
Total species	56	20	26	15	20	20	25	23	16	22	18

District VI	**Site Number**	59	60	61	62	63	64	65	66	67	68	69	70
Choctawhatchee	**Stream Name**	Spring	Hurricane	Panther	Judy	Steephead	L Choc	Beaver	Panther	Rock	L Choc	Mossy	Unnamed Trib.
Scientific name	**Common name**												
Ichthyomyzon gagei	southern brook lamprey	1											1
Lepisosteus oculatus	spotted gar									2			
Anguilla rostrata	American eel	2						1					
Cyprinella venusta	blacktail shiner	73	38	2	10	25	62	4	1	6	8	37	11
Hybopsis sp cf winchelli	coastal clear chub	12	9		4	9	3						
Lythrurus atrapiculus	blacktip shiner		3	18	1	3	2	2	2	15	4		5
Macrhybopsis sp cf aestivalis	Florida chub						14	2			20		
Notropis amplamala	longjaw minnow	3	15	15		11	6					66	112
Notropis longirostris	longnose shiner		2		1		13					183	86
Notropis texanus	weed shiner	255	52	49	21	12	33	31		58	48	2	16
Pteronotropis merlini	orangetail shiner	4	27	1				4	5				17
Semotilus thoreauianus	Dixie chub											67	54
Erimyzon sucetta	lake chubsucker											2	1
Minytrema melanops	spotted sucker							3		4			
Moxostoma poecilurum	blacktail redhorse	8	1						1		1		2
Ameiurus natalis	yellow bullhead							1		2		1	3
Ictalurus punctatus	channel catfish						3						
Noturus funebris	black madtom	1	1	1		3							
Noturus leptacanthus	speckled madtom	14	2	4	3	4	11	2	9		4	11	4
Esox americanus	redfin pickerel	1	2	10					1			1	
Aphredoderus sayanus	pirate perch	3	11	7		2	4	4	5			1	5
Labidesthes sicculus	brook silverside	1			8				1				
Fundulus olivaceus	blackspotted topminnow			19	10	8	1	4	3	4	1		
Gambusia holbrooki	eastern mosquitofish			2	1				1	15			1
Ambloplites ariommus	shadow bass	1	3		1		4		1				
Centrarchus macropterus	flier		1					1					
Lepomis auritus	redbreast sunfish	1					4	7	1	86	12		9
Lepomis cyanellus	green sunfish	1	1				12	3	2	3	2	1	
Lepomis gulosus	warmouth	2	4	1			2	2		5			
Lepomis macrochirus	bluegill	2	13		5	6	7	34		26	2	2	3
Lepomis megalotis	longear sunfish	3	4	21	11	3	5	3	5	11	7		
Lepomis microlophus	redear sunfish		1				3	2		11			

District VI	**Site Number**	59	60	61	62	63	64	65	66	67	68	69	70
Choctawhatchee	**Stream Name**	Spring	Hurricane	Panther	Judy	Steephead	L Choc	Beaver	Panther	Rock	L Choc	Mossy	Unnamed Trib.
Scientific name	**Common name**												
Lepomis miniatus	redspotted sunfish	4	2	7	2		14	24	3	10	2	1	1
Micropterus punctulatus	spotted bass	1	1		1	1	3			1			
Micropterus salmoides	largemouth bass		1	1				2	2	14	1	1	1
Ammocrypta bifascia	Florida sand darter	3	8				4						
Etheostoma colorosum	coastal darter				11	3	1		3				
Etheostoma davisoni	Choctawhatchee darter		1	4	7	4			3	5	2		
Etheostoma edwini	brown darter	1	2	2					1				
Etheostoma swaini	gulf darter	9	1	2	8	5	1		8	1	4		
Percina nigrofasciata	blackbanded darter	13	29	7	30	33	19	3	21		4	12	7
Elassoma zonatum	banded pygmy sunfish												4
	hybrid centrarchid							2					
Total Individuals	2982	478	295	234	197	195	231	141	79	279	122	388	343
Total Species	43	25	27	19	18	16	24	22	21	19	16	15	20

Project 2

GEOLOGICAL SURVEY OF ALABAMA

Berry H. (Nick) Tew, Jr.
State Geologist

WATER INVESTIGATIONS PROGRAM

CALIBRATION OF THE INDEX OF BIOTIC INTEGRITY FOR THE SOUTHERN PLAINS ICHTHYOREGION IN ALABAMA

OPEN-FILE REPORT 0908

by

Patrick E. O'Neil and Thomas E. Shepard

Prepared in cooperation with the Alabama Department of Environmental Management and the Alabama Department of Conservation and Natural Resources

Tuscaloosa, Alabama
2009

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The Southern Plains ichthyoregion in southeast Alabama was sampled in May and June 2008 to develop data for creating and calibrating the Index of Biotic Integrity (IBI). Eighty sampling sites in 16 counties were selected to represent a range of watershed areas and levels of human disturbance. Watersheds ranged in area from 2.88 square miles (mi^2) to 435 mi^2 with 37 percent of the watersheds <20 mi^2, 40 percent ranging from 21 to100 mi^2, and 23 percent were >100 mi^2. Rapid habitat assessments were completed for each sampling site and eight measures of human disturbance in each watershed were derived from a geographic information system. Thirty-four candidate IBI metrics were screened for inclusion in the IBI by evaluating their relationship to the habitat assessment and human disturbance parameters. Human disturbance parameters were poorly related, whereas habitat parameters were correlated to IBI metrics. Twelve metrics were selected for the Southern Plains IBI: number of native species, number of cyprinid species, number of centrarchid species, number of darter+madtom species, proportion of tolerant species, proportion of green sunfish+yellow bullheads, proportion of insectivorous cyprinids, proportion of invertivores, proportion of top carnivores, catch per effort, number of lithophilic spawning species, and proportion with DELT+hybrids. The IBI was effective in discriminating sites with good habitat scores from sites with poor habitat scores. Thirty-two percent of the sites scored in the poor to very poor range, 41 percent in the fair range, and 27 percent in the good to excellent range. The Southern Plains IBI scoring criteria were adjusted slightly lower than criteria developed for the Valley and Ridge/Piedmont ichthyoregion. The Southern Plains IBI integrity classes were applied to the USEPA biological condition gradient concept for tiered aquatic life uses to model the response of biological condition to ecosystem stress in the region. This model can be used to better assess stream aquatic life use in the Southern Plains ichthyoregion and provide an additional tool for screening streams for water quality and habitat impairment.

INTRODUCTION

The Geological Survey of Alabama (GSA), in cooperation with the Alabama Department of Environmental Management (ADEM) and the Wildlife and Freshwater

Fisheries Division (WFFD) of the Alabama Department of Conservation and Natural Resources (ADCNR), has initiated a multi-year research effort to develop and calibrate a comprehensive fish community bioassessment tool, known as the Index of Biotic Integrity (IBI), for the state of Alabama. This tool will be useful in helping agencies assign designated water-use classifications for all the state's waters to manage water quality more efficiently and effectively, to understand aquatic resources more broadly and in greater depth, and to better manage aquatic habitat. Additionally, this tool will be useful in managing the state's water resources by communicating to the public and water-management agencies more clearly the need for and benefits of incorporating biological perspectives into water resource protection and management. Specifically, the process of establishing minimum instream flows and evaluating environmental flows will benefit substantially by incorporating biological monitoring and assessment methodologies.

The process of biological assessment is a systems approach for evaluating water resources that focuses on the actual condition of the resource, assessing chemical and physical water quality, biotic interactions, hydrology, energy and trophic interactions, and habitat structure. Ultimately, it is the measurable performance of the natural biological system relative to a reference condition that should be a goal for determining whether or not regulatory programs have successfully maintained or improved water quality or whether instream flows are adequate to sustain biological condition.

Biological assessments can now be used with confidence for water resource evaluation for several reasons. First, technical support for the use of standardized techniques and methods has been developed (Karr and others, 1986; Plafkin and others, 1989; Barbour and others, 1999). Second, field and laboratory techniques have been refined and modified for use within a regulatory scheme. Third, a practical, working definition of biological integrity has been developed (Karr and Dudley, 1981) from which the process of biological assessment can be defended and biological performance measured. And finally, the concept of using data from ecoregional reference watersheds has been incorporated into the evaluation process, compensating for the natural variation inherent in biological populations and systems (U.S.

Environmental Protection Agency (USEPA), 2005). Full integration of the chemical-specific, toxicity, and biological water-quality assessment approaches is essential for a broad-based, technically sound, and cost-effective system for regulating and managing water resources.

One of the many assets of the IBI method is its ability to reduce very complex ecological processes into simple terms that managers, industry and business representatives, regulators, and the public can understand. Application of the IBI to fishery management problems and water-quality issues can be done with confidence because the science behind the IBI method is extensive and peer reviewed. The GSA applied the IBI to a large regional watershed, the Cahaba River, in 1997 (Shepard and others, 1997), developing metrics and associated scoring criteria for the first time in an Alabama watershed. Later, in conjunction with ADEM, GSA developed another application of the IBI for streams in the Cahaba and Black Warrior River systems (O'Neil and Shepard, 2000a, b). Since these studies, the GSA has applied the IBI to the Locust Fork system (Shepard and others, 2004), the Mulberry Fork system (Shepard and others, 2002), the Cahaba River system again (O'Neil, 2002), and the Hatchet Creek system (O'Neil and Shepard, 2004). The IBI sampling methodology was refined and the new protocol applied in a study of the Terrapin Creek watershed (O'Neil and others, 2006). The Tennessee Valley Authority (TVA) has used the IBI for many years to assess the biological condition of streams throughout the Tennessee River drainage and several aspects of the TVA sampling methodology were incorporated into the Alabama Cooperative IBI method (O'Neil and others, 2006).

Although the IBI is routinely used for water-quality regulation in other states and has been successfully applied in selected drainages in Alabama, it is underutilized in Alabama as an assessment tool. Several needs have been identified that should be met before the IBI biomonitoring method can be fully implemented statewide in Alabama for assessing streams and other aquatic habitats. Some of these needs have been met and other research needs are currently underway.

The GSA, in conjunction with WFFD, recently developed a standardized stream sampling protocol during a 3-year study in the Terrapin Creek watershed (O'Neil and

others, 2006) for use with the IBI. This sampling protocol is now being used for all IBI fish bioassessments by ADEM, WFFD, and GSA. Research is currently underway to explore lake, reservoir, and nonwadeable river sampling protocols.

Alabama's high fish biodiversity was evaluated with respect to its high ecoregional and drainage diversity (O'Neil and Shepard, 2007) in order to reduce the set of unique eco-biotic regions to a manageable number for IBI scoring criteria development. This preliminary analysis resulted in five unique ecological-ichthyological regions in Alabama which were termed ichthyoregions. These were named the Tennessee Valley, Ridge and Valley/Piedmont, Plateau, Hills and Coastal Terraces, and Southern Plains (fig. 1). Preliminary IBI scoring criteria for the Ridge and Valley/Piedmont ichthyoregion have been developed (O'Neil and others, 2006). Results of criteria development for the Southern Plains are presented in this report. Criteria development for the Tennessee Valley will take place in 2009 with criteria development for the Hills and Coastal Terraces and Plateau ichthyoregions slated for 2011 and 2012.

Application of the IBI requires accurate species identifications by well-trained individuals. Individuals applying the IBI in Alabama must take this requirement into account because of Alabama's high fish biodiversity and consequently higher probability of mis-identifications. As such, unsure identity of collected specimens will require that they be brought to the laboratory for identification and verification by outside experts. "Green" sampling (i.e., non-destructive sampling), meaning identifications are made on site and individuals are returned to the stream, should also be a priority given the impaired state of many waterways and fish species in Alabama.

A list of standardized ecological and tolerance designations for all species of fishes in the state has been presented in other reports (O'Neil and Shepard, 2000b; O'Neil and others, 2006) and was updated for this report. This list should be peer reviewed by fisheries biologists, fish ecologists, and ichthyologists familiar with the state's fishes. Ichthyoregional and (or) drainage-specific reference sites should be established and sampled systematically over time. The ADEM has established ecoregional reference sites for their macroinvertebrate program, and these sites need to be sampled for fishes on a prescribed basis. The WFFD has recognized that

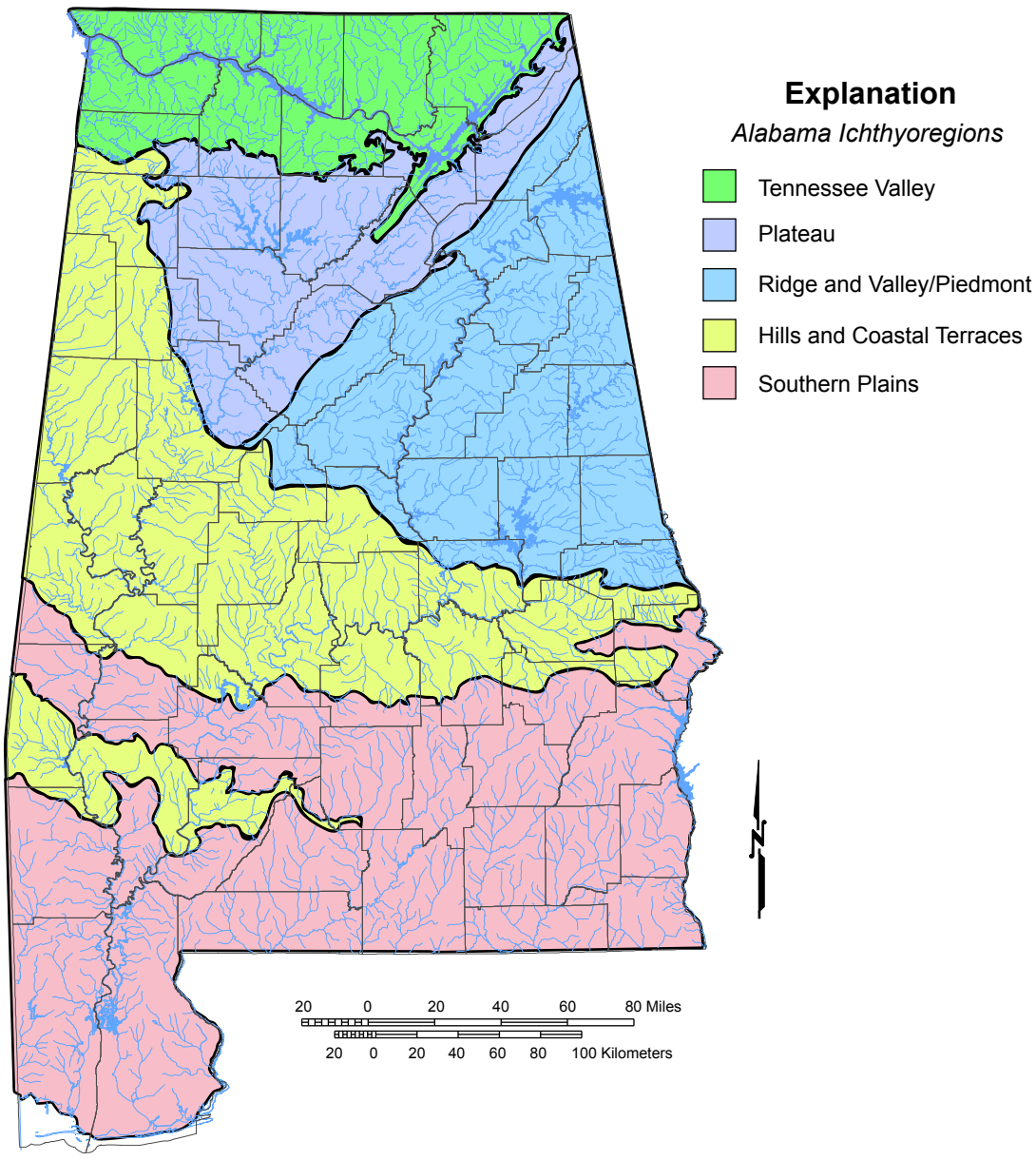


Figure 1. Preliminary ichthyoregion classification for Alabama (O'Neil and Shepard, 2007).

additional stream and reservoir assessment tools will be needed by their department in future years for managing habitat and stream resources to benefit fish populations in the state.

ACKNOWLEDGMENTS

Several individuals and institutions provided assistance with this study, and we sincerely appreciate their time and contributions. Fred Leslie, Chris Johnson, Lynn Sisk, and Norm Blakey of ADEM were involved in designing this cooperative project, discussing many aspects of project implementation, and in providing partial funding under Section 319 of the Clean Water Act. We appreciate the work of Mark Sport for coordinating this project at ADEM. Stan Cook, Nick Nichols, and Steve Rider of WFFD were also instrumental in designing the project, providing funding and encouragement for implementing this study, and participating in field sampling. Biologists with ADEM who participated in field sampling included Dusty Miller, Keith Gilliland, Rick Dowling, Scott Hicks, Michael Len, Aaron Goar, James Worley, and Tonya Mayberry. Travis Powell, Tom Ringenberg, Ken Weathers, Ben Ricks, and Jason Thomas of WFFD assisted with sampling and toted the backpack shocker in challenging environments. Cal Johnson, Brett Smith, Josh Hunter, and Stuart McGregor of the Geological Survey of Alabama also assisted with field collections and data entry while Anne Wynn handled all of our GIS mapping and GIS-based landscape analysis for the study. Dr. Duan Tian, also of the GSA, created a field data entry procedure based on an ACCESS database template. Amanda McKenzie, Jonathan Miller, Jeremy Turner, and Dr. Michael Stewart of Troy University assisted with field collections, and John Moran of the USDA Forest Service assisted with field collections in the Conecuh National Forest. Charlie Saylor and Amy Wales of the Tennessee Valley Authority worked cooperatively with GSA biologists for several years during which time the basic concepts of the Alabama Cooperative IBI Project were formed and the fundamental sampling concepts were refined.

OBJECTIVES

The goal of year 2 of the Alabama Cooperative IBI Project was to develop a workable and calibrated IBI for the Southern Plains ichthyoregion. This was accomplished by completing several objectives:

- ❑ Select, by way of in-house analysis and field reconnaissance, IBI sampling sites that reflect a range of watershed sizes and a range of human disturbance and habitat degradation from highly disturbed to minimally disturbed. The sampling sites should also flow during dry periods and be readily accessible by road and bridge crossings. Emphasis was placed on sites that presented sufficient riffle, run, and pool habitat to produce adequate samples for evaluating IBI metrics and scoring criteria.
- ❑ Attempt to sample approximately 100 sites in the Southern Plains ichthyoregion. The GSA was tasked with sampling 40 sites, the WFFD in conjunction with the GSA was assigned 20 sites, and ADEM was assigned 40 sites.
- ❑ Sample selected sites using the standard 30+2 IBI sampling protocol and use the resulting data to establish IBI metrics and scoring criteria specific for the Southern Plains ichthyoregion.

STUDY AREA

SOUTHERN PLAINS ICHTHYOREGION

Classifying the state into unique regions of similar fish community structure and composition—known as ichthyoregions in the Alabama IBI program—is especially important in a state like Alabama with its high biodiversity of fishes, large number of unique aquatic habitats, and its unique and complex physiographic, geologic, and ecoregional footprint. O'Neil and Shepard (2007) classified Alabama into five ichthyoregions: Tennessee Valley, Plateau, Ridge and Valley/Piedmont, Hills and Coastal Terraces, and Southern Plains (fig. 1). The Southern Plains ichthyoregion is large and comprises a combination of stream systems in the lower Mobile River basin including the lower Tombigbee and Alabama River systems (excluding those occurring in the Hills and Coastal Terraces ichthyoregion), streams of the Mobile-Tensaw River

Delta, and streams draining directly into Mobile Bay. It also includes all coastal river systems in Alabama: the Escatawpa, Perdido, Escambia-Conecuh, Blackwater, Yellow, Choctawhatchee-Pea, Chipola, and Chattahoochee. Ecoregions encompassed in the Southern Plains ichthyoregion are 65d, Southern Hilly Gulf Coastal Plain, 65g, Dougherty Plain, 65f, Southern Pine Plains and Hills, and 75i, Coastal floodplains and low terraces (Griffith and others, 2001). This is a large ichthyoregion with highly variable stream types, habitat quality, disturbance and pollution stress, geomorphology, and hydrology. Sampled streams ranged from the Perdido River system east to the Chattahoochee River system. Scoring criteria for Southern Plains streams in the Mobile River basin may require adjustment or the development of a subset of metrics and criteria specific to Mobile basin streams to account for faunal differences.

METHODS

IBI SAMPLE COLLECTION

A study completed in an earlier phase of the cooperative IBI project (O'Neil and others, 2006) outlined a fish community sampling protocol that proved acceptable for collecting a representative fish community sample for the purpose of calculating an IBI score. Results of the study indicated that sampling should be stratified over four habitat types (riffles, runs, pools, and shorelines) with a minimum of 10 sampling efforts each dedicated to riffle, run, and pool habitats. Two additional sampling efforts along stream shorelines were added to the protocol. This level of sampling effort and intensity, termed the "30+2" method, was determined sufficient to yield a fish community sample acceptable for calculating IBIs that reflect biological condition in wadeable streams. All four habitat types are generally present at sampling sites upstream of the Fall Line whereas hard rock riffles are generally absent at sites downstream of the Fall Line in the Coastal Plain. Thirty-two efforts were completed at all sites, and for those sites missing certain habitat components, the effort that would have been expended in that missing habitat component was proportioned to other habitats that were present.

The effectiveness of sampling fishes depends on many factors such as stream size, substrate conditions, flow, amount of cover in the stream channel, type of sampling gear, and the expertise and knowledge of the collectors. Karr (1981) indicated

that one of the basic foundations of the IBI is that all species of the fish community should be adequately sampled relative to their proportions in nature with minimal bias towards certain species or size classes of fishes. This is difficult to accomplish unless a standardized sampling protocol like the 30+2 method has been adopted that assures a representative and valid fish sample will be collected.

Fish samples collected for purposes other than bioassessment can be problematical when used in the IBI process because these samples are usually biased to the intended use of the data. For example, samples collected for taxonomic purposes target species of research interest and are generally restricted to narrowly defined habitat types while sampling gear for fisheries investigations typically select for large, commercially important species or sport fishes.

Within the 30+2 IBI sampling method, small-mesh minnow seines serve as a complement to the electroshocker and are used to catch, scoop, or dip stunned fishes and to trap fishes in sloughs and backwaters. At other times, seines are used as the primary device for capturing fishes in pools and runs and along shoals. Each sampling team had a variety of seine lengths for different size streams. The standard nylon minnow seine used was 10 to 15 feet wide, 6 feet deep, with a delta weave of 3/16 inch. An 8-foot-wide seine was sometimes necessary for very narrow streams while a 15-foot seine was used in larger streams and rivers.

An effective sampling technique was to use the backpack shocker in combination with the seine. In riffles, runs, and glides the seine was set in shallow, rocky areas or deeper, swifter chutes; the backpacker then walked upstream for 15 to 20 feet outside of the area to be sampled and proceeded to shock downstream through the habitat walking toward the seine while disturbing the bottom. Stunned fishes in the water column were washed into the net, while benthic fishes were dislodged from the bottom by kicking the substrate. A variation of this technique was to have a crew member walk behind the backpacker skating his feet from side to side to disturb the bottom and dislodge stunned benthic fishes. Most microhabitats in run/glide habitats were sampled because they are quite often very productive areas. Vegetated shorelines along glide and shoal margins were usually very productive areas as were areas where stream flow

becomes turbulent when entering runs and glides. Plunge pools where runs and glides transition to pools often yielded a diverse catch of minnow species.

Deeper stream runs and glides between pools were also productive habitats and were sampled by either seining downstream or by moving from bank to bank with the seine across the stream in a downstream direction either alone or following the backpack shocker. Pools were a common habitat feature in the Southern Plains ichthyoregion and generally supported species not found in either run, glide, or shoreline habitats. Lower velocity in pools required more effort to pull the seine through the water column reducing collecting efficiency. Following the electroshocker was effective in pools, and trapping fishes against the shore or in a slough at the end of a seine haul was also effective. Deep pools with structure were sampled by blocking the downstream end with the seine and working the upstream area with a shocker and dip nets for a few minutes. Wider seines were more advantageous in pools for trapping fishes.

Shorelines along pools, runs, and glides can have complex habitat structure and yield sunfish and sucker species not normally found in the basic run-pool or glide-pool sequence in Coastal Plain streams. The shoreline sampling technique consisted of a crew member working the electroshocker in an upstream direction along a shoreline reach for a length of about 150 feet, shocking around all habitat features. The field crew followed closely, scooping the stunned individuals with dip nets. Distance was measured with a forestry-type hip chain. A minimum of two 150-foot shoreline samples were collected per station.

HABITAT MEASURES

A rapid habitat assessment was completed for each IBI sample collected. Habitat evaluations are an integral part of efforts to describe biological conditions because good biological condition is quite often predicated on the presence of stable and diverse habitat. The term “habitat” is an inclusive term that incorporates several features and processes in streams including the physical components such as rock and rubble, logs, mud, channel and substrate condition; the chemical and physical components of water quality such as pH, dissolved chemical constituents, temperature,

and dissolved gases; and flow components such as flood and drought frequencies, velocity regimes, and discharge. For quantitative assessment purposes the habitat concept is generally narrowed to include the physical components of habitat and substrate structure, the degree of channel alteration, and the condition of banks and the adjacent riparian corridor. All of these components directly affect the structure and function of the aquatic biological community and they can be visually assessed for quality and relative degree of impairment. The visual glide-pool and riffle-run assessment procedures used in this study to quantify habitat conditions were originally reported in Plafkin and others (1989) and modified by Barbour and others (1999).

Stream habitat assessments entail evaluating the structure of the surrounding physical habitat that influences water resource quality and thus the condition of the resident biological community (Barbour and others, 1999). Generally, three characteristics of habitat contribute to the maintenance and persistence of aquatic biological communities: the availability and quality of the habitat-substrate components and instream cover, morphology of the instream channel, and structure of the bank and riparian vegetation zone (Plafkin and others, 1989). Barbour and others (1999) developed two sets of habitat metrics, one for evaluating upland stream habitat dominated by riffle-run microhabitats and hard substrates and the other for evaluating lowland and Coastal Plain streams that are dominated by glide-pool and run-pool habitats with unconsolidated sandy substrates (appendix A). The 11 habitat metrics of the glide-pool index and 12 metrics of the riffle/run index are individually scored on a scale of 0 (poor quality) to 20 (optimal quality) then summed to give a final score, the maximum possible habitat score is 220 for the glide-pool method and 240 for the riffle-run method. Final habitat scores are sometimes compared to reference streams that are minimally, or least impaired, in the area. Habitat quality is also sometimes taken as a percentage of the maximum habitat score possible. The percent maximum habitat score method was adopted for this study.

HABITAT METRICS

Instream cover - This habitat metric refers to the quantity and variety of natural substrate features such as fallen trees, logs, branches, undercut banks, and hard substrate particles that aquatic organisms can use as refugia, feeding sites, or for spawning. A diversity of substrate objects and microhabitat types leads to a diverse and productive aquatic community and, hence, a good biological condition. The presence of clean gravel, rocks, and log snags in flowing streams is generally most desirable. However, other objects such as tree roots, aquatic vegetation, and undercut banks provide good habitat for many species.

Pool substrate characterization – This metric is substituted for embeddedness in the riffle-run index for high-gradient streams and evaluates the type and condition of bottom substrates in pools. Firm substrates, like gravel and sand, and aquatic vegetation generally support a greater variety of aquatic organisms compared to pools with unconsolidated mud, bedrock, and silt with no aquatic vegetation.

Pool variability – This metric evaluates the overall mixture of pool types in the stream relative to size and depth. Pools of variable sizes and depths (large-deep, large-shallow, small-deep, and small-shallow) are preferable to pools of uniform depth (small or large-shallow) because they will generally support a greater variety of organisms. Extreme bedload sedimentation will lead to pools of uniform width and depth which strongly impairs aquatic biodiversity.

Man-made channel alteration – This metric quantifies the degree of channel alteration, usually in the form of stream channelization. Channelization changes the fundamental hydrodynamic and energy-flow relationships of a stream resulting in bank erosion and habitat degradation. Channel alteration can result in deposition on the inside of bends, below channel constrictions, and where stream gradient flattens. Channelization decreases stream sinuosity thereby increasing velocities and the

potential for channel and bank scour and possibly accelerated downcutting of the channel.

Sediment deposition - This characteristic quantifies the amount of sediment that has accumulated in pools and changes that have taken place on stream bottoms from the processes of erosion and sedimentation. The character of sediment deposits is an indication of the severity of watershed erosion, bank erosion, and stability of the stream. Sediment bars will appear and increase in coverage with continual upstream erosion in the watershed.

Channel sinuosity – Streams with a higher degree of sinuosity provide greater habitat diversity and more opportunities for the stream to support a varied fauna. Streams with sinuous channels are also better structured geomorphologically to hydraulically attenuate floods and storm flows by dissipating energy and protecting banks from excessive erosion.

Channel flow status – The degree to which a channel is filled with water is important because as flow volume decreases the amount of suitable substrate for aquatic organisms also decreases and biological condition can degrade. Having a suitable amount of submerged area and volume of flow is also important for maintaining acceptable water quality.

Condition of banks – Bank stability is a measure of whether banks are eroded or have the potential for erosion. Steep banks are more likely to collapse and are more prone to erosion than are gently sloping banks and are, therefore, considered unstable. Crumbling and unvegetated banks, exposed tree roots, and exposed soil are signs of accelerated bank erosion.

Bank vegetative protection – This metric is an evaluation of the vegetative protection on stream banks and the near-stream portion of the riparian zone. Roots hold soil in

place and reduce erosion potential thus enhancing the local aquatic biological community.

Grazing or other disruptive pressure – The degree to which stream side cover has been removed by animal grazing, mowing or herbicides, and mechanical tree removal is evaluated for this metric. Streams with natural vegetative cover have been shown to have a higher standing crop and variety of organisms compared to streams that are routinely disrupted or managed through mowing and grazing.

Riparian vegetative zone width – The riparian zone serves to buffer the stream from runoff, controls erosion, and provides organic matter and nutrients to the stream. Undisturbed riparian zones with natural vegetation help maintain highly diverse and functional aquatic communities while narrow and impaired riparian zones yield poor biological conditions and are associated with roads, fields, parking lots, and lawns.

The riffle-run habitat assessment method substitutes three habitat metrics and includes one additional metric in order to capture the character of streams with hard, rocky substrates and their associated flow-stream depth regimes.

Epifaunal surface - This parameter evaluates the relative amount and types of natural structures in the stream like cobble, large rocks, trees, logs and branches, and undercut banks which serve as places for spawning and habitat for aquatic macroinvertebrates and fishes. As variety and abundance of structures decreases, habitat structure becomes simplified and biodiversity will decrease.

Embeddedness - Embeddedness is a measure of the relative degree to which rocks and snags are covered or sunken into the silt, sand, and mud. As substrate features become buried, the available high-quality surfaces for shelter, spawning, and feeding decrease resulting in reduced biodiversity. This parameter is evaluated in riffle and run

habitats and is a substitute for the pool substrate character and variability parameter of the glide-pool method.

Velocity/depth regimes - High-quality riffle-run streams generally have four velocity/depth regimes present: slow-deep, slow-shallow, fast-deep, and fast-shallow. The presence of these regimes relates to the stream's ability to support stable aquatic habitat and reflects the degree of geomorphic stability. This parameter is a substitute for the pool variability parameter of the glide-pool method.

Frequency of riffles - Riffles are high-quality habitat in upland streams and this parameter assesses the heterogeneity and occurrence of riffles in a stream. More riffle habitat generally results in a greater variety and abundance of aquatic organisms. This parameter is a substitute for the channel sinuosity parameter of the glide-pool method for low gradient streams.

THE HUMAN DISTURBANCE GRADIENT

Stresses to aquatic resources are diverse in type and magnitude and affect ecosystem processes variably. A conceptual model for what is termed a generalized stressor gradient has been defined (USEPA, 2005) to help characterize and better understand environmental processes and mechanisms that generate stresses that lead to biological responses within aquatic communities. Events and activities that alter aquatic ecosystems are termed **disturbances**. Aquatic ecosystems normally operate at varying levels of disturbance within their ambient range of natural variation such as flood events and other extreme weather-related phenomena. Disturbances outside of this ambient range are human induced and exert **pressures** on aquatic systems by changing the fundamental environmental processes and ultimately generating **stressors** on the resident biota. Stressors are defined as physical, chemical, or biological factors that cause an adverse response from aquatic biota (USEPA, 2000) with the degree of response determined by the magnitude, frequency, and duration of exposure to stressors. This conceptual process is outlined in figure 2 with an example of how riparian tree removal leads to altered biological condition. Unstable banks

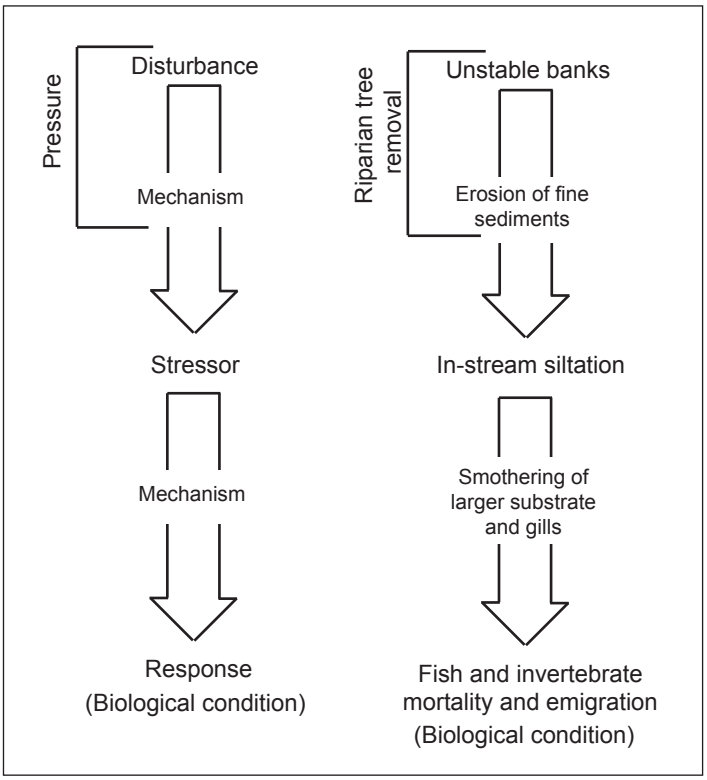


Figure 2. Conceptual model illustrating the relationship between disturbance, stressor, and response (adapted from USEPA, 2005).

(disturbance), caused by tree removal (pressures), leads to increased erosion of fine sediments from stream banks (mechanism). This mechanism causes in-stream siltation (stressor) which smothers the substrate with fine particles and causes gill irritation in fishes (mechanism). The stressor ultimately leads to fish and invertebrate mortality or emigration (biological response) out of the disturbed area.

Karr and others (1986) listed five factors that define the structural and functional integrity of aquatic resources and are the major receptors of ecosystem disturbance: water-quality, flow regime, biotic factors, energy source, and habitat structure. Water-quality factors such as hardness, nutrient concentrations, dissolved oxygen, turbidity, toxic trace metals, and toxic organic compounds all affect, either directly or indirectly, the survival of biota. Factors related to flow regime, including velocity gradients, groundwater inflows, diversions, dams, and relative variability of stream flows indirectly shape habitat quality. Severe disruption of natural flow regimes can accelerate channel scour, introduce additional bedload material, lower base flows, and weaken stream banks. Biotic factors such as increased rates of disease, parasitism, predation, and competition can directly affect the survival of the resident biota by weakening a population's ability to cope with added environmental stress. Removal of riparian vegetation through logging or urban development disrupts vital sources of energy for the stream including allochthonous organic matter and larger woody debris. Removal of riparian cover also exposes the stream to more sunlight and, when coupled with increased nutrient input, can lead to excessive algal growth and eutrophic conditions. Reach-specific habitat variables very often are significant determinants of biological integrity. Increased embeddedness of a naturally variable substrate with fine sediments can lead to loss of habitat diversity and a parallel loss of species diversity. The degree that finer sediments are embedded between larger substrate particles, the stability and quality of riparian vegetation cover, and the quality of habitat components such as riffles, pools, and runs are all intimately related to biological condition and ultimately to condition of the water resource.

One use of biological assessment tools is to assist in evaluating stream and habitat conditions in relation to human disturbance. Human activities will degrade water

resources by altering one or more of the five basic factors of ecosystem structure and function—water quality, flow regime, biotic factors, energy source, and habitat structure—(Karr and Chu, 1999) through the disturbance-stressor-response model. Because the multimetric IBI is sensitive to changes in these five factors, it can be used to quantify biological effects over a broad range of human disturbance activities. Understanding how the IBI and its individual metrics respond to human disturbance (sensitivity) is therefore a basic step in creating and calibrating an effective IBI index for a region or watershed.

The diverse array of human activities can make the task of defining and quantifying human disturbance difficult, but recent advances in geographic information systems (GIS) technology has resulted in more accurate and useful information for quantifying human disturbance at the landscape scale. Landscape features that stream ecologists have qualitatively known for years to be sources of ecosystem stress such as type of land cover, type and intensity of land use, number of road-stream intersections, number of point-source discharges, population density, and agricultural animal density can now be quantified into useable datasets for analysis using GIS.

Disturbance can be quantified on a number of levels ranging from human disturbance metrics that describe landscape-level features (Brown and Vivas, 2003; Fore, 2004) to the rapid habitat assessment metrics that describe reach-level features (Rankin, 1989; Barbour and others, 1999). Both landscape and reach-level measures were used in this investigation and are important for quantifying disturbance and relating it to multimetric indices such as the IBI.

The Analytical Tools Interface for Landscape Assessments (ATtILA) program has been developed by the USEPA to readily calculate many common landscape metrics. ATtiLA (version 2004), an Arc View extension, uses GIS data in order to create landscape metrics. Shape files containing population density and roads coverage for each county (U.S. Bureau of the Census), streams (National Hydrography Database), and a raster grid of land cover (National Land Cover Database 2001) were used to develop the following metrics for this project:

- ❑ Human density - (population count / watershed area in square kilometers).
- ❑ Phosphorus load (kg/ha/yr).
- ❑ Percent urban (percentage of watershed that is urban).
- ❑ Percent barren (percentage of the watershed that is man-made barren).
- ❑ Percent pasture (percentage of the watershed that is pasture).
- ❑ Percent crop (percentage of the watershed that is crop land).
- ❑ Road density (km of roads / square kilometer of watershed).
- ❑ Road x stream crossings (Number of road-stream crossings per kilometer of stream in the watershed).

IBI METRICS AND SCORING CRITERIA

Biological responses to stressors in the environment are quantified into measures called metrics which are calculated from fish collection data. Typical IBI metrics can be classified into one of four basic types. Diversity metrics generally evaluate total fish community diversity, such as total native species, or components of community diversity, such as darter or minnow species diversity; trophic metrics evaluate the trophic or production status of a fish community and quantify proportions of fishes in certain feeding guilds; tolerance and intolerance metrics measure the relative proportions and(or) counts of species present that are either tolerant or intolerant of pollutants, stressors, and habitat degradation; and reproduction/fish health metrics measure the relative proportions of species within certain reproductive guilds and the relative presence of health problems that may be environmentally caused such as lesions, tumors, and deformities.

Testing and validating biological responses across a gradient of habitat and(or) human disturbance is an important step in IBI development (Karr and Chu, 1997; Smogor and Angermeier, 1999a). The ability of individual metrics, and ultimately the IBI itself, to segregate most from least degraded and disturbed sites was evaluated by comparing a sample of stations with similar-sized watershed areas from each end of the habitat disturbance gradient similar to the method of Teels and Danielson (2001).

All sites were first ordered according to watershed area and this distribution was split into two groups, one consisting of sites with a watershed area <25 mi^2 and the other of sites with a watershed area ≥25 mi^2. Within each group, the sites were ordered from those with lowest habitat scores (most disturbed) to those with highest habitat scores (least disturbed). From this array, the ten most and least disturbed sites were selected from the ends of the distribution to compare statistically. The mean metric values for these two samples were then compared using the Student t-test. In similar fashion, the ten most and least disturbed sites from watersheds ≥25 mi^2 were also compared using the Student t-test.

DESIGNATION OF GUILDS

Biological responses to aquatic ecosystem stressors are manifested through changes in the structure (species diversity and abundance) and function (trophic relationships and reproductive patterns) of faunal communities. Within the fish community, species must be classified into appropriate trophic and reproductive guilds so accurate and responsive IBI metrics can be constructed (Goldstein and Simon, 1999; Simon, 1999a). Guild determination should be based on regionally specific ichthyology texts and natural history information. Recent books of Alabama fishes (Mettee and others, 1996; Boschung and Mayden, 2004) and fish books of adjoining states, Etnier and Starnes (1993) for Tennessee and Ross (2001) for Mississippi, contain excellent information for establishing guild associations for southeastern fishes. O'Neil and Shepard (2000b) provided a list of all Alabama freshwater fishes with ecological and distributional characteristics that included trophic status and tolerance. This list was modified using definitions and descriptions by Smoger and Angermeier (1999a) and Dauwalter and others (2003) to refine trophic guilds and add reproductive guild designations (appendix B).

Two classification factors were considered for assigning reproductive guild: spawning substrate and spawning behavior. Lithophilic spawners obligately use clean mineral substrates (i.e., rocks, sand, gravel) to deposit their eggs in or on top of. The non-lithophilic spawner guild captures the remaining types of substrate or spawning surfaces (aquatic vegetation, coarse organic matter, and other features not related to

lithophilic substrates). Simple spawners typically invest little energy in nest preparation or parental care and generally broadcast or bury their eggs. Manipulative spawners construct simple nests such as depressions, mounds, or cavities and(or) have some form of parental care such as egg or young guarding. Four reproductive guilds were designated for Alabama fishes: (1) simple lithophils, (2) manipulative lithophils, (3) simple non-lithophilic spawners, and (4) manipulative non-lithophilic spawners.

Trophic guild classifications were slightly more complex, and three classification factors were considered, as established by Smogor and Angermeier (1999b): number of food types consumed, feeding behavior, and foods consumed. Fish food types were grouped into four categories: detritus, algae or vascular plants, invertebrates, and fish-crayfish. Generalist feeders were those that eat three or more food types, specialists eat only one or at most two types. Benthic versus non-benthic feeding behaviors were also considered in the classification process with benthic behaviors associated with bottom-feeding species. Seven trophic guilds were established: (1) DAH - detritivore, algivore, herbivore. Detritus, algae, and(or) vascular plants comprise the major diet items for this guild with *Campostoma* and *Hybognathus* as examples. (2) AHI - algivore, herbivore, invertivore. This guild is similar to DAH, but species consume less detritus and more invertebrates with *Erimyzon*, *Polyodon*, carp, and *Hypentelium* as examples. (3) INV - invertivore. These species consume a variety of invertebrate taxa including crustaceans, insects, and mollusks. Examples are *Moxostoma, Fundulus, Ictalurus*, and *Ameiurus.* (4) INS - insectivore. Many species consume insect immatures as their major food type. Practically all of the darters and many cyprinid species are insectivores. (5) PIS - piscivore. Piscivores, such as *Lepisosteus* and *Morone*, consume fishes almost exclusively as adults. (6) IP - invertivore, piscivore. Many large predators, such as *Micropterus* and *Esox,* will consume fishes and larger invertebrates as adults. (7) PAR - parasite. This is a very restricted classification for those species (such as *Ichthyomyzon*) that may parasitize other fishes.

RESULTS AND DISCUSSION

SAMPLING SITES AND COLLECTION RESULTS

Eighty sites in 16 counties were sampled in May and June 2008 (fig. 3, table 1, appendix C) to assess fish communities for use in calibrating IBI metrics for the Southern Plains ichthyoregion. Sites were selected to represent a range of watershed areas and levels of human disturbance (fig. 4). Watershed areas ranged from 2.88 mi^2 to 435 mi^2 with 37 percent (30 sites) of the watersheds <20 mi^2, 39 percent (31 sites) ranging from 21 to100 mi^2, 22 percent (18 sites) were large ranging from 101 to 300 mi^2, and one watershed was 435 mi^2. Rapid habitat assessment scores were summed for each site (table 2) to yield a raw total habitat score. This raw value was then divided by the highest possible habitat score possible for the index (220 for the glide-pool method, 240 for the riffle-run method) to yield a value which was termed percent of maximum habitat (percent max habitat). This value formed the basis of how habitat impairment was quantified and evaluated. Habitat disruption appears to be the most significant manifestation of human disturbance in the region, particularly in the habitat parameters that assess pool and substrate quality and channel conditions.

Eight measures of human disturbance were calculated using the GIS (table 3). These parameters were then weighted by the Landscape Development Index (LDI) (table 4) and the resulting values summed to yield a human disturbance gradient (HDG) value for each site. This value has no units and allows comparison of watersheds relative to the degree of disturbance due to human causes. The HDG varied from <50, a low level of disturbance, to more than 1,000, a high level of disturbance (fig. 4). Twenty-five percent of the sites (20) rated lowest for human disturbance, 45 percent (36 sites) rated low, 22 percent (18 sites) rated moderately disturbed, while 8 percent (6 sites) rated highly disturbed (fig. 4).

Correlation analyses between candidate IBI metrics and human disturbance parameters (table 5) revealed weak relationships for most all disturbance parameters with the exception of percent pasture (PAS). This parameter was significantly related to IBI diversity metrics. Because of their overall poor correlations with biological condition metrics the human disturbance parameters were not used further to describe IBI

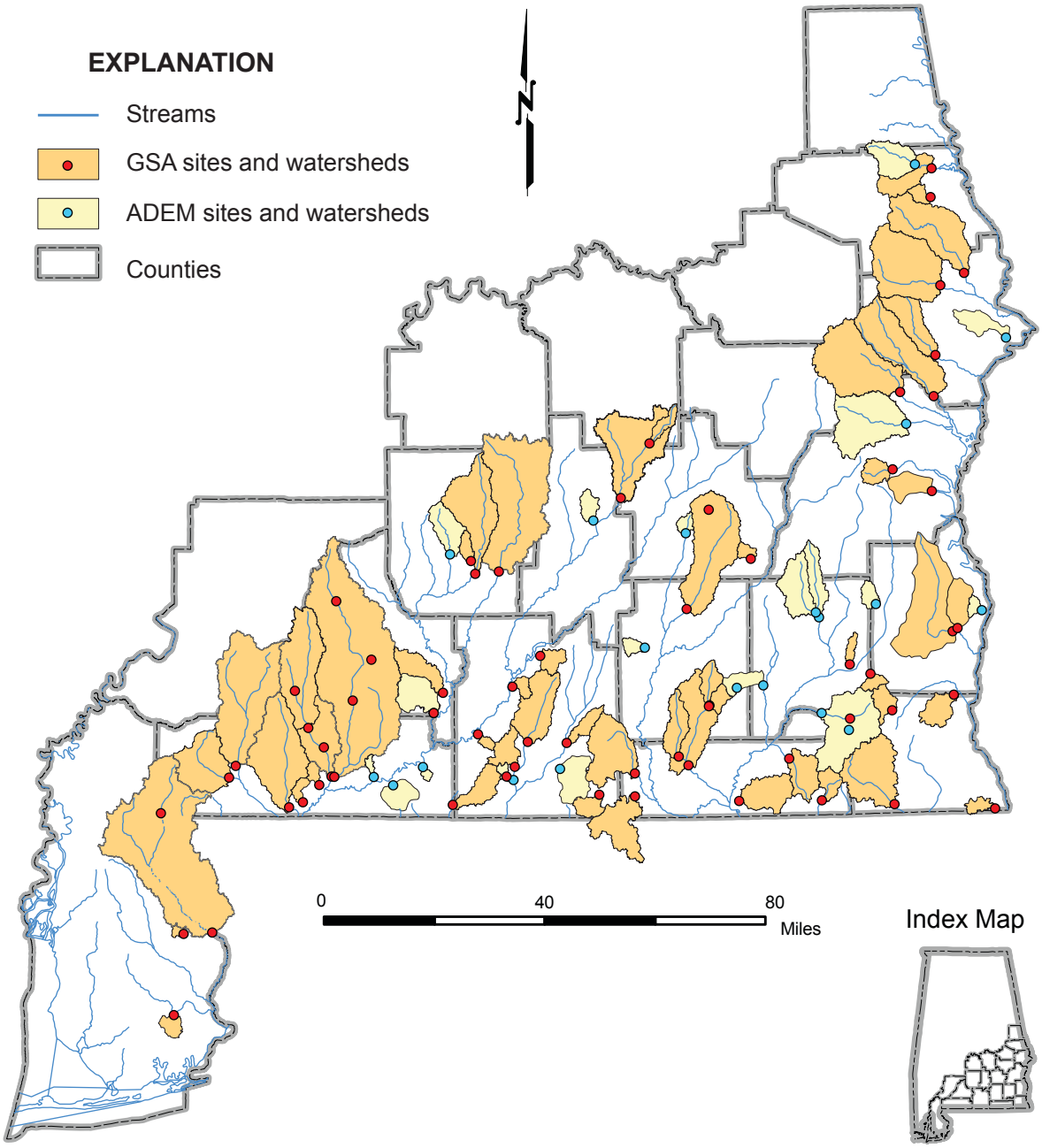


Figure 3. Location of IBI sampling sites and watersheds in the Southern Plains ichthyoregion.

Table 1. IBI sampling sites in the Southern Plains ichthyoregion, 2008.

Agency	ADEM station code	Stream name	County	Latitude	Longitude	Section, township, range	Watershed area (mi^2)	Ecoregion	8-Digit HUC code	GSA no.	Sample date
Perdido River system											
GSA	BFCB-2	Bellefontaine Creek at Co. Hwy. 87	Baldwin	30.68664	-87.52784	sec. 24, T. 4 S., R. 5 E.	3.85	65f	3140106	2261	25-Jun-08
GSA	PDBB-5	Perdido River at Duck Place Road (near Barrineau Park)	Baldwin	30.69084	-87.44028	sec. 23, T. 4 S., R. 5 E.	204.67	65f	3140106	2262	25-Jun-08
GSA	PRDE-1	Perdido River at Railroad Street in Nokomis	Escambia	31.00373	-87.59928	sec. 31, T. 1 N., R. 5 E.	41.08	65f	3140106	2263	26-Jun-08
GSA	TMEB-1	Threemile Creek at Co. Hwy. 32	Baldwin	30.47309	-87.55526	sec. 3/34, T. 6/7 S., R. 5 E.	12.37	65f	3140106	2260	25-Jun-08
Escambia/Conecuh River system											
GSA	BECE-1	Big Escambia Creek at Ala. Hwy. 27	Escambia	31.12950	-87.37070	sec. 16, T. 2 N., R. 7 E.	194.5	65f	3140305	2258	24-Jun-08
ADEM	BOTC-1	Bottle Creek at Co. Hwy. 43	Conecuh	31.26865	-86.76314	sec. 33, T. 4 N., R. 13 E.	40.42	65f	3140303	--	20-May-08
GSA	BOTC-1	Bottle Creek at Co. Hwy. 43	Conecuh	31.26865	-86.76314	sec. 33, T. 4 N., R. 13 E.	40.66	65f	3140303	2252	18-Jun-08
GSA/WFFD	BRSC-1	Brushy Creek at Co. Hwy. 6	Conecuh	31.32702	-87.19046	sec. 8, T. 4 N., R. 9 E.	23.56	65f	3140304	2273	18-Jul-08
GSA/WFFD	BCRE-4	Burnt Corn Creek at Co. Hwy. 40	Escambia	31.22912	-87.14843	sec. 15, T. 3 N., R. 9 E.	124.47	65f	3140304	2274	17-Jul-08
GSA	BCRE-1	Burnt Corn Creek at U.S. Hwy. 29/31	Escambia	31.10248	-87.07602	sec. 29, T. 2 N., R. 10 E.	186.85	65f	3140304	2254	19-Jun-08
GSA/WFFD	FGNC-1	Feagin Creek at Co. Hwy. 41	Covington	31.41857	-86.43477	sec. 10, T. 5 N., R. 16 E.	15.93	65f	3140301	2217	17-Jun-08
ADEM	FYCE-1	Folley Creek at Co. Hwy. 53	Escambia	31.12779	-86.79647	sec. 19, T. 2 N., R. 13 E.	3.45	65f	3140304	--	20-May-08
GSA	FRME-1	Franklin Mill Creek at U.S. Hwy. 31	Escambia	31.07986	-87.11396	sec. 1, T. 1 N., R. 9 E.	7.53	65f	3140304	2256	19-Jun-08
GSA	JRME-3	Jernigan Mill Creek at Louisville Street	Escambia	31.03378	-87.16449	sec. 21, T. 1 N., R. 9 E.	8.11	65f	3140304	2253	19-Jun-08
GSA/WFFD	LEC-1	Little Escambia Creek at U.S. Hwy. 31	Escambia	31.02026	-87.20725	sec. 30, T. 1 N., R. 9 E.	135.51	65f	3140304	2275	17-Jul-04
ADEM	MYCE-1	Maye Creek at U.S. Hwy 29	Escambia	31.10124	-86.94736	sec. 27, T. 1 N., R. 11 E.	4.08	65f	3140304	--	20-May-08
GSA/WFFD	MDRC-1	Murder Creek at Co. Hwy. 30, Fairnelson	Conecuh	31.56266	-87.06314	sec. 21, T. 7 N., R. 10 E.	42.63	65f	3140304	2272	18-Jul-08
GSA/WFFD	MDRE-2	Murder Creek at Co. Hwy. 6, Castleberry	Conecuh	31.30189	-87.01215	sec. 24, T. 4 N., R 10 E.	290.28	65f	3140304	2222	19-Jun-08
GSA	MDRE-1	Murder Creek at U.S. Hwy. 29/31	Escambia	31.10139	-87.06793	sec. 28, T. 2 N., R. 10 E.	435.01	65f	3140304	2255	19-Jun-08
GSA	OLUM-1	Olustee Creek at Moore Road	Montgomery	31.97398	-86.09317	sec. 31, T. 12 N., R. 20 E.	13.43	65d	3140302	2271	25-Jun-08
GSA	PALC-3	Patsaliga Creek at Co. Hwy. 30	Crenshaw	31.83178	-86.18336	sec. 19, T. 10 N., R. 19 E.	135.04	65d	3140302	2270	25-Jun-08
GSA	PRSB-3	Persimmon Creek at Ala. Hwy. 106	Butler	31.63375	-86.63518	sec. 27, T. 8 N., R. 14 E.	104.9	65d	3140303	2257	20-Jun-08
GSA	PGNB-7	Pigeon Creek at Ala. Hwy. 106	Butler	31.63301	-86.56018	sec.28, T. 8 N., R. 15 E.	233.29	65d	3140303	2215	25-Jun-08
ADEM	PDCC-1	Pond Creek at unnamed Co. Hwy. E of Vernledge	Crenshaw	31.77317	-86.26817	sec. 8, T. 9 N., R. 18 E.	14.29	65d	3140302	--	4-Jun-08
GSA	PRWC-1	Prestwood Creek at U.S. Hwy. 84	Covington	31.33798	-86.52090	sec. 2, T. 4 N., R. 15 E.	8.71	65f	3140301	2244	16-Jun-08
ADEM	RYC-5	Rocky Creek at unnamed Co. Hwy. in S1/2 of section 1	Butler	31.68532	-86.71178	sec. 1, T. 8 N., R. 13 E.	36.84	65d	3140303	--	14-May-08
ADEM	SSCE-1	Silas Creek at Co. Rd. 4	Escambia	31.07934	-86.88759	sec. 6, T. 1 N., R. 12 E.	2.88	65f	3140304	--	20-May-08
GSA/WFFD	SIMC-1	Simmons Creek at Co. Hwy. 43	Conecuh	31.32262	-86.73464	sec. 11, T. 4 N., R. 13 E.	34.09	65f	3140303	2221	19-Jun-08
GSA	SECE-3	Sizemore Creek at Co. Hwy. 27	Escambia	31.09858	-87.39126	sec. 32, T. 2 N., R. 7 E.	31.8	65f	3140305	2259	24-Jun-08
GSA	TELC-1	Teel Creek at Co. Hwy. 25	Covington	31.21275	-86.62649	sec. 23, T. 3 N., R. 24 E.	5.3	65f	3140301	2245	16-Jun-08

Table 1. IBI sampling sites in the Southern Plains ichthyoregion, 2008 -- continued.

Agency	ADEM station code	Stream name	County	Latitude	Longitude	Section, township, range	Watershed area (mi^2)	Ecoregion	8-Digit HUC code	GSA no.	Sample date
Blackwater/Yellow River system											
GSA	BKRE-1	Blackwater River at Co. Hwy. 2	Escambia	31.02859	-86.70474	sec. 24, T.1 N., R. 13 E.	87.62	65f	3140104	2251	18-Jun-08
ADEM	PONC-1	Pond Cr. at Blue Springs WMA road 45	Covington	31.09315	-86.51805	sec. 35, T. 2 N., R. 15 E.	5.84	65g	3140104	--	21-May-08
ADEM	CLC-1	Clear Creek on dirt road upstream of Covington Co. Hwy. 2	Covington	31.12153	-86.37575	sec. 20, T. 2 N., R. 17 E.	41	65g	3140103	--	21-May-08
GSA/WFFD	FVRC-2	Five Runs Creek at unnumbered road	Covington	31.19314	-86.47443	sec. 29, T. 3 N., R. 16 E.	70.36	65g	3140103	2218	18-Jun-08
GSA/WFFD	HFCC-1	Hog Foot Creek unnumbered road, Blue Springs WMA	Covington	31.12730	-86.51372	sec. 23/24, T. 2 N., R. 15 E.	24.77	65g	3140103	2219	18-Jun-08
GSA/WFFD	INC-1	Indian Creek Co. Hwy. 32	Covington	31.18976	-86.35407	sec. 33, T. 3 N., R. 17 E.	16.93	65f	3140103	2220	18-Jun-08
GSA	PONC-2	Pond Creek at Co. Hwy. 24	Covington	31.10253	-86.53885	sec. 27, T. 2 N., R. 15 E.	4.53	65g	3140103	2250	18-Jun-08
Choctawhatchee River system											
ADEM	BVC-2	Beaver Creek at Houston Co. Hwy. 59	Houston	31.21647	-85.48691	sec. 24, T. 3 N., R. 25 E.	19.41	65g	3140201	--	28-May-08
ADEM	BIGP-1A	Big Creek at unnanmed Co. Hwy. nr. Ala. Hwy. 87	Pike	31.73780	-85.98310	sec. 19, T. 9 N., R. 21 E.	8.53	65d	3140201	--	29-May-08
GSA/WFFD	BKCC-2	Blanket Creek at Co. Hwy. 610	Coffee	31.28543	-85.91492	sec. 25, T. 4 N., R. 21 E.	31.83	65g	3140201	2267	11-Jun-08
GSA	BMCP-2	Bowden Mill Creek at Co. Hwy. 2	Pike	31.66901	-85.78297	sec. 18, T. 8 N., R. 23 E.	7.74	65d	3140202	2233	9-Jun-08
GSA	CNRG-1	Corner Creek at Corner Creek Road	Covington	31.05356	-86.25481	sec. 9, T. 1 N., R. 19 E.	17.27	65g	3140202	2237	17-Jun-08
GSA	DBCG-2	Double Bridges Creek at Co. Hwy. 40	Geneva	31.12897	-85.98059	sec. 19, T. 2 N., R. 21 E.	142.06	65g	3140201	2242	12-Jun-08
GSA/WFFD	DBCC-8	Double Bridges Creek at Co. Hwy. 610	Coffee	31.28337	-85.91602	sec. 35, T. 4 N., R. 21 E.	31.75	65g	3140201	2266	11-Jun-08
GSA	DNMH-1	Dunham Creek at Co. Hwy. 16 (14 in Dale Co.)	Henry	31.36331	-85.41749	sec. 35, T. 5 N., R. 26 E.	9.52	65g	3140201	2240	12-Jun-08
GSA	EMCG-1	Eightmile Creek at Co. Hwy. 10	Geneva	31.04882	-86.14497	sec. 16, T. 1 N., R. 19 E.	63.35	65g	3140202	2246	17-Jun-08
GSA	FTCG-4	Flat Creek at Co. Hwy. 54	Geneva	31.10913	-86.14587	sec. 28, T. 2 N., R. 19 E.	83.73	65g	3140202	2248	17-Jun-08
ADEM	HDC-1	Harrand Creek at Lowe Field Road.	Dale	31.33706	-85.74834	sec. 9, T. 4 N., R. 23 E.	20.23	65d	3140201	--	22-May-08
GSA/WFFD	HURG-2	Hurricane Creek at Co. Hwy. 69	Geneva	31.14384	-85.67132	sec. 17/18, T. 2 N., R. 24 E.	38.15	65g	3140201	2264	10-Jun-08
ADEM	JDYD-2	Judy Creek at Co. Hwy. 15	Dale	31.52639	-85.58350	sec. 6, T. 6 N., R. 24 E.	51.04	65d	3140201	--	29-May-08
ADEM	JDYD-1	Judy Creek at Hwy 105 (Bottoms Mill Bridge)	Dale	31.51339	-85.57347	sec. 7, T. 6 N., R. 25 E.	82.25	65d	3140201	--	29-May-08
GSA	LCHH-1	Little Choctawhatchee River at Brannon Stand Road	Houston	31.24622	-85.48203	sec. 7, T. 3 N., R. 26 E.	24.85	65g	3140201	2243	13-Jun-08
ADEM	LCHH-4	Little Choctawhatchee River Co. Hwy. 9 south of Newton	Dale	31.26250	-85.57000	sec. 5, T. 3 N., R. 25 E.	111.75	65g	3140201	--	28-May-08
ADEM	PRCH-1	Panther Creek at Co. Hwy. 40	Henry	31.54617	-85.39748	sec. 36, T. 7 N., R. 26 E.	11.91	65d	3140201	--	4-Jun-08
ADEM	PATC-1	Patrick Creek on Co. Hwy. 368 (was Co. Hwy. 97)	Coffee	31.43840	-86.11210	sec. 2, T. 5 N., R. 19 E.	9.14	65d	3140201	--	22-May-08
GSA	SSCD-1	Seabes Creek at Co. Hwy. 67	Dale	31.38932	-85.48063	sec. 19, T. 5 N., R. 26 E.	7.68	65d	3140201	2241	12-Jun-08
GSA/WFFD	SPRG-4	Spring Creek at Co. Hwy. 4	Geneva	31.03356	-85.82631	sec. 23, T. 1 N., R. 22 E.	48.27	65g	3140203	2268	12-Jun-08
GSA/WFFD	TECG-2	Tight Eye Creek at Co. Hwy. 43	Geneva	31.15164	-86.00999	sec. 11, T. 2 N., R. 20 E.	36.34	65g	3140201	2269	12-Jun-08
ADEM	UTHC-1	Harrand Creek tributary at Dixie Drive	Coffee	31.33150	-85.82980	sec. 10, T. 4 N., R. 22 E.	2.93	65g	3140201	--	21-May-08
GSA	WCP-4	Walnut Creek at Co. Hwy. 26 (5513), Elm Street Road	Pike	31.79831	-85.91061	sec. 35, T. 10 N., R. 21 E.	10.49	65d	3140202	2232	9-Jun-08
GSA/WFFD	WWCC-2	Whitewater Creek at Co. Hwy. 215	Coffee	31.53857	-85.98182	sec. 32, T. 7 N., R. 21 E.	149.19	65d	3140202	2216	17-Jun-08
GSA/WFFD	WRIG-2	Wrights Creek at unnumbered dirt road	Geneva	31.03347	-85.57231	sec. 18, T. 7 N., R. 13 E.	17.59	65g	3140203	2265	10-Jun-08

Table 1. IBI sampling sites in the Southern Plains ichthyoregion, 2008 -- continued.

Agency	ADEM station code	Stream name	County	Latitude	Longitude	Section, township, range	Watershed area (mi^2)	Ecoregion	8-Digit HUC code	GSA no.	Sample date
Chipola/Chattahoochee River system											
GSA	BGC-1	Big Creek at Co. Hwy. 55	Houston	31.02026	-85.35012	sec. 33, T. 1 N., R. 27 E.	97.61	65g	3130012	2235	10-Jun-08
GSA	ABBH-6	Abbie Creek at Ala. Hwy. 95	Henry	31.47182	-85.16190	sec. 20, T. 6 N., R. 29 E.	147.67	65d	3130004	2237	11-Jun-08
ADEM	SFCB-1	S. Fork Cowikee at Co. Hwy. 79	Barbour	32.01750	-85.29583	sec. 14, T. 12 N., R. 27 E.	112.21	65d	3130003	--	5-Jun-08
GSA	BRC-2	Barbour Creek at Co. Hwy. 79	Barbour	31.89819	-85.33995	sec. 33, T. 11 N., R. 27 E.	20.24	65d	3130003	2226	4-Jun-08
ADEM	BMCH-1	Bennett Mill Creek at Co. Rd. 97	Henry	31.52586	-85.07152	sec. 6, T. 6 N., R. 30 E.	6.86	65d	3130004	--	4-Jun-08
GSA	CHCB-1	Cheneyhatchee Creek at Co. Hwy. 32	Barbour	31.83991	-85.21925	sec. 22, T. 10 N., R. 28 E.	43.28	65d	3130003	2227	4-Jun-08
ADEM	HACL-1	Halawakee Creek at Co. Hwy. 390	Lee	32.69600	-85.43211	sec. 29, T. 20 N., R. 28 E.	42.78	45a	3130002	--	10-Jun-08
GSA	HACL-2	Halawakee Creek at Co. Hwy. 259	Lee	32.68554	-85.20348	sec. 35, T. 20 N., R. 28 E.	77.43	45b	3130002	2223	3-Jun-08
GSA	HECR-1	Hatchechubbee Creek at Co. Hwy. 4	Russell	32.19665	-85.20055	sec. 14, T. 14 N., R. 28 E.	51.38	45b	3130003	2229	5-Jun-08
GSA	HRCH-1	Hurricane Creek at Co. Hwy. 22	Houston	31.30539	-85.16175	sec. 20, T. 4 N., R. 29 E.	27.29	65g	3130004	2236	11-Jun-08
ADEM	IHGR-1	Ihagee Creek at Co. Hwy. 18. nr Ft. Benning	Russell	32.23850	-84.98069	sec. 1, T. 14 N., R. 30 E.	26.99	65d	3130003	--	5-Jun-08
GSA	IRMC-1	Irwin Mill Creek at Ala. Hwy. 95	Houston	31.00530	-85.04100	sec. 17, T. 7 N., R. 8 W.	10.47	65g	3130004	2234	10-Jun-08
GSA	LUCR-1	Little Uchee Creek at Co. Hwy. 28	Russell	32.41076	-85.10774	sec. 2, T. 16 N., R. 29 E.	114.58	65d	3130003	2231	6-Jun-08
GSA	MFCB-1	Middle Fork Cowikee Creek at Co. Hwy. 49	Barbour	32.10077	-85.31265	sec. 22, T. 13 N., R. 27 E.	142.61	65d	3130003	2225	4-Jun-08
GSA	NFCAU01	North Fork Cowikee Creek at unnumbered road	Barbour	32.08924	-85.20893	sec. 27, T. 13 N., R. 28 E.	114.05	65d	3130003	2228	5-Jun-08
GSA	CH2U5-20	Omussee Creek at Kinsey Road (Co. Hwy. 48)	Houston	31.26733	-85.35174	sec. 32, T. 3 N., R. 27 E.	18.12	65g	3130004	2239	11-Jun-08
GSA	PTRH-1	Peterman Creek at Co. Hwy. 28	Henry	31.47943	-85.14670	sec. 20, T. 6 N., R. 29 E.	31.64	65d	3130004	2238	11-Jun-08
GSA	UCCR-2	Uchee Creek at Ala. Hwy. 169	Russell	32.37863	-85.18233	sec. 13, T. 16 N., R. 28 E.	133.97	45b	3130003	2230	5-Jun-08
GSA	WACL-1	Wacoochee Creek at Co. Hwy. 279	Lee	32.60981	-85.20864	sec. 20, T. 19 N., R. 29 E.	11.25	45b	3130002	2224	3-Jun-08

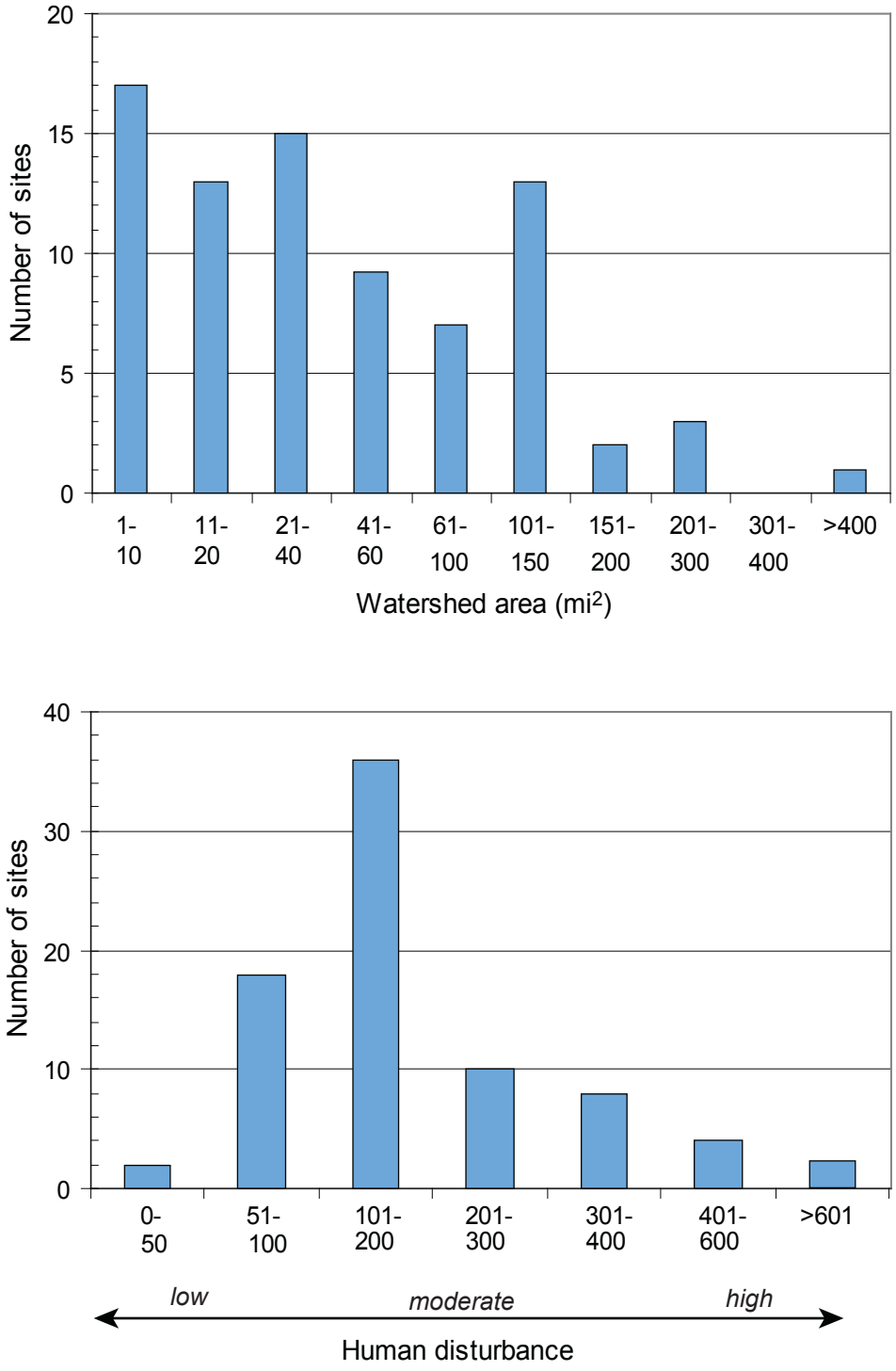


Figure 4. Frequency distribution of sampling sites by watershed area and human disturbance.

Table 2. Rapid habitat assessment scores for sites in the Southern Plains ichthyoregion.

Stream sites	Rapid habitat assessment parameters															Sum	Percent max habitat
	Glide-pool											Riffle-run					
	INCOV	PSUB	PVAR	CHALT	SEDDEP	CHSIN	CHSTA	BKCON	BKVEG	DISP	RIPVEG	EPISUR	EMBED	VELDEP	RIFREQ		
ABBH-6	12	5	12	16	12	9	10	13	18	18	12	--	--	--	--	137	62.27
BCRE-1	16	17	17	17	13	12	13	14	14	12	12	--	--	--	--	157	71.36
BCRE-4	11	12	12	17	11	14	19	14	14	20	18	--	--	--	--	162	73.64
BECE-1	16	18	16	17	15	12	13	13	14	18	16	--	--	--	--	168	76.36
BFCB-2	11	11	9	12	15	14	14	18	18	18	16	--	--	--	--	156	70.91
BGC-1	9	13	10	16	13	12	17	12	14	18	18	--	--	--	--	152	69.09
BIGP-1A	5	10	6	16	8	8	16	8	6	15	12	--	--	--	--	110	50.00
BKCC-2	15	6	8	12	4	5	9	8	10	12	12	--	--	--	--	101	45.91
BKRE-1	13	16	12	18	12	15	14	12	16	18	14	--	--	--	--	160	72.73
BMCH-1	6	6	5	16	14	11	14	13	14	16	18	--	--	--	--	133	60.45
BMCP-2	6	6	10	16	11	11	6	12	12	16	16	--	--	--	--	122	55.45
BOTC-1	14	--	--	16	6	--	13	12	16	18	16	8	7	12	10	148	61.67
BOTC-1	13	12	10	16	13	13	11	16	10	16	16	--	--	--	--	146	66.36
BRC-2	3	6	3	16	5	10	6	11	10	18	16	--	--	--	--	104	47.27
BRSC-1	17	16	13	12	12	17	11	10	12	20	11	--	--	--	--	151	68.64
BVC-2	5	6	7	16	7	10	13	7	8	16	16	--	--	--	--	111	50.45
CH2U5-20	12	12	9	14	11	9	12	10	16	14	12	--	--	--	--	131	59.55
CHCB-1	5	--	--	16	3	--	10	16	18	18	18	10	5	11	5	135	56.25
CLC-1	6	7	10	16	11	11	13	8	6	16	18	--	--	--	--	122	55.45
CNRG-1	9	10	9	16	11	14	14	13	16	16	14	--	--	--	--	142	64.55
DBCC-8	8	11	7	13	7	10	9	4	14	16	16	--	--	--	--	115	52.27
DBCG-2	11	14	12	17	10	13	9	18	16	18	16	--	--	--	--	154	70.00
DNMH-1	12	16	10	16	11	13	11	13	16	18	18	--	--	--	--	154	70.00
EMCG-1	7	11	10	17	12	15	17	12	12	10	8	--	--	--	--	131	59.55
FGNC-1	16	13	8	16	10	11	13	17	17	20	16	--	--	--	--	157	71.36
FRME-1	6	7	2	12	6	10	9	4	14	12	8	--	--	--	--	90	40.91
FTCG-4	6	8	10	16	6	14	7	6	14	18	18	--	--	--	--	123	55.91
FVRC-2	12	10	16	18	9	13	16	17	14	19	20	--	--	--	--	164	74.55
FYCE-1	4	7	8	17	7	6	12	13	16	18	14	--	--	--	--	122	55.45
HACL-1	9	--	--	15	6	--	14	6	8	12	12	11	7	15	16	131	54.58

INCOV-instream cover, PSUB-pool substrate characterization, PVAR-pool variability, CHALT-man-made channel alteration,
SEDDEP-sediment deposition, CHSIN-channel sinuosity, CHSTA-channel flow status, BKCON-bank condition, BKVEG-bank vegetative protection,
DISP-bank disruptive pressure, RIPVEG-riparian vegetative zone width, EPISUR-epifaunal surface development, EMBED-embeddedness,
VELDEP-velocity/depth regimes, RIFREQ-frequency of riffles.

Table 2. Rapid habitat assessment scores for sites in the Southern Plains ichthyoregion--continued.

Stream sites	Rapid habitat assessment parameters															Sum	Percent max habitat
	Glide-pool											Riffle-run					
	INCOV	PSUB	PVAR	CHALT	SEDDEP	CHSIN	CHSTA	BKCON	BKVEG	DISP	RIPVEG	EPISUR	EMBED	VELDEP	RIFREQ		
HACL-2	16	--	--	18	16	--	16	15	18	20	20	5	16	16	20	196	81.67
HDC-1	6	9	5	16	12	7	16	11	12	18	13	--	--	--	--	125	56.82
HECR-1	9	10	6	16	11	10	8	6	14	18	16	--	--	--	--	124	56.36
HFCC-1	15	13	18	19	7	16	15	15	18	20	16	--	--	--	--	172	78.18
HRCH-1	12	13	12	15	12	10	15	15	16	16	15	--	--	--	--	151	68.64
HURG-2	14	13	15	16	12	10	16	17	18	16	18	--	--	--	--	165	75.00
IHGR-1	16	--	--	18	12	--	14	16	16	16	18	10	12	13	16	177	73.75
INC-1	6	7	10	16	7	12	12	7	6	16	18	--	--	--	--	117	53.18
IRMC-1	11	16	11	17	16	9	19	17	20	20	20	--	--	--	--	176	80.00
JDYD-1	10	--	--	11	7	--	7	6	10	16	18	8	8	11	9	121	50.42
JDYD-2	3	6	4	16	6	10	6	5	4	16	18	--	--	--	--	94	42.73
JRME-3	16	16	9	14	13	10	15	15	18	18	18	--	--	--	--	162	73.64
LCHH-1	15	12	16	14	12	11	13	18	18	20	16	--	--	--	--	165	75.00
LCHH-4	7	7	11	16	7	7	16	11	14	16	13	--	--	--	--	125	56.82
LEC-1	13	10	11	16	13	16	18	15	18	20	17	--	--	--	--	167	75.91
LUCR-1	16	16	10	16	11	12	8	12	16	18	14	--	--	--	--	149	67.73
MDRC-1	16	13	12	16	11	16	17	15	18	20	16	--	--	--	--	170	77.27
MDRE-1	16	15	13	13	10	11	12	13	14	16	16	--	--	--	--	149	67.73
MDRE-2	14	16	16	18	11	8	12	15	18	14	16	--	--	--	--	158	71.82
MFCB-1	6	8	8	16	12	10	8	10	12	18	18	--	--	--	--	126	57.27
MYCE-1	10	13	9	17	12	13	16	14	14	12	11	--	--	--	--	141	64.09
NFCAU01	5	10	10	16	11	11	8	6	10	16	4	--	--	--	--	107	48.64
OLUM-1	11	8	11	16	7	16	8	8	12	20	16	--	--	--	--	133	60.45
PALC-3	8	6	12	9	7	9	17	12	12	18	16	--	--	--	--	126	57.27
PATC-1	8	8	10	16	8	14	8	12	14	18	17	--	--	--	--	133	60.45
PDBB-5	13	12	12	15	16	10	13	15	16	16	12	--	--	--	--	150	68.18
PDCC-1	7	11	9	16	4	10	11	7	6	16	18	--	--	--	--	115	52.27
PGNB-7	11	14	12	18	10	9	16	11	14	18	16	--	--	--	--	149	67.73
PONC-1	6	8	8	16	8	7	18	14	14	16	18	--	--	--	--	133	60.45
PONC-2	17	13	10	13	16	1	16	17	18	18	20	--	--	--	--	159	72.27

INCOV-instream cover, PSUB-pool substrate characterization, PVAR-pool variability, CHALT-man-made channel alteration, SEDDEP-sediment deposition, CHSIN-channel sinuosity, CHSTA-channel flow status, BKCON-bank condition, BKVEG-bank vegetative protection, DISP-bank disruptive pressure, RIPVEG-riparian vegetative zone width, EPISUR-epifaunal surface development, EMBED-embeddedness, VELDEP-velocity/depth regimes, RIFREQ-frequency of riffles.

Table 2. Rapid habitat assessment scores for sites in the Southern Plains ichthyoregion--continued.

Stream sites	Rapid habitat assessment parameters															Sum	Percent max habitat
	Glide-pool											Riffle-run					
	INCOV	PSUB	PVAR	CHALT	SEDDEP	CHSIN	CHSTA	BKCON	BKVEG	DISP	RIPVEG	EPISUR	EMBED	VELDEP	RIFREQ		
PRCH-1	4	4	5	16	6	8	4	10	14	16	18	--	--	--	--	105	47.73
PRDE-1	11	12	11	16	12	13	13	17	18	18	16	--	--	--	--	157	71.36
PRSB-3	14	12	16	17	9	10	18	11	18	20	18	--	--	--	--	163	74.09
PRWC-1	3	6	1	14	1	9	8	11	14	16	12	--	--	--	--	95	43.18
PTRH-1	1	6	1	16	1	13	12	16	18	18	18	--	--	--	--	120	54.55
RYC-5	16	--	--	14	17	--	6	16	16	18	12	7	17	11	7	157	65.42
SECE-3	14	14	10	16	15	10	11	15	16	16	12	--	--	--	--	149	67.73
SFCB-1	6	--	--	16	4	--	6	10	13	16	18	6	8	8	10	121	50.42
SIMC-1	11	3	4	16	14	12	7	17	18	20	17	--	--	--	--	139	63.18
SPRG-4	14	8	9	12	4	13	17	12	10	10	12	--	--	--	--	121	55.00
SSCD-1	14	16	9	16	9	12	11	9	12	12	10	--	--	--	--	130	59.09
SSCE-1	7	8	8	16	7	9	8	8	14	18	16	--	--	--	--	119	54.09
TECG-2	5	4	6	13	6	10	14	9	8	14	14	--	--	--	--	103	46.82
TELC-1	10	12	6	16	3	17	11	16	18	16	16	--	--	--	--	141	64.09
TMEB-1	12	12	10	14	12	16	14	16	18	18	18	--	--	--	--	160	72.73
UCCR-2	16	16	10	16	11	11	9	10	14	18	14	--	--	--	--	145	65.91
UTHC-1	3	8	3	8	3	7	8	8	9	9	4	--	--	--	--	70	31.82
WACL-1	5	12	3	17	6	8	8	11	10	16	18	--	--	--	--	114	51.82
WCP-4	6	6	5	16	9	14	7	14	16	18	18	--	--	--	--	129	58.64
WRIG-2	16	13	10	11	8	10	17	9	12	10	12	--	--	--	--	128	58.18
WWCC-2	17	11	16	16	11	9	14	17	16	20	16	--	--	--	--	163	74.09

INCOV-instream cover, PSUB-pool substrate characterization, PVAR-pool variability, CHALT-man-made channel alteration,
SEDDEP-sediment deposition, CHSIN-channel sinuosity, CHSTA-channel flow status, BKCON-bank condition, BKVEG-bank vegetative protection,
DISP-bank disruptive pressure, RIPVEG-riparian vegetative zone width, EPISUR-epifaunal surface development, EMBED-embeddedness,
VELDEP-velocity/depth regimes, RIFREQ-frequency of riffles.

Table 3. Human disturbance parameters for sites in the Southern Plains ichthyoregion.

Site code	Human density (no./km^2)	Phosphorus load (kg/ha/yr)	Land cover (percent)				Road density (km/km^2)	Stream-road crossings (no./km)
			Urban	Barren	Pasture	Cropland		
ABBH-6	14.49	0.550	6.04	0.22	6.28	18.28	1.347	0.348
BCRE-1	12.56	0.232	3.91	0.69	9.64	4.29	1.225	0.271
BCRE-4	7.09	0.230	3.56	0.80	11.38	3.67	1.130	0.280
BECE-1	12.00	0.510	3.38	0.15	9.98	16.51	1.753	0.395
BFCB-2	5.82	0.235	4.85	0.00	5.84	5.17	1.429	0.286
BGC-1	65.28	0.979	9.77	0.00	12.73	32.47	2.050	0.713
BIGP-1A	152.66	1.110	23.52	0.00	13.80	28.40	3.132	0.950
BKCC-2	135.97	0.838	21.25	0.00	14.61	19.62	2.931	0.753
BKRE-1	1.72	0.125	3.25	0.00	6.96	1.02	1.025	0.243
BMCH-1	14.12	0.464	3.72	0.00	8.10	8.28	1.160	0.308
BMCP-2	14.23	0.333	5.22	0.00	17.03	5.07	1.139	0.158
BOTC-1	3.88	0.222	2.83	0.00	8.12	4.99	1.008	0.324
BRC-2	5.69	0.127	3.08	0.00	3.45	2.58	0.834	0.132
BRSC-1	9.30	0.307	3.94	2.04	19.36	3.71	1.222	0.212
BVC-2	3.80	0.391	2.82	0.00	8.21	4.99	1.011	0.317
CH2U5-20	96.29	1.296	17.17	0.00	9.59	43.64	2.553	0.982
CHCB-1	8.99	0.113	3.38	0.00	2.63	2.12	0.698	0.109
CLC-1	0.67	0.378	6.56	0.00	10.72	1.46	1.833	0.496
CNRG-1	16.79	0.266	7.12	0.00	14.21	2.26	1.929	0.465
DBCC-8	38.34	0.615	7.41	0.00	13.18	17.70	1.730	0.280
DBCG-2	26.52	0.729	6.56	0.00	15.91	22.04	1.500	0.409
DNMH-1	22.33	1.155	6.37	0.00	17.37	40.11	1.619	0.701
EMCG-1	4.62	0.313	3.27	0.00	12.45	7.01	1.021	0.330
FGNC-1	13.82	0.401	4.63	0.00	21.00	6.79	1.648	0.495
FRME-1	3.72	0.040	2.47	0.31	0.20	0.21	0.607	0.108
FTCG-4	8.71	0.375	5.33	0.00	15.55	7.43	1.649	0.451
FVRC-2	43.78	0.410	9.35	0.00	24.93	3.18	1.873	0.405
FYCE-1	0.46	0.307	1.25	0.00	2.28	3.43	1.084	0.265
HACL-1	2.46	0.484	2.73	0.00	6.94	10.15	0.875	0.088
HACL-2	41.34	0.290	7.96	1.04	20.58	0.19	1.452	0.438
HDC-1	0.86	0.297	4.84	0.00	2.88	0.09	1.648	0.445
HECR-1	4.07	0.224	3.48	0.00	6.33	5.43	0.750	0.247
HFCC-1	5.37	0.216	4.98	0.00	14.18	1.25	1.436	0.281
HRCH-1	15.87	1.073	5.63	0.00	13.85	38.24	1.556	0.631
HURG-2	29.29	0.956	7.61	0.04	20.43	29.54	1.896	0.604
IHGR-1	21.06	0.450	5.53	1.34	26.37	0.34	1.257	0.327
INC-1	79.83	0.488	14.43	0.00	28.81	2.41	2.889	0.604
IRMC-1	6.56	1.119	4.08	0.00	8.55	43.16	1.567	0.000
JDYD-1	3.81	0.553	3.61	0.00	2.27	14.42	0.927	0.044
JDYD-2	9.20	0.334	1.08	0.00	6.32	3.26	1.974	0.317
JRME-3	18.58	0.687	6.09	0.09	14.02	21.16	1.805	0.473
LCHH-1	258.42	1.116	42.57	0.00	8.81	22.86	4.190	1.009
LCHH-4	22.81	0.589	8.59	0.00	11.30	11.84	1.185	0.340
LEC-1	4.83	0.211	2.80	1.36	4.24	5.93	1.444	0.540
LUCR-1	62.05	0.284	11.36	0.50	10.49	2.23	1.656	0.455
MDRC-1	1.73	0.190	1.92	0.00	7.09	4.49	1.286	0.321
MDRE-1	11.61	0.214	3.69	0.05	9.22	3.78	1.320	0.356
MDRE-2	10.17	0.221	3.98	0.05	9.96	3.64	1.226	0.358
MFCB-1	3.10	0.240	3.21	0.06	9.36	5.09	0.697	0.298

Table 3. Human disturbance parameters for sites in the Southern Plains ichthyoregion--continued.

Site code	Human density (no./km^2)	Phosphorus load (kg/ha/yr)	Land cover (percent)				Road density (km/km^2)	Stream-road crossings (no./km)
			Urban	Barren	Pasture	Cropland		
MYCE-1	2.34	0.352	3.78	0.00	4.17	3.96	0.899	0.217
NFCAU01	6.77	0.306	4.42	0.02	9.35	7.31	0.832	0.263
OLUM-1	4.90	0.317	3.32	0.00	9.90	8.17	0.918	0.281
PALC-3	7.54	0.260	3.68	0.02	8.04	6.23	1.132	0.315
PATC-1	95.03	0.527	16.74	0.00	8.56	4.80	2.435	0.357
PDBB-5	14.77	0.362	5.02	0.09	4.35	11.27	1.522	0.438
PDCC-1	3.97	0.459	4.40	0.00	13.39	5.78	1.063	0.257
PGNB-7	9.47	0.270	4.53	0.00	13.13	4.25	1.242	0.322
PONC-1	6.00	0.345	4.66	0.00	9.90	1.24	1.360	0.343
PONC-2	1.08	0.094	5.05	0.00	3.47	0.11	1.739	0.371
PRCH-1	8.12	0.447	2.72	0.00	6.33	8.19	0.745	0.105
PRDE-1	10.50	0.697	3.60	0.03	5.68	26.02	1.320	0.536
PRSB-3	37.23	0.237	7.64	0.25	10.87	2.04	1.579	0.525
PRWC-1	126.50	0.328	20.71	0.00	7.08	0.70	3.345	0.607
PTRH-1	6.35	0.396	4.00	0.00	6.24	12.70	1.126	0.258
RYC-5	566.41	0.990	76.47	0.00	1.41	0.49	9.146	2.743
SECE-3	24.55	0.832	4.70	0.43	11.14	29.29	1.810	0.609
SFCB-1	222.61	0.749	29.09	0.00	7.81	9.26	3.918	0.870
SIMC-1	5.28	0.190	4.22	0.00	7.87	2.99	1.159	0.269
SPRG-4	14.81	1.024	6.19	0.00	14.39	35.63	1.554	0.550
SSCD-1	9.77	0.669	3.66	0.00	10.16	23.17	1.265	0.307
SSCE-1	6.90	0.440	3.68	0.00	7.42	7.30	1.100	0.305
TECG-2	8.26	0.808	5.21	0.00	18.71	25.10	1.318	0.478
TELC-1	1.51	0.193	3.60	0.00	14.70	0.78	0.808	0.076
TMEB-1	14.94	1.367	4.90	0.00	3.80	55.33	1.429	0.537
UCCR-2	16.63	0.346	5.42	0.00	13.31	7.02	1.055	0.308
UTHC-1	0.73	0.360	1.71	0.00	4.08	4.89	1.414	0.177
WACL-1	11.70	0.284	6.08	3.18	22.80	0.07	1.509	0.317
WCP-4	17.42	0.337	6.87	0.00	10.41	6.98	1.566	0.160
WRIG-2	15.13	0.876	6.28	0.00	20.43	26.77	1.758	0.661
WWCC-2	35.21	0.388	7.40	0.01	11.63	8.48	1.539	0.324

Table 4. LDI-weighted values for human disturbance parameters for sites in the Southern Plains ichthyoregion.

Site code	Human density (no./km^2)	Phosphorus load (kg/ha/yr)	Land cover (percent)				Road density (km/km^2)	Stream-road crossings (no./km)	HDG value (sum)
			Urban	Barren	Pasture	Cropland			
	LDI values								
	1.00	**5.00**	**8.00**	**7.00**	**3.10**	**4.70**	**8.30**	**8.30**	
ABBH-6	14.49	2.748	48.31	1.53	19.48	85.92	11.178	2.892	186.54
BCRE-1	12.56	1.162	31.25	4.83	29.87	20.14	10.164	2.250	112.23
BCRE-4	7.09	1.148	28.47	5.59	35.27	17.26	9.380	2.326	106.53
BECE-1	12.00	2.552	27.04	1.04	30.95	77.58	14.552	3.278	168.98
BFCB-2	5.82	1.173	38.79	0.00	18.10	24.32	11.864	2.378	102.44
BGC-1	65.28	4.895	78.15	0.00	39.46	152.60	17.016	5.915	363.31
BIGP-1A	152.66	5.548	188.16	0.00	42.80	133.49	25.994	7.884	556.53
BKCC-2	135.97	4.189	170.01	0.00	45.28	92.21	24.325	6.247	478.23
BKRE-1	1.72	0.625	25.98	0.00	21.58	4.77	8.505	2.020	65.21
BMCH-1	14.12	2.319	29.73	0.00	25.12	38.92	9.629	2.553	122.39
BMCP-2	14.23	1.663	41.78	0.00	52.80	23.81	9.450	1.315	145.04
BOTC-1	3.88	1.109	22.62	0.00	25.17	23.45	8.364	2.691	87.28
BRC-2	5.69	0.637	24.60	0.00	10.71	12.12	6.924	1.098	61.78
BRSC-1	9.30	1.535	31.54	14.25	60.03	17.43	10.144	1.763	145.99
BVC-2	3.80	1.953	22.54	0.00	25.44	23.44	8.391	2.630	88.18
CH2U5-20	96.29	6.481	137.33	0.00	29.72	205.10	21.191	8.147	504.25
CHCB-1	8.99	0.565	27.01	0.00	8.16	9.95	5.792	0.903	61.38
CLC-1	0.67	1.890	52.47	0.00	33.23	6.87	15.211	4.117	114.46
CNRG-1	16.79	1.328	57.00	0.00	44.05	10.64	16.012	3.863	149.69
DBCC-8	38.34	3.073	59.24	0.00	40.87	83.18	14.361	2.328	241.39
DBCG-2	26.52	3.644	52.46	0.00	49.31	103.59	12.449	3.395	251.37
DNMH-1	22.33	5.777	50.99	0.00	53.85	188.51	13.440	5.821	340.71
EMCG-1	4.62	1.564	26.12	0.00	38.61	32.97	8.476	2.737	115.09
FGNC-1	13.82	2.004	37.07	0.00	65.09	31.89	13.677	4.111	167.66
FRME-1	3.72	0.200	19.77	2.15	0.63	1.00	5.035	0.893	33.41
FTCG-4	8.71	1.874	42.65	0.00	48.19	34.90	13.687	3.744	153.75
FVRC-2	43.78	2.049	74.77	0.00	77.28	14.94	15.545	3.362	231.72
FYCE-1	0.46	1.537	9.97	0.00	7.06	16.14	9.000	2.200	46.37
HACL-1	2.46	2.422	21.83	0.00	21.52	47.69	7.265	0.727	103.91
HACL-2	41.34	1.451	63.68	7.28	63.79	0.90	12.052	3.639	194.13
HDC-1	0.86	1.486	38.74	0.00	8.92	0.41	13.681	3.695	67.80
HECR-1	4.07	1.118	27.80	0.00	19.63	25.50	6.225	2.049	86.39
HFCC-1	5.37	1.081	39.84	0.00	43.97	5.86	11.917	2.330	110.37
HRCH-1	15.87	5.363	45.03	0.00	42.94	179.75	12.916	5.238	307.10
HURG-2	29.29	4.779	60.90	0.31	63.34	138.85	15.736	5.016	318.22
IHGR-1	21.06	2.249	44.25	9.40	81.75	1.62	10.431	2.711	173.47
INC-1	79.83	2.439	115.44	0.00	89.31	11.31	23.981	5.015	327.32
IRMC-1	6.56	5.595	32.63	0.00	26.49	202.86	13.006	0.000	287.15
JDYD-1	3.81	2.767	28.85	0.00	7.03	67.78	7.697	0.362	118.29
JDYD-2	9.20	1.668	8.66	0.00	19.59	15.30	16.382	2.632	73.44
JRME-3	18.58	3.437	48.68	0.60	43.46	99.47	14.978	3.927	233.13
LCHH-1	258.42	5.580	340.53	0.00	27.31	107.44	34.781	8.375	782.44
LCHH-4	22.81	2.946	68.71	0.00	35.03	55.67	9.832	2.823	197.83
LEC-1	4.83	1.055	22.43	9.49	13.14	27.88	11.983	4.480	95.28

Table 4. LDI-weighted values for human disturbance parameters for sites in the Southern Plains ichthyoregion--continued.

Site code	Human density (no./km^2)	Phosphorus load (kg/ha/yr)	Land cover (percent)				Road density (km/km^2)	Stream-road crossings (no./km)	HDG value (sum)
			Urban	Barren	Pasture	Cropland			
	LDI values								
	1.00	**5.00**	**8.00**	**7.00**	**3.10**	**4.70**	**8.30**	**8.30**	
LUCR-1	62.05	1.421	90.88	3.48	32.51	10.46	13.743	3.778	218.31
MDRC-1	1.73	0.951	15.36	0.00	21.97	21.10	10.673	2.663	74.45
MDRE-1	11.61	1.071	29.54	0.35	28.59	17.76	10.957	2.951	102.82
MDRE-2	10.17	1.106	31.86	0.36	30.87	17.12	10.178	2.969	104.63
MFCB-1	3.10	1.201	25.66	0.43	29.03	23.95	5.788	2.474	91.63
MYCE-1	2.34	1.759	30.27	0.00	12.93	18.60	7.461	1.800	75.16
NFCAU01	6.77	1.528	35.33	0.15	29.00	34.37	6.906	2.180	116.23
OLUM-1	4.90	1.584	26.55	0.00	30.68	38.40	7.619	2.329	112.06
PALC-3	7.54	1.298	29.41	0.11	24.92	29.26	9.396	2.614	104.54
PATC-1	95.03	2.637	133.95	0.00	26.52	22.54	20.207	2.963	303.84
PDBB-5	14.77	1.809	40.14	0.64	13.49	52.98	12.635	3.638	140.11
PDCC-1	3.97	2.296	35.18	0.00	41.51	27.19	8.821	2.131	121.10
PGNB-7	9.47	1.352	36.25	0.03	40.70	19.97	10.308	2.672	120.75
PONC-1	6.00	1.727	37.30	0.00	30.70	5.81	11.285	2.849	95.68
PONC-2	1.08	0.472	40.43	0.00	10.75	0.53	14.434	3.077	70.78
PRCH-1	8.12	2.236	21.76	0.00	19.63	38.49	6.185	0.868	97.29
PRDE-1	10.50	3.484	28.78	0.21	17.61	122.28	10.957	4.445	198.27
PRSB-3	37.23	1.183	61.14	1.76	33.70	9.60	13.106	4.359	162.06
PRWC-1	126.50	1.641	165.66	0.00	21.94	3.28	27.766	5.034	351.82
PTRH-1	6.35	1.982	31.96	0.00	19.35	59.71	9.347	2.143	130.84
RYC-5	566.41	4.951	611.80	0.00	4.37	2.31	75.912	22.766	1,288.52
SECE-3	24.55	4.161	37.63	3.03	34.55	137.65	15.026	5.055	261.66
SFCB-1	222.61	3.744	232.71	0.00	24.21	43.50	32.520	7.225	566.53
SIMC-1	5.28	0.951	33.74	0.00	24.40	14.07	9.617	2.232	90.29
SPRG-4	14.81	5.120	49.52	0.00	44.60	167.47	12.900	4.568	298.98
SSCD-1	9.77	3.344	29.32	0.00	31.51	108.91	10.497	2.544	195.89
SSCE-1	6.90	2.201	29.45	0.00	23.00	34.30	9.127	2.532	107.50
TECG-2	8.26	4.042	41.66	0.00	58.00	117.98	10.937	3.964	244.85
TELC-1	1.51	0.967	28.83	0.00	45.57	3.64	6.706	0.635	87.87
TMEB-1	14.94	6.835	39.19	0.00	11.78	260.06	11.863	4.461	349.11
UCCR-2	16.63	1.731	43.35	0.01	41.27	32.98	8.759	2.553	147.29
UTHC-1	0.73	1.801	13.68	0.00	12.64	23.00	11.736	1.472	65.06
WACL-1	11.70	1.419	48.60	22.24	70.67	0.32	12.521	2.630	170.11
WCP-4	17.42	1.684	54.94	0.00	32.27	32.83	12.994	1.329	153.46
WRIG-2	15.13	4.382	50.24	0.00	63.32	125.81	14.595	5.489	278.97
WWCC-2	35.21	1.941	59.17	0.05	36.04	39.84	12.770	2.691	187.70

Table 5. Correlation coefficients between candidate IBI metrics and human disturbance parameters.

Candidate IBI metrics	Human disturbance parameter							
	HUDEN	PLOAD	%URB	%BAR	%PAS	%CROP	RDDENS	STXRD
Species Richness and Composition								
Number of native species *	-0.135	0.012	-0.124	0.104	0.339	0.175	-0.120	-0.033
Number of darter+madtom species *	-0.162	-0.036	-0.151	0.014	0.282	0.107	-0.102	-0.055
Number of cyprinid species *	-0.153	0.053	-0.144	0.139	0.349	0.217	-0.134	-0.048
Number of *Lepomis* species	0.116	0.026	0.122	0.113	0.219	-0.039	0.091	0.113
Number of centrarchid species *	0.061	-0.011	0.058	0.124	0.231	-0.015	0.027	0.073
Number of shiner species	-0.114	0.098	-0.100	-0.036	0.305	0.257	-0.084	0.000
Number of terete minnow species	-0.081	-0.063	-0.092	0.527	0.097	-0.087	-0.097	-0.104
Number of sucker species	-0.153	-0.167	-0.152	0.212	-0.018	-0.056	-0.154	-0.074
Number of darter species	-0.172	-0.029	-0.161	0.083	0.338	0.106	-0.111	-0.060
Tolerance - Intolerance								
Percent tolerant species *	0.106	0.000	0.105	-0.107	-0.113	-0.137	0.083	-0.012
Percent green sunfish+yellow bullhead *	0.170	0.058	0.177	-0.104	-0.114	-0.125	0.138	0.099
Percent dominant species	-0.088	-0.007	-0.105	-0.007	-0.299	0.055	-0.061	-0.020
Number of intolerant species	-0.107	-0.065	-0.111	-0.118	-0.134	0.053	-0.120	-0.128
Percent green sunfish	0.071	0.059	0.074	-0.080	-0.032	-0.065	0.028	-0.007
Percent stonerollers	0.010	0.093	-0.010	0.285	0.200	0.057	0.022	0.045
Percent green SF+bluegill+ yellow BH+channel CF[1]	0.179	0.047	0.182	-0.107	-0.057	-0.137	0.142	0.060
Percent *Lepomis* species	0.168	-0.026	0.173	-0.045	-0.018	-0.166	0.095	0.081
Percent sunfish	0.168	-0.026	0.173	-0.045	-0.017	-0.166	0.095	0.083
Trophic Structure								
Percent insectivorous cyprinids *	-0.130	-0.009	-0.115	-0.007	0.144	0.162	-0.101	-0.040
Percent invertivores *	0.128	-0.042	0.115	0.017	0.146	-0.114	0.064	0.090
Percent top carnivores *	0.101	0.019	0.109	-0.118	-0.027	-0.066	0.095	0.081
Percent omnivores	0.002	0.087	-0.017	0.279	0.194	0.048	0.011	0.035
Abundance, Condition, and Reproduction								
Catch per effort *	-0.127	-0.079	-0.142	0.045	-0.015	0.093	-0.152	-0.090
Percent hybrids	-0.035	0.003	-0.030	-0.026	-0.006	0.043	-0.058	-0.031
Percent with DELT+hybrids *	-0.035	0.003	-0.030	-0.026	-0.006	0.043	-0.058	-0.031
Percent simple lithophils	-0.214	-0.017	-0.188	0.027	0.055	0.169	-0.157	-0.101
Percent manipulative lithophils	0.067	-0.067	0.051	0.045	-0.076	-0.194	0.013	-0.016
Percent lithophilic spawners	-0.230	-0.093	-0.211	0.084	-0.002	0.036	-0.207	-0.158
Number of lithophilic spawners *	-0.170	-0.074	-0.168	0.252	0.343	0.080	-0.152	-0.055
Percent simple miscellaneous	0.090	0.026	0.076	-0.025	0.174	0.001	0.066	0.084
Percent manipulative miscellaneous	0.236	0.124	0.223	-0.101	-0.239	-0.037	0.226	0.133
Percent miscellaneous spawners	0.239	0.108	0.219	-0.091	-0.026	-0.025	0.213	0.162
Percent manipulative spawners	0.172	0.012	0.153	-0.018	-0.181	-0.167	0.126	0.056
Percent simple lithophils+tolerants	-0.204	-0.020	-0.173	-0.022	0.009	0.134	-0.147	-0.128

* - metric included in Southern Plains ichthyoregion IBI.

Shaded box indicates coefficients statistically different from 0, critical r value = 0.217 [p=0.05, df=80], .

HUDEN-human density; PLOAD-phosphorus load; URB-percent urban cover; BAR-percent man-made-barren cover.

PAS-percent pasture cover; CROP-percent cropland cover; RDDENS-road density; STXRD-number of stream-road crossings.

[1]- SF-sunfish, BH-bullhead, CF-catfish

metric variation. Habitat parameters were more widely correlated with IBI metrics (table 6) allowing them to be used for evaluating Southern Plains IBI metrics.

The number of species collected in the five river systems totaled 78 with the fewest number (33) collected in the Yellow-Blackwater system and the most (59) collected in the Conecuh-Escambia system (table 7). Average catch rates varied substantially across river systems with the fewest individuals captured per effort in the Choctawhatchee-Pea system (5.2) and the most in samples from the Perdido system (14.2).

Minnows in the family Cyprinidae dominated the fauna, comprising 61.8 percent of all individuals collected at the 80 sites (table 7) ranging from a low of 54 percent in the Escambia-Conecuh system to a dominating high of 81 percent in the Perdido system. The next most common group was sunfishes of the family Centrarchidae (15.1 percent overall) ranging from a low of 5.2 percent in the Yellow-Blackwater system to a high of 17.3 percent in the Escambia-Conecuh system. Darters of the family Percidae were the third most common group (10.6 percent overall) ranging from a low of 6.4 percent in the Perdido to a high of 15 percent in the Escambia-Conecuh system.

Minnow diversity was highest in the Escambia-Conecuh and Chattahoochee-Chipola systems with 19 species in both and lowest in the Yellow-Blackwater system with 9 species. Three cyprinid species comprised close to one-third of the total catch from all sites: *Cyprinella venusta* (blacktail shiner) 14.8 percent, *Notropis texanus* (weed shiner) 9.1 percent, and *Notropis longirostris* (longnose shiner) 7.8 percent (table 7). Blacktail and weed shiners were not equally abundant across river systems ranging from lowest numbers in the Yellow-Blackwater system to the highest numbers in the Perdido system. Twelve sunfish species were collected during the study with total species between systems somewhat similar ranging from 8 to 10 (table 7). The longear sunfish, *Lepomis megalotis*, was the most common species collected (5.5 percent overall) ranging from only 0.8 percent in the Yellow-Blackwater system to 9.5 percent in the Escambia-Conecuh system. Twelve darter species were collected in all river systems sampled with the greatest number of species (11) found in the Escambia-Conecuh system and the fewest number (5) in both the Yellow-Blackwater and the

Table 6. Correlation coefficients between candidate IBI metrics and selected habitat assessment parameters.

Candidate IBI metrics	Habitat Parameter										
	INCOV	PSUB	PVAR	CHALT	SEDEP	CHSIN	CHSTA	BKCON	BKVEG	DISP	RIVEG
Species Richness and Composition											
Number of native species *	0.441	0.407	0.437	0.044	0.235	0.315	0.120	0.125	0.231	0.130	-0.083
Number of darter+madtom species *	0.389	0.426	0.404	0.050	0.166	0.323	0.329	0.214	0.287	0.014	-0.132
Number of cyprinid species *	0.253	0.298	0.197	0.143	0.075	0.197	0.002	0.102	0.162	0.080	-0.005
Number of *Lepomis* species	0.217	0.023	0.329	-0.032	0.130	0.145	-0.084	-0.183	-0.087	0.186	-0.032
Number of centrarchid species *	0.295	0.180	0.410	0.055	0.196	0.218	-0.056	-0.076	0.016	0.219	0.046
Number of shiner species	0.273	0.269	0.295	0.146	0.084	0.297	0.039	0.111	0.170	0.104	-0.007
Number of terete minnow species	-0.200	0.000	-0.445	0.094	-0.152	-0.243	-0.245	-0.105	-0.072	-0.129	-0.010
Number of sucker species	0.271	0.272	0.297	0.089	0.381	0.156	0.219	0.071	0.200	0.129	-0.014
Number of darter species	0.398	0.418	0.419	0.094	0.145	0.359	0.335	0.202	0.266	0.047	-0.078
Tolerance - Intolerance											
Percent tolerant species *	-0.278	-0.323	-0.137	-0.224	-0.243	-0.095	-0.140	-0.268	-0.337	-0.145	-0.191
Percent green sunfish+yellow bullhead *	-0.227	-0.249	-0.110	-0.021	-0.193	-0.209	-0.031	-0.258	-0.336	-0.236	-0.132
Percent dominant species	-0.093	-0.057	-0.232	-0.038	0.078	-0.215	0.142	0.185	0.100	-0.100	0.083
Number of intolerant species	-0.046	0.066	-0.105	-0.043	0.023	-0.065	0.119	0.182	0.139	0.032	0.100
Percent green sunfish	-0.225	-0.208	-0.046	0.027	-0.262	-0.202	-0.008	-0.305	-0.342	-0.170	-0.046
Percent stonerollers	0.142	0.122	-0.005	0.137	0.155	-0.057	-0.033	0.123	0.077	-0.035	-0.001
Percent green SF+bluegill+ yellow BH+channel CF[1]	-0.234	-0.322	-0.086	0.006	-0.197	-0.076	-0.131	-0.272	-0.334	-0.115	-0.110
Percent *Lepomis* species	-0.059	-0.198	0.045	0.002	-0.012	-0.032	-0.160	-0.273	-0.281	0.087	-0.060
Percent sunfish	-0.057	-0.195	0.048	0.005	-0.010	-0.030	-0.158	-0.273	-0.281	0.086	-0.062
Trophic Structure											
Percent insectivorous cyprinids *	0.187	0.283	0.164	0.055	0.037	0.154	0.153	0.131	0.180	-0.007	0.140
Percent invertivores *	0.201	-0.031	0.297	0.047	0.059	0.207	-0.092	-0.164	-0.237	0.022	-0.071
Percent top carnivores *	-0.100	-0.146	-0.086	0.087	0.027	0.009	-0.048	-0.002	-0.133	0.045	0.081
Percent omnivores	0.138	0.134	-0.007	0.148	0.150	-0.052	-0.022	0.118	0.061	-0.051	-0.005
Abundance, Condition, and Reproduction											
Catch per effort *	0.176	0.290	0.129	0.118	0.269	-0.019	0.030	0.077	0.218	0.144	0.023
Percent hybrids	0.136	0.038	0.062	0.051	0.096	-0.047	-0.088	-0.034	0.078	0.088	-0.089
Percent with DELT+hybrids *	0.136	0.038	0.062	0.051	0.096	-0.047	-0.088	-0.034	0.078	0.088	-0.089
Percent simple lithophils	0.153	0.336	0.096	0.092	0.116	0.052	0.206	0.161	0.277	0.077	0.137
Percent manipulative lithophils	-0.289	-0.331	-0.298	0.067	-0.128	-0.171	-0.207	-0.167	-0.162	0.031	-0.057
Percent lithophilic spawners	-0.084	0.120	-0.175	0.198	0.031	-0.104	0.074	0.053	0.221	0.141	0.132
Number of lithophilic spawners *	0.416	0.411	0.420	0.179	0.219	0.273	0.141	0.067	0.183	0.139	-0.019
Percent simple miscellaneous	0.235	0.051	0.332	0.063	0.003	0.291	0.015	-0.049	-0.174	-0.081	-0.054
Percent manipulative miscellaneous	-0.192	-0.265	-0.177	-0.384	-0.067	-0.239	-0.134	-0.056	-0.145	-0.134	-0.124
Percent miscellaneous spawners	0.057	-0.132	0.159	-0.218	-0.045	0.084	-0.082	-0.079	-0.245	-0.161	-0.132
Percent manipulative spawners	-0.319	-0.395	-0.325	-0.146	-0.132	-0.256	-0.227	-0.156	-0.198	-0.045	-0.107
Percent simple lithophils+tolerants	0.044	0.251	0.051	-0.003	0.016	0.018	0.177	0.058	0.162	0.019	0.067

* - metric included in Southern Plains ichthyoregion IBI.

Shaded box indicates coefficients statistically different from 0, critical r value = 0.217 [p=0.05, df=80], .

INCOV-instream cover; PSUB-pool substrate characterization; PVAR-pool variability; CHALT-channel alteration;

SEDDEP-sediment deposition; CHSIN-channel sinuosity; CHSTA-channel flow status; BKCON-bank condition;

BKVEG-bank vegetative protection; DISP-grazing or other disruptive pressure; RIPVEG-riparian vegetation zone width

Table 7. Fish species colllected in five river systems draining the Southern Plains ichthyoregion.

Family	Species	Common name	Perdido River		Escambia-Conecuh Rivers		Yellow-Blackwater Rivers		Choctawhatchee-Pea Rivers		Chattahoochee-Chipola Rivers		Totals	
			No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Petromyzontidae - lampreys			**--**	**--**	**13**	**0.21**	**--**	**--**	**--**	**--**	**--**	**--**	**13**	**0.06**
	Ichthyomyzon gagei	southern brook lamprey	--	--	13	0.21	--	--	--	--	--	--	13	0.06
Lepisosteidae - gars			**--**	**--**	**1**	**0.02**	**--**	**--**	**2**	**0.05**	**--**	**--**	**3**	**0.01**
	Lepisosteus oculatus	spotted gar	--	--	1	0.02	--	--	2	0.05	--	--	3	0.01
Anguillidae - freshwater eels			**7**	**0.39**	**3**	**0.05**	**--**	**--**	**6**	**0.14**	**--**	**--**	**16**	**0.08**
	Anguilla rostrata	American eel	7	0.39	3	0.05	--	--	6	0.14	--	--	16	0.08
Cyprinidae - minnows and carps			**1,468**	**80.97**	**3,315**	**54.15**	**1,176**	**75.14**	**2,346**	**56.29**	**4,517**	**63.94**	**12,822**	**61.85**
	Campostoma oligolepis	largescale stoneroller	--	--	325	5.31	--	--	--	--	--	--	325	1.57
	Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--	129	1.83	129	0.62
	Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--	1	0.01	1	<.01
	Cyprinella venusta	blacktail shiner	457	25.21	964	15.75	78	4.98	684	16.41	877	12.42	3,060	14.76
	Hybopsis sp cf *winchelli*	coastal clear chub	--	--	253	4.13	3	0.19	150	3.60	244	3.45	650	3.14
	Luxilus chrysocephalus	striped shiner	--	--	10	0.16	--	--	--	--	--	--	10	0.05
	Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--	136	1.93	136	0.66
	Lythrurus atrapiculus	blacktip shiner	--	--	73	1.19	53	3.39	184	4.41	97	1.37	407	1.96
	Nocomis leptocephalus	bluehead chub	--	--	11	0.18	--	--	--	--	5	0.07	16	0.08
	Notemigonus crysoleucas	golden shiner	--	--	13	0.21	--	--	8	0.19	1	0.01	22	0.11
	Notropis baileyi	rough shiner	--	--	7	0.11	--	--	1	0.02	--	--	8	0.04
	Notropis amplamala	longjaw minnow	76	4.19	349	5.70	153	9.78	226	5.42	309	4.37	1,113	5.37
	Notropis harperi	redeye chub	3	0.17	1	0.02	1	0.06	2	0.05	202	2.86	209	1.01
	Notropis longirostris	longnose shiner	79	4.36	151	2.47	54	3.45	305	7.32	1,018	14.41	1,607	7.75
	Notropis maculatus	taillight shiner	--	--	--	--	--	--	1	0.02	--	--	1	<.01
	Notropis petersoni	coastal shiner	--	--	5	0.08	--	--	--	--	7	0.10	12	0.06
	Notropis texanus	weed shiner	450	24.82	540	8.82	54	3.45	301	7.22	548	7.76	1,893	9.13
	Opsopoeodus emiliae	pugnose minnow	--	--	7	0.11	--	--	3	0.07	7	0.10	17	0.08
	Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--	24	0.34	24	0.12
	Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--	125	1.77	125	0.60
	Pteronotropis hypselopterus	sailfin shiner	343	18.92	317	5.18	202	12.91	8	0.19	--	--	870	4.20
	Pteronotropis merlini	orangetail shiner	--	--	37	0.60	--	--	428	10.27	556	7.87	1,021	4.92
	Pteronotropis signipinnis	flagfin shiner	60	3.31	50	0.82	578	36.93	--	--	--	--	688	3.32
	Semotilus atromaculatus	creek chub	--	--	1	0.02	--	--	--	--	9	0.13	10	0.05
	Semotilus thoreauianus	Dixie chub	--	--	201	3.28	--	--	45	1.08	222	3.14	468	2.26

Table 7. Fish species colllected in five river systems draining the Southern Plains ichthyoregion--continued.

Family	Species	Common name	Perdido River		Escambia-Conecuh Rivers		Yellow-Blackwater Rivers		Choctawhatchee-Pea Rivers		Chattahoochee-Chipola Rivers		Totals	
			No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Catostomidae - suckers			**17**	**0.94**	**39**	**0.64**	**7**	**0.45**	**16**	**0.38**	**85**	**1.20**	**164**	**0.79**
	Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--	1	0.01	1	<.01
	Erimyzon sucetta	lake chubsucker	10	0.55	3	0.05	1	0.06	6	0.14	2	0.03	22	0.11
	Erimyzon tenuis	sharpfin chubsucker	--	--	2	0.03	--	--	--	--	--	--	2	0.01
	Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--	12	0.17	12	0.06
	Minytrema melanops	spotted sucker	--	--	5	0.08	1	0.06	1	0.02	13	0.18	20	0.10
	Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--	2	0.03	2	0.01
	Moxostoma poecilurum	blacktail redhorse	7	0.39	29	0.47	5	0.32	9	0.22	--	--	50	0.24
	Moxostoma sp cf *poecilurum*	Apalachicola redhorse	--	--	--	--	--	--	--	--	11	0.16	11	0.05
	Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--	44	0.62	44	0.21
Ictaluridae - North American catfishes			**28**	**1.54**	**163**	**2.66**	**30**	**1.92**	**145**	**3.48**	**236**	**3.34**	**602**	**2.90**
	Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--	73	1.03	73	0.35
	Ameiurus natalis	yellow bullhead	7	0.39	25	0.41	7	0.45	20	0.48	45	0.64	104	0.50
	Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	4	0.10	--	--	4	0.02
	Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--	10	0.14	10	0.05
	Ictalurus punctatus	channel catfish	--	--	--	--	--	--	1	0.02	6	0.08	7	0.03
	Noturus funebris	black madtom	5	0.28	4	0.07	4	0.26	1	0.02	--	--	14	0.07
	Noturus gyrinus	tadpole madtom	1	0.06	--	--	--	--	--	--	13	0.18	14	0.07
	Noturus leptacanthus	speckled madtom	15	0.83	134	2.19	19	1.21	119	2.86	89	1.26	376	1.81
Esocidae - pikes			**7**	**0.39**	**64**	**1.05**	**27**	**1.73**	**73**	**1.75**	**74**	**1.05**	**245**	**1.18**
	Esox americanus	redfin pickerel	7	0.39	54	0.88	19	1.21	61	1.46	23	0.33	164	0.79
	Esox niger	chain pickerel	--	--	10	0.16	8	0.51	12	0.29	51	0.72	81	0.39
Aphredodreidae - pirate perch			**11**	**0.61**	**54**	**0.88**	**24**	**1.53**	**112**	**2.69**	**155**	**2.19**	**356**	**1.72**
	Aphredoderus sayanus	pirate perch	11	0.61	54	0.88	24	1.53	112	2.69	155	2.19	356	1.72
Atherinopsidae - new world silversides			**15**	**0.83**	**32**	**0.52**	**4**	**0.26**	**24**	**0.58**	**49**	**0.69**	**124**	**0.60**
	Labidesthes sicculus	brook silverside	15	0.83	32	0.52	4	0.26	24	0.58	49	0.69	124	0.60
Fundulidae - topminnows			**13**	**0.72**	**326**	**5.33**	**64**	**4.09**	**184**	**4.41**	**100**	**1.42**	**687**	**3.31**
	Fundulus escambiae	russetfin topminnow	4	0.22	1	0.02	--	--	--	--	--	--	5	0.02
	Fundulus olivaceus	blackspotted topminnow	9	0.50	325	5.31	64	4.09	184	4.41	100	1.42	682	3.29
Poeciliidae - livebearers			**15**	**0.83**	**91**	**1.49**	**--**	**--**	**72**	**1.73**	**74**	**1.05**	**252**	**1.22**
	Gambusia holbrooki	eastern mosquitofish	15	0.83	91	1.49	--	--	72	1.73	74	1.05	252	1.22

Table 7. Fish species colllected in five river systems draining the Southern Plains ichthyoregion--continued.

Family	Species	Common name	Perdido River		Escambia-Conecuh Rivers		Yellow-Blackwater Rivers		Choctawhatchee-Pea Rivers		Chattahoochee-Chipola Rivers		Totals	
			No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Centrarchidae - sunfishes			**112**	**6.18**	**1,057**	**17.27**	**82**	**5.24**	**673**	**16.15**	**1,200**	**16.99**	**3,124**	**15.07**
	Ambloplites ariommus	shadow bass	1	0.06	16	0.26	--	--	6	0.14	--	--	23	0.11
	Centrarchus macropterus	flier	--	--	--	--	--	--	--	--	1	0.01	1	--
	Lepomis auritus	redbreast sunfish	--	--	--	--	1	0.06	33	0.79	488	6.91	522	2.52
	Lepomis cyanellus	green sunfish	--	--	26	0.42	9	0.58	56	1.34	68	0.96	159	0.77
	Lepomis gulosus	warmouth	5	0.28	20	0.33	1	0.06	17	0.41	11	0.16	54	0.26
	Lepomis macrochirus	bluegill	18	0.99	104	1.70	19	1.21	162	3.89	247	3.50	550	2.65
	Lepomis marginatus	dollar sunfish	4	0.22	1	0.02	--	--	--	--	--	--	5	0.02
	Lepomis megalotis	longear sunfish	37	2.04	580	9.47	13	0.83	207	4.97	295	4.18	1,132	5.46
	Lepomis microlophus	redear sunfish	--	--	12	0.20	--	--	6	0.14	2	0.03	20	0.10
	Lepomis miniatus	redspotted sunfish	40	2.21	215	3.51	28	1.79	156	3.74	60	0.85	499	2.41
	Micropterus punctulatus	spotted bass	4	0.22	66	1.08	8	0.51	19	0.46	9	0.13	106	0.51
	Micropterus salmoides	largemouth bass	3	0.17	17	0.28	3	0.19	11	0.26	19	0.27	53	0.26
Percidae - perches and darters			**116**	**6.40**	**919**	**15.01**	**151**	**9.65**	**515**	**12.36**	**504**	**7.13**	**2,205**	**10.64**
	Ammocrypta bifascia	Florida sand darter	2	0.11	51	0.83	16	1.02	29	0.70	--	--	98	0.47
	Etheostoma colorosum	coastal darter	--	--	161	2.63	18	1.15	43	1.03	--	--	222	1.07
	Etheostoma davisoni	Choctawhatchee darter	--	--	2	0.03	--	--	20	0.48	--	--	22	0.11
	Etheostoma edwini	brown darter	9	0.50	2	0.03	--	--	13	0.31	15	0.21	39	0.19
	Etheostoma fusiforme	swamp darter	1	0.06	--	--	--	--	--	--	45	0.64	46	0.22
	Etheostoma histrio	harlequin darter	--	--	2	0.03	--	--	--	--	--	--	2	0.01
	Etheostoma parvipinne	goldstripe darter	--	--	18	0.29	--	--	4	0.10	2	0.03	24	0.12
	Etheostoma stigmaeum	speckled darter	4	0.22	32	0.52	1	0.06	--	--	--	--	37	0.18
	Etheostoma swaini	gulf darter	1	0.06	36	0.59	1	0.06	40	0.96	58	0.82	136	0.66
	Percina austroperca	southern logperch	--	--	5	0.08	--	--	1	0.02	--	--	6	0.03
	Percina nigrofasciata	blackbanded darter	99	5.46	572	9.34	115	7.35	365	8.76	384	5.44	1,535	7.40
	Percina vigil	saddleback darter	--	--	38	0.62	--	--	--	--	--	--	38	0.18
Elassomatidae - pygmy sunfishes			**4**	**0.22**	**15**	**0.25**	**--**	**--**	**--**	**--**	**70**	**0.99**	**89**	**0.43**
	Elassoma zonatum	banded pygmy sunfish	4	0.22	15	0.25	--	--	--	--	70	0.99	89	0.43
Achiridae - American soles			**--**	**--**	**30**	**0.49**	**--**	**--**	**--**	**--**	**--**	**--**	**30**	**0.14**
	Trinectes maculatus	hogchoker	--	--	30	0.49	--	--	--	--	--	--	30	0.14
	Number of samples		4		26		7		25		19		81	
	Number of species		35		59		33		48		54		78	
	Total individuals collected		1,813		6,122		1,565		4,168		7,064		20,732	
	Catch per sample		453		235		224		167		372		256	
	Catch per effort		14.2		7.4		7.0		5.2		11.6		8.0	

Chattahoochee-Chipola systems (table 7). The blackbanded darter (*Percina nigrofasciata*) was the most common darter encountered at 7.4 percent overall with lowest abundance in the Perdido and Chattahoochee-Chipola systems (5.5 and 5.4 percent, respectively) and greatest in the Escambia-Conecuh system at 9.3 percent.

SELECTION AND SCORING OF SOUTHERN PLAINS IBI METRICS

A total of 34 candidate metrics were evaluated for inclusion in the Southern Plains IBI (table 6). Candidate metrics were selected because of their use in other applications of the IBI in Alabama by GSA (O'Neil and Shepard, 2000b; O'Neil and others, 2006) and presented in literature sources (Karr, 1981; Barbour and others, 1999; Karr and others, 1986; Miller and others, 1988; Dauwalter and others, 2003; Simon, 1999b; Paller and others, 1996; Schleiger, 2000; Teels and Danielson, 2001). The candidate metrics were screened for inclusion in the IBI based on our familiarity with the local fauna and the potential suitability of the metrics to reflect stream habitat conditions in the Southern Plains ichthyoregion. The ability of each metric to discriminate between low and high habitat degradation was also considered in the selection process but did not override the ecological rationale behind the metrics along with our sampling experience with the local fauna and past application of IBI metrics to Alabama streams. Our sample sizes were not large in this study and the failure of a given metric to discriminate between least and most disturbed sites in many cases may be an artifact of small sample size and paucity of data collected from severely impaired streams in our dataset.

Angermeier and Karr (1986) conducted a detailed investigation into the relative contribution of various combinations of metrics to IBIs developed for Illinois, Ohio, and West Virginia. One of the important findings of their investigation was that "no metric appeared consistently best or worst at detecting degradation, and an IBI comprising all 12 metrics probably features greater utility than an IBI with fewer metrics." For this reason we retained 12 metrics divided among the broad categories of species richness and composition, tolerance-intolerance level, trophic structure, and abundance-condition-reproduction for development of the Southern Plains IBI. Metrics in table 6 marked with an asterisk were selected for inclusion in the IBI. Metrics were substituted

and swapped systematically within the 12 to determine if different combinations of metrics yielded an IBI that captured a greater range of biotic conditions at these sites. The 12 included metrics allow for a Southern Plains IBI that is reasonably sensitive to habitat changes related to channel and substrate degradation.

The method of Karr and others (1986) was used in scoring the 12 IBI metrics for datasets with some modifications intended to make the index more sensitive to local conditions. Scoring criteria for metrics 1 through 12 were developed by plotting values for these categories as a function of drainage area. Based on these plots, maximum species richness lines were drawn, and the area below this line was generally trisected to derive ranges for the scores: 5 (best), 3, or 1 (worst). Several of the IBI metrics that measure species richness and composition are strongly related to stream size with larger streams supporting more species. This relationship is in many cases drainage specific and generally holds true up to a certain critical watershed size after which species richness remains relatively constant or declines. Regional differences in faunal composition are strongly apparent in Alabama, with distributions of many species highly correlated with ecoregion and (or) specific drainage basins (Mettee and others, 1996). Tolerance and trophic metrics are many times unrelated to stream size, and scoring criteria were derived by drawing two horizontal lines at metric values that divided the data into approximately thirds.

1. NUMBER OF NATIVE SPECIES

The negative relationship between species richness and habitat degradation is well documented (Karr, 1981; Karr and others, 1986; Ohio EPA, 1987a). Species richness was found to be the metric most closely correlated with overall IBI score in a study of several regional applications of the IBI by Angermeier and Karr (1986). Hughes and Oberdorff (1999) found the species richness metric was used in all IBI applications they examined outside of the U.S. and Canada. Species richness is strongly related to stream size, stream order, and watershed area in small- to medium-sized watersheds (Karr and others, 1986). In our comparison of candidate metrics we found that total number of native species was positively correlated with increasing substrate and channel quality. This metric discriminated well between sites with good

and poor habitat in both small and large watersheds (fig. 5). The mean metric values for sites with poor habitat were statistically lower than sites with good habitat. We selected number of native species over total number of species in order to exclude several species of nonnative fishes distributed throughout the state which are generally tolerant, invasive, and could detract from the responsiveness of this metric in impaired streams. Hughes and Oberdorff (1999) also recommended that the native species metric was an improvement over total species, particularly where nonnatives are common or highly invasive.

2. NUMBER OF CYPRINID SPECIES

Minnows are a diverse and abundant group in the Southern Plains ichthyoregion with a range of tolerances, habitat preferences, and trophic and reproductive guilds (O'Neil and Shepard, 2000b). Minnows as a group are adapted to a wide variety of habitats and habitat disturbances and can thrive in highly variable substrate and sediment regimes. The family Cyprinidae becomes more diverse and ecologically dominant moving from Tennessee Valley streams to Mobile basin streams to coastal drainage streams in the south part of Alabama. Minnow diversity is high in streams with complex snag and high pool variability. The number of minnow species generally decreases with increasing disturbance and increases with stream size. Statistically, in our dataset, number of cyprinid species was weakly related to habitat disturbance with minnow diversity generally increasing in habitats of high quality (fig. 6). Mean number of cyprinid species was lower in streams with high habitat disturbance in both small and large watersheds but these relationships were not statistically different (fig. 6).

3. NUMBER OF CENTRARCHID SPECIES

Number of centrarchid species was incorporated in the IBI because sunfishes are a relatively diverse group throughout the Southern Plains ichthyoregion and because the glide-pool habitats of these streams will tend to favor the generally pool-loving bass and bream populations. Number of centrarchid species was positively related to higher quality habitat (fig. 7). Mean number of centrarchid species was lower in poor habitats compared to good habitats, although this relationship was statistically significant only in larger watersheds. This is not a surprising result since these larger

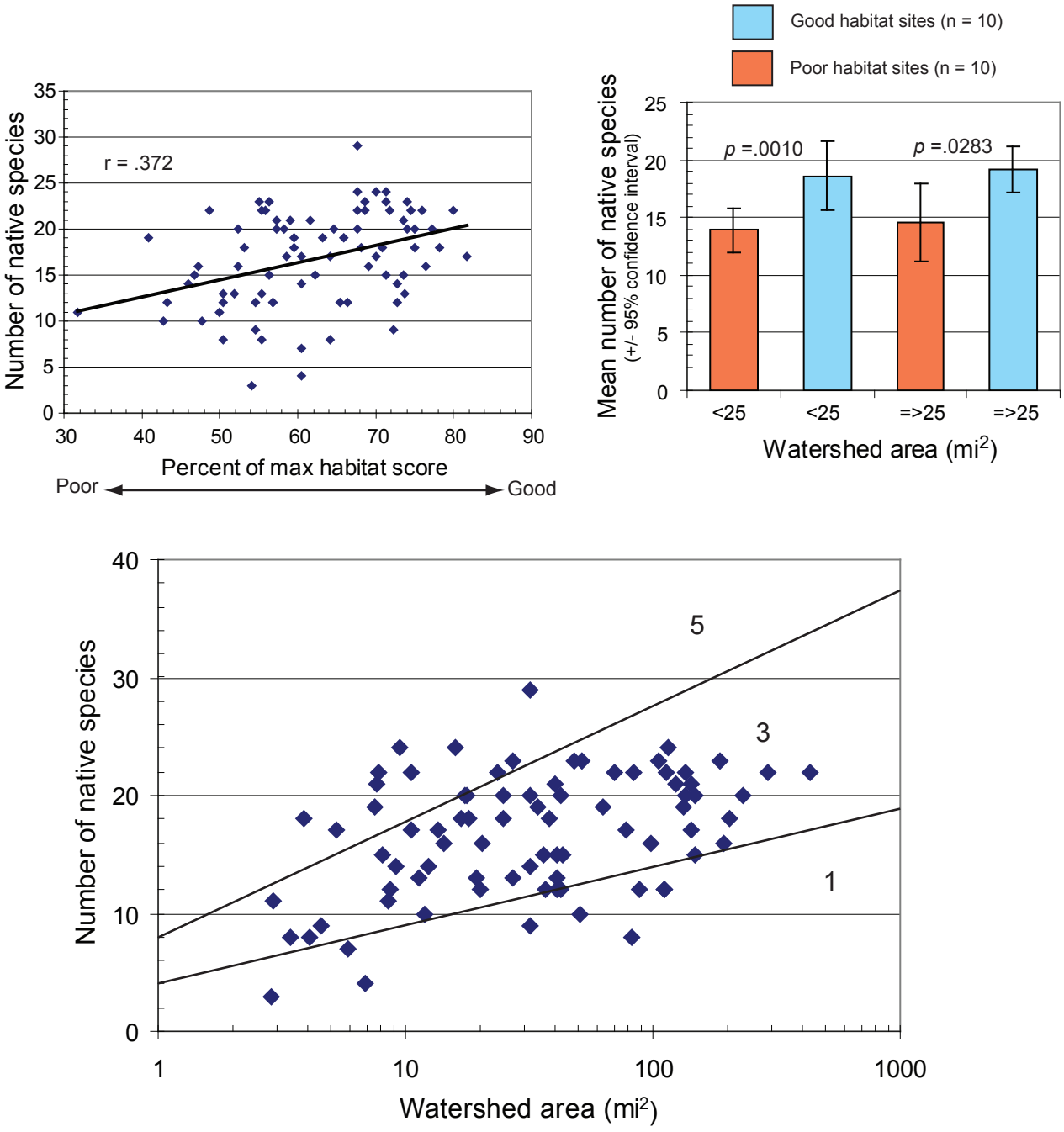


Figure 5. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - number of native species.

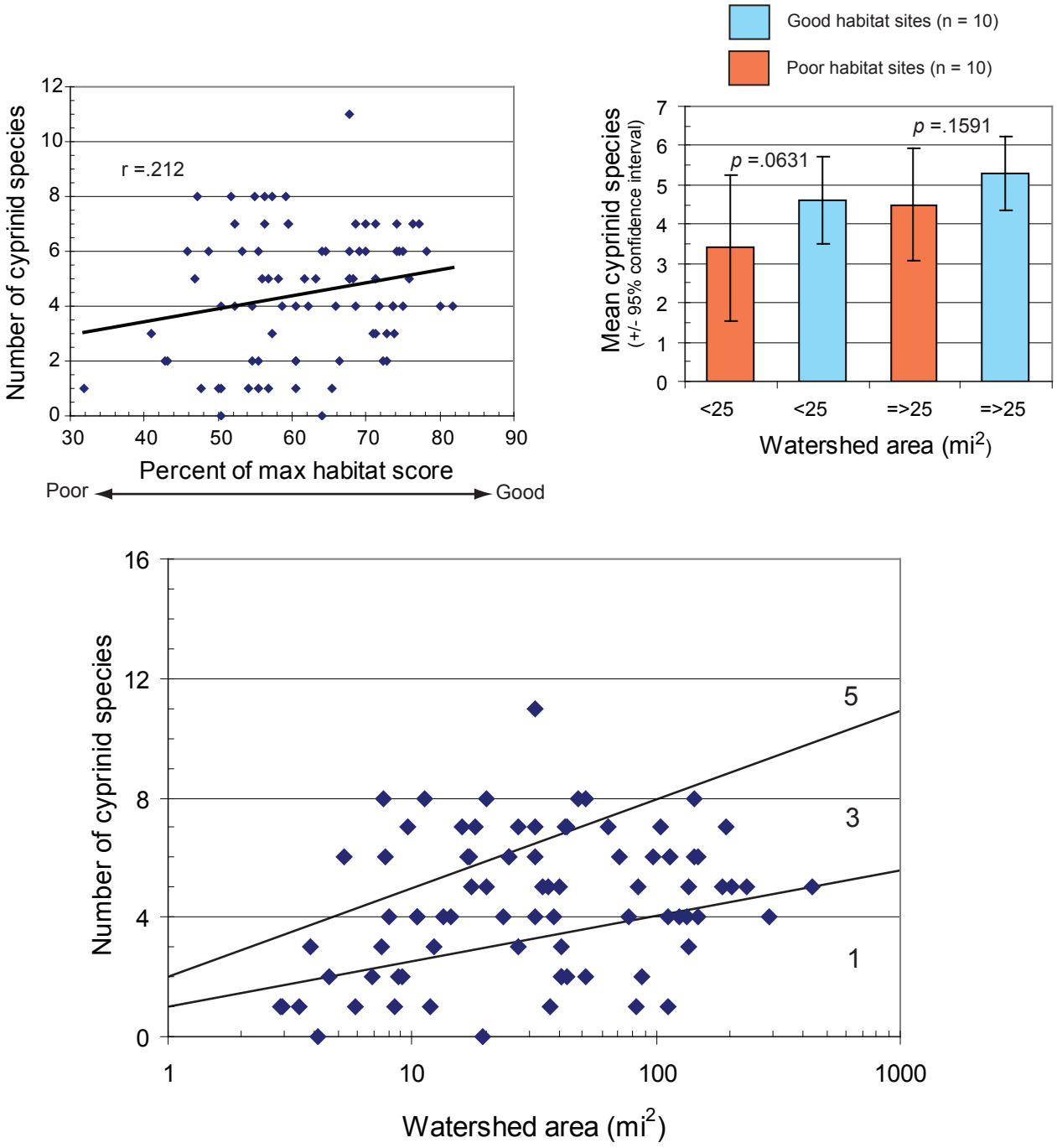


Figure 6. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - number of cyprinid species.

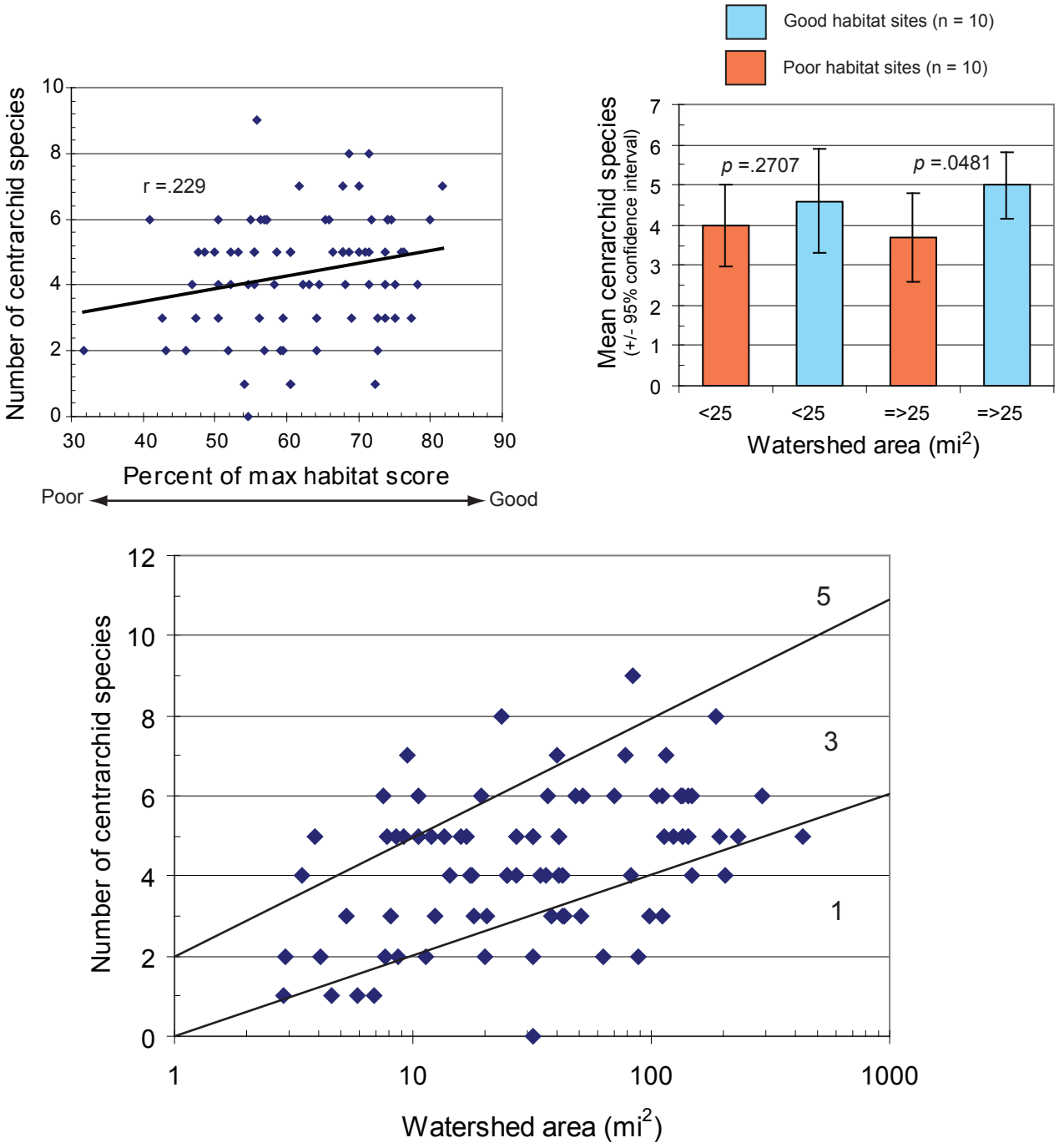


Figure 7. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - number of centrarchid species.

bodied fishes need a relatively large amount of habitat space for several species to successfully coexist. Hence, the contribution of this metric may be more important in large streams than in small streams. Another advantage of including a centrarchid diversity metric is that centrarchids are sensitive to physical and chemical degradation and most species are long-lived incorporating environmental changes over a number of years.

4. NUMBER OF DARTER + MADTOM SPECIES

Darters and madtoms are benthic species and generally intolerant of habitat impairments, particularly sedimentation which covers their preferred microhabitats. Karr (1981) used darter species richness as one of the original IBI metrics because, as a group, they are sensitive to disturbance. The darters are an even more speciose group in Alabama than in the midwest with nearly 75 species occurring in the state (Mettee and others, 1996). Paller and others (1996) and Shleiger (2000) have modified the darter metric to include madtoms or madtoms+sculpins since these groups are also benthic and are similar to darters in their feeding and spawning requirements. We evaluated the darter metric alone and with madtoms; sculpins do not occur in the streams sampled. This metric was significantly correlated with habitat quality and discriminated well between poor and good habitat quality in small and large watersheds (fig. 8). Like darters, madtoms are benthic species and in the Southern Plains can be frequently found in snags, leaf packs, root masses, and woody debris along banks. These habitat components are important for both darters and madtoms, and their loss or degradation generally leads to fewer darter and madtom species.

5. PROPORTION AS TOLERANT SPECIES

The presence of tolerant species is a clear indication that habitat is disturbed or that water-quality conditions are well below optimum. Tolerant species may become dominant in highly disturbed streams. Species occurring in the Southern Plains that were included in this metric were striped shiners, creek and Dixie chubs, golden shiners, spotted suckers, yellow and brown bullheads, green sunfish, and bluegills. This metric was negatively and significantly related to habitat quality, increasing as habitat disturbance increases (fig. 9). This metric was used by O'Neil and others (2006) as a

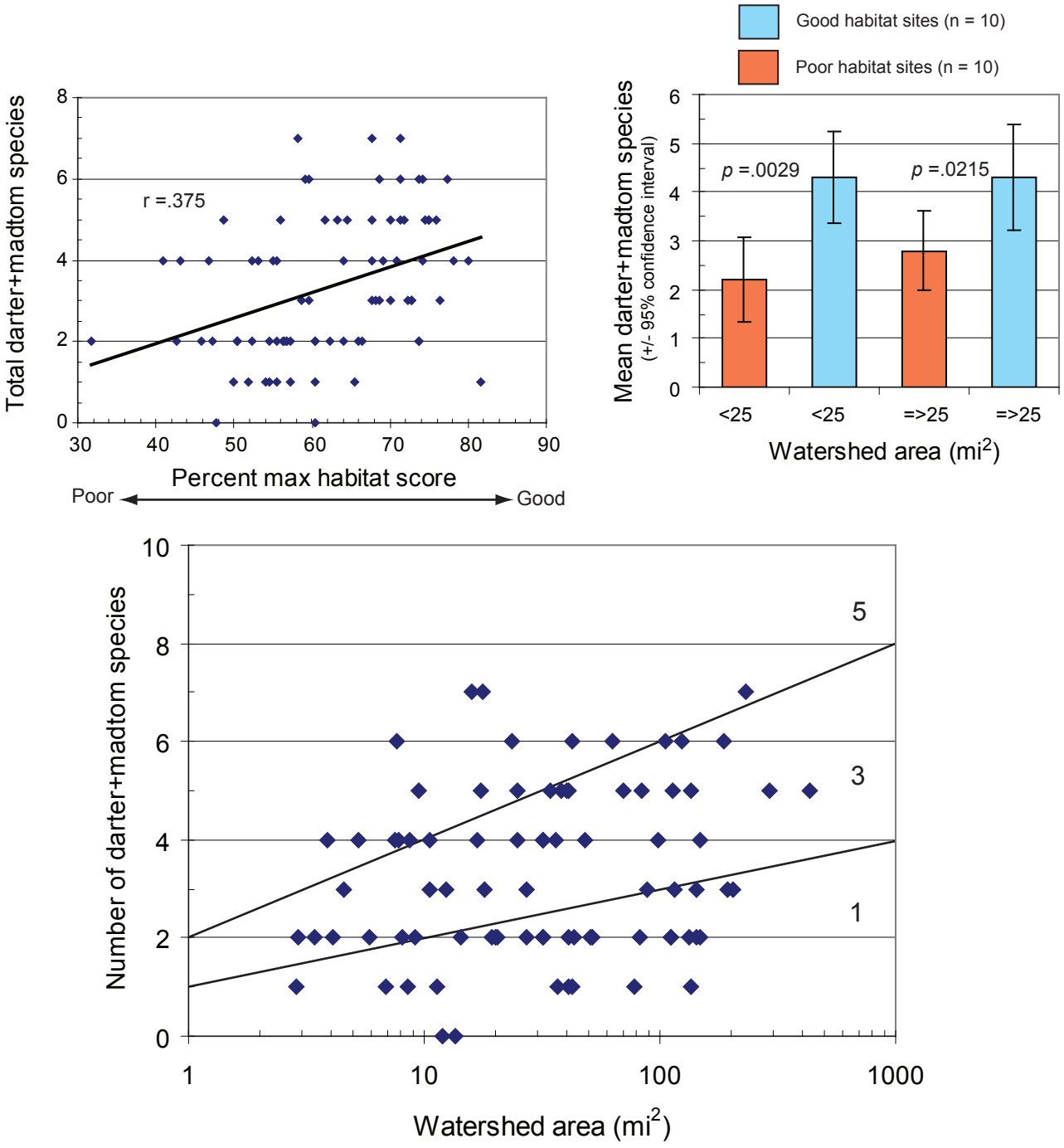


Figure 8. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - number of darter + madtom species.

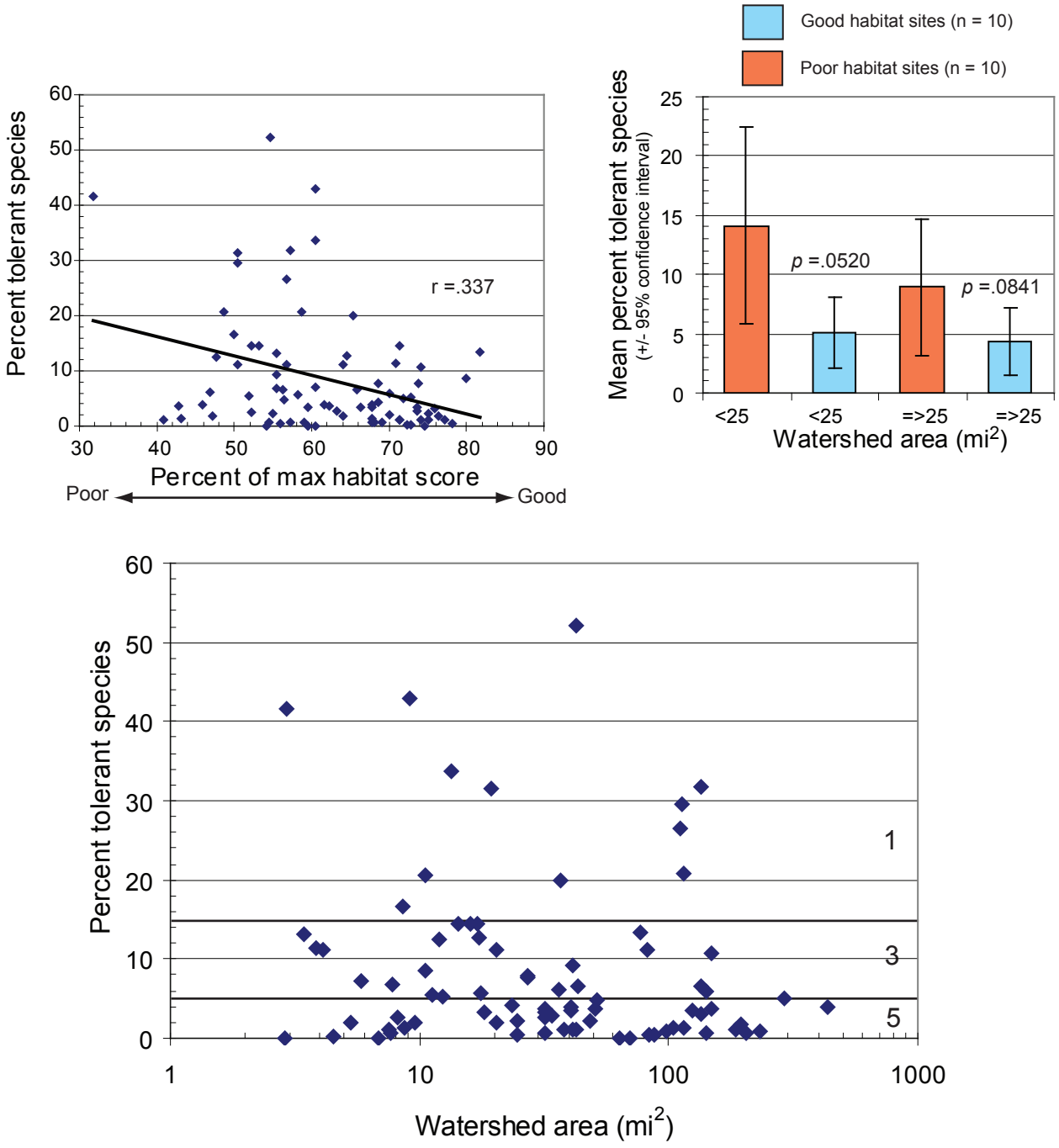


Figure 9. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - percent tolerant species.

replacement for Karr's (1981) original metric of proportion as green sunfish as recommended by Karr and others (1986), Ohio EPA (1987a), and Hughes and Oberdorff (1999). We have retained a modified green sunfish metric to use in conjunction with this metric to capture stream threats and degradation, such as sedimentation and over nutrification, that may be related to agricultural activities. Mean tolerant species was higher in poor habitats in both small and large streams (fig. 9) and was very near to being statistically significant ($p<0.05$). This metric was not related to stream size, and scoring criteria were adopted from those established for streams in the Valley and Ridge/Piedmont ichthyoregion (O'Neil and others, 2006).

6. PROPORTION OF GREEN SUNFISH + YELLOW BULLHEADS

The metric proportion of green sunfish is a classic IBI metric that Karr (1981) used in his original formulation for midwestern streams. Green sunfish, along with yellow bullheads, are highly tolerant of disturbed habitats and diminished water quality and can thrive in very impaired streams. Green sunfish are also commonly found in headwater streams because of their hardy nature and ability to tolerate poor flows. This metric was significantly related to habitat quality with proportions increasing in more disturbed habitats particularly when habitat degrades to less than 65 percent of the maximum habitat score. Mean percent green sunfish+yellow bullheads was higher in poor habitats compared to good habitats and this relationship was statistically significant in small watersheds and almost so in large watersheds (fig. 10).

7. PROPORTION AS INSECTIVOROUS CYPRINIDS

Insectivorous cyprinids are a dominant trophic group in southeastern streams and their abundance generally declines with increasing environmental stress. This is thought to be in response to an altered insect food supply which, in turn, is altered by changes in water quality, energy sources, and habitat (Karr, 1981). Thus, when the community becomes dominated by a few insect taxa in disturbed streams, specialized insectivorous fishes will be replaced by species more suited to exploit the new food base. Ohio EPA (1987b) uses total insectivores, choosing not to restrict the metric to cyprinids only, and reported a positive relationship between proportion of insectivores (total) and watershed area up to about 30 mi^2. No such relationship was evident in the

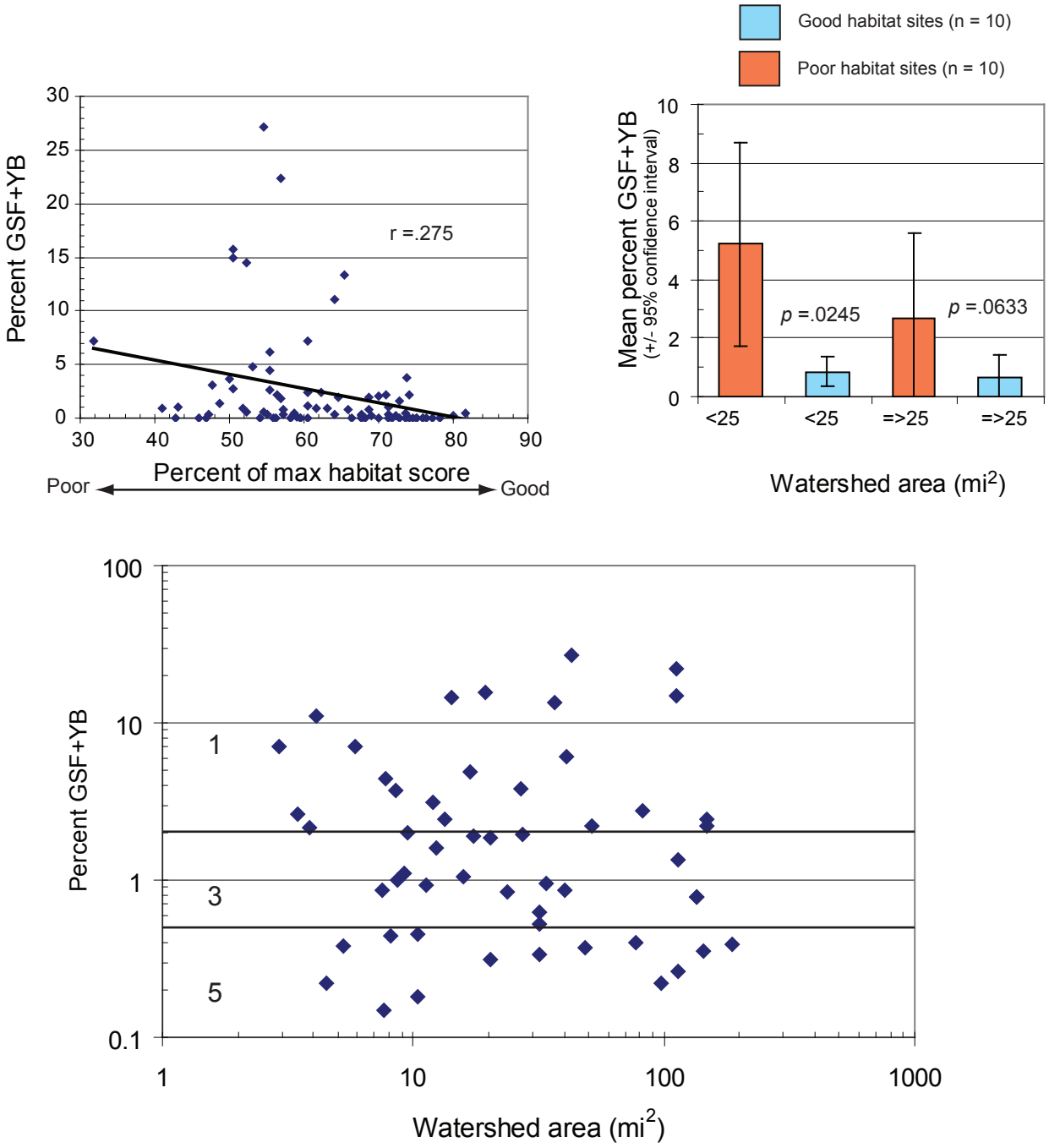


Figure 10. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - percent green sunfish + yellow bullheads.

Southern Plains data; therefore, Karr's original scoring criteria were adopted. Insectivorous cyprinids do appear to be more abundant in Southern Plains streams compared to streams in central and north Alabama and, as applied here, include most cyprinid species with the exception of stonerollers and chubs. The relationship of this metric to habitat scores was positive though poor (fig. 11). Mean percent insectivorous cyprinids was lower in poor habitats than good habitats in small streams and equal in larger streams. Neither of these comparisons was statistically significant.

8. PROPORTION AS INVERTIVORES

We have adopted this metric as an additional trophic metric. Hughes and Oberdorff (1999) recommend this metric since it is more inclusive and ecologically accurate than percent insectivorous cyprinids as another measure for assessing the degree to which the invertebrate community is degraded. This metric decreases with increasing impairment as the invertebrate community declines and invertivores are replaced by omnivores and herbivores (O'Neil and Shepard, 2000b). It was correlated with disturbance for streams in the Valley and Ridge/Piedmont ichthyoregion (O'Neil and others, 2006) and discriminated between disturbed and undisturbed stations in large streams but not in smaller streams in that study. As applied in the Southern Plains this metric includes blacktail shiners, suckers, catfish, topminnows, and selected sunfishes. This metric was very poorly related to habitat scores and good versus poor habitat sites were not statistically different in both small and large watersheds (fig. 12).

9. PROPORTION AS TOP CARNIVORES

Karr (1981) proposed this metric because healthy populations of top carnivores indicate a relatively functional, trophically diverse community. The top carnivore metric was designed to measure biological integrity in the upper functional levels of the fish community. To be considered a top carnivore, a species has to consume primarily fish, vertebrates, or crayfish, while species that equally consume other organisms as well are not considered top carnivores. Top carnivores include all black bass, temperate bass, crappie, rock bass, pickerel, walleye, bowfins, and gar species. Hughes and Oberdorff (1999) also point out that top carnivores are susceptible to bioaccumulation of toxins and can be affected by long-term physical and chemical impacts since they are typically

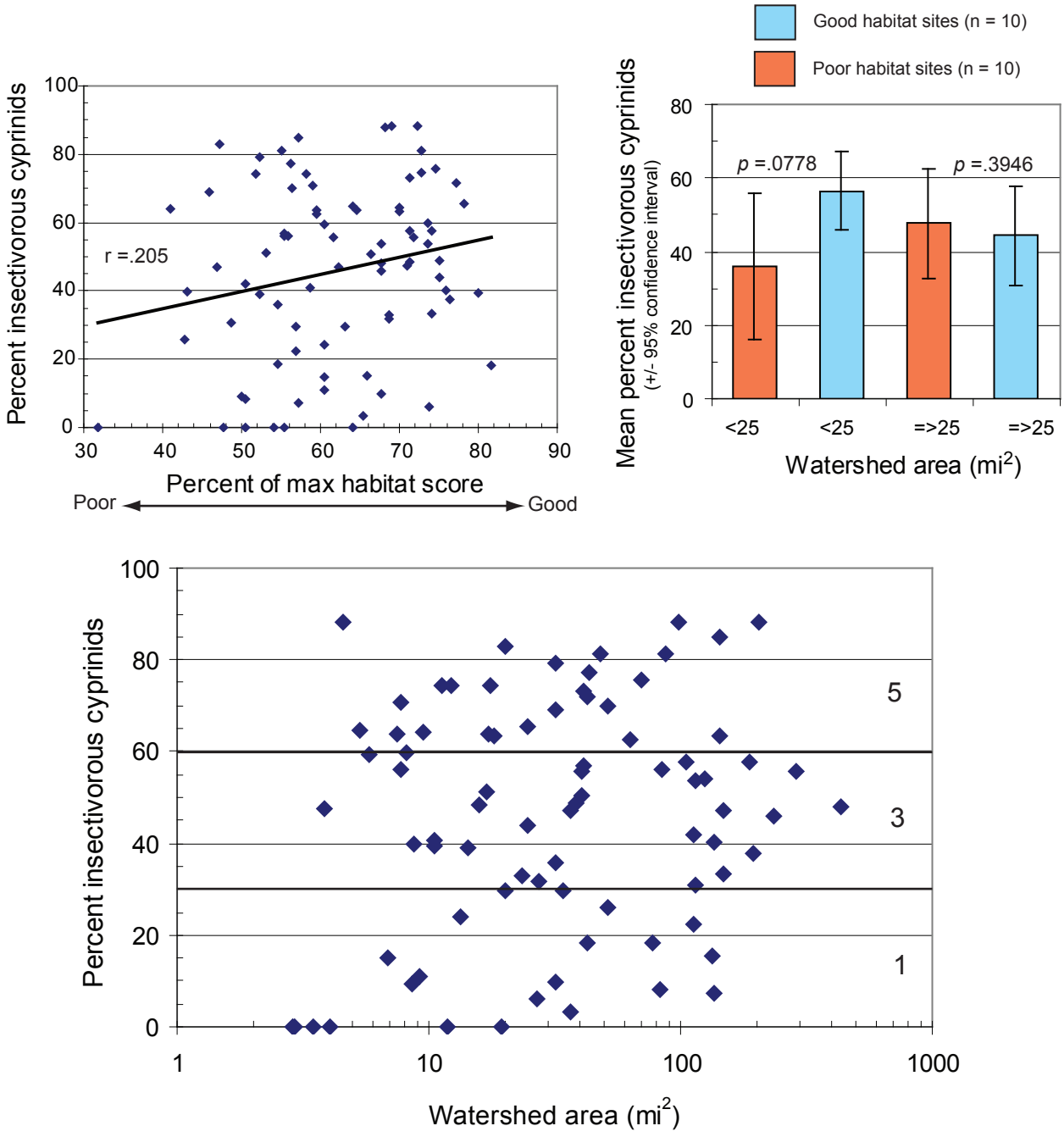


Figure 11. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - percent insectivorous cyprinids.

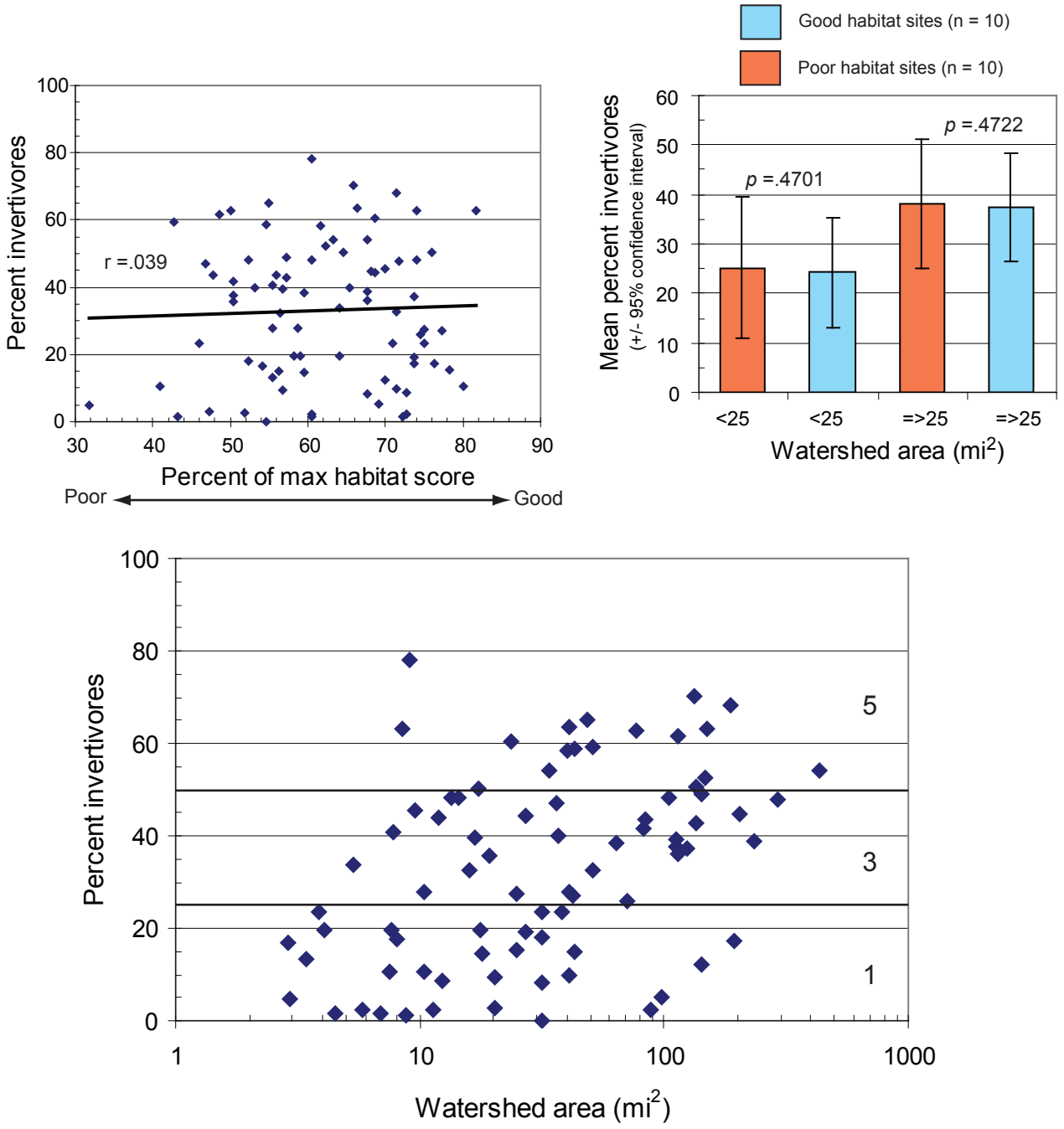


Figure 12. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - percent invertivores.

long-lived. In our data, the top carnivore metric correlated poorly with habitat quality and did not separate poor from good habitat in either small or large streams (fig. 13). This metric performed well in the Valley and Ridge/Piedmont ichthyoregion (O'Neil and others, 2006). Ohio EPA (1987b) reported that top carnivores are absent or present in very low abundance in headwater streams and they have substituted the top carnivore metric with the proportion of pioneering species metric in watersheds <20 mi^2. This was not the case in Southern Plains streams where top carnivores appeared to be in higher proportion in small watersheds. This metric will be further examined as more data are collected statewide.

10. CATCH PER EFFORT

This metric is a measure of the overall density of individuals in the sampled reach expressed as catch per sampling effort and is calculated as the total number of individuals collected in a sample divided by the total number of efforts, usually 32 in the standardized sampling method. Abundance is one of the original Karr (1981) metrics and has been widely employed in IBI applications (Hughes and Oberdorff, 1999). Fish abundance is generally assumed to decrease with increasing habitat disturbance; however, in some streams impacted by nutrient enrichment, increased primary production can lead to very high catch rates due to increased numbers of omnivores and herbivores (O'Neil and Shepard, 2000b; Hughes and Oberdorff, 1999; Barbour and others, 1999). We have observed this phenomenon in many nutrient-rich streams in Alabama, particularly those with reduced canopy cover. Extremely high or very low catch per effort values are scored as "1". Values that deviated moderately, either above or below, what we considered to be an optimum value were scored as "3". Values falling in the optimum range of individuals per effort, were scored as "5". Catch per effort was positively related to habitat quality with mean catch per effort lower in poor habitat versus good habitat in both small and large watersheds although the relationship was not significant statistically (fig. 14).

11. NUMBER OF LITHOPHILIC SPAWNERS

Number of lithophilic spawners refers to the number of species that utilize rock and mineral substrates for spawning either simply by depositing eggs in the sediment or

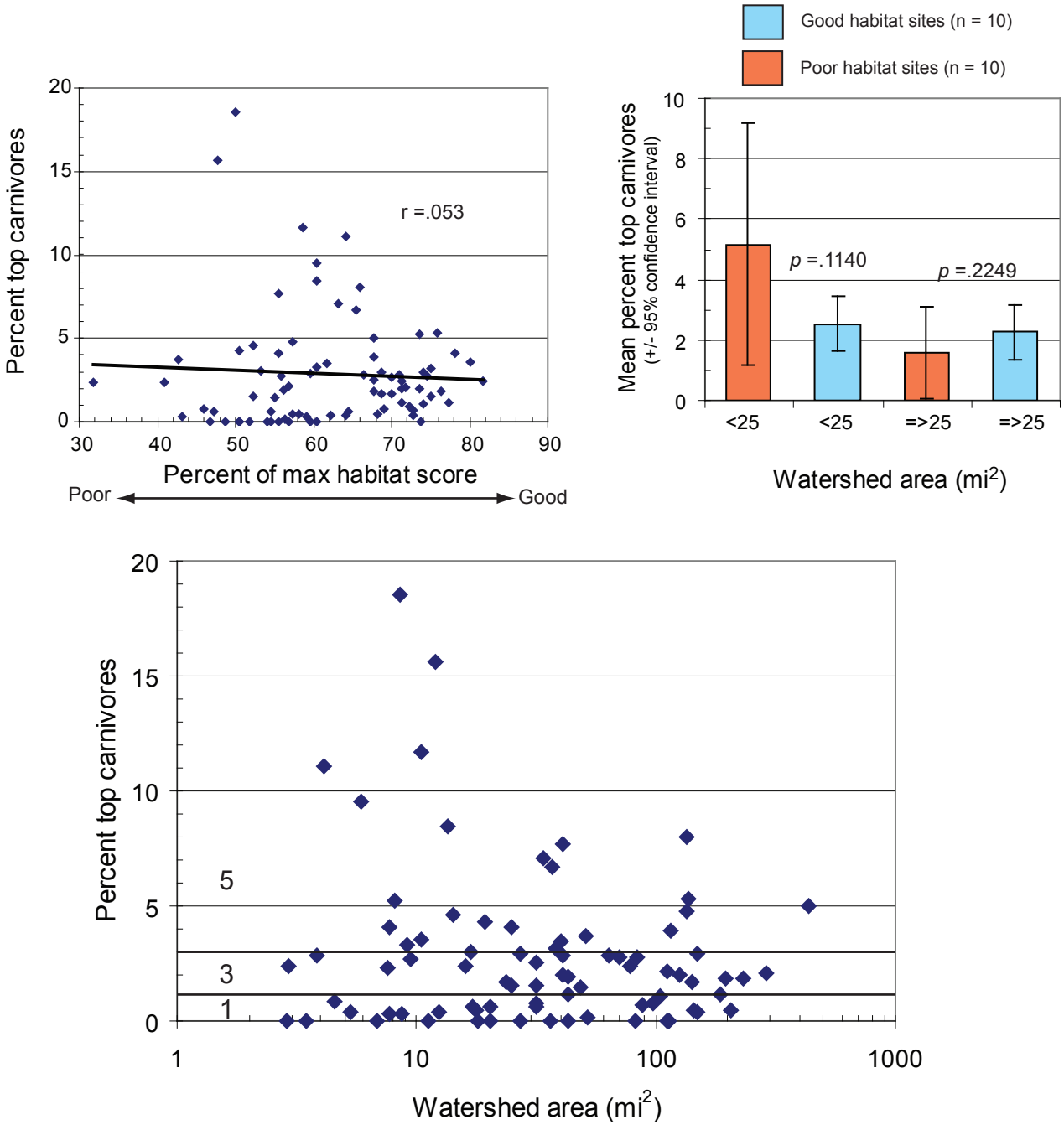


Figure 13. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - percent top carnivores.

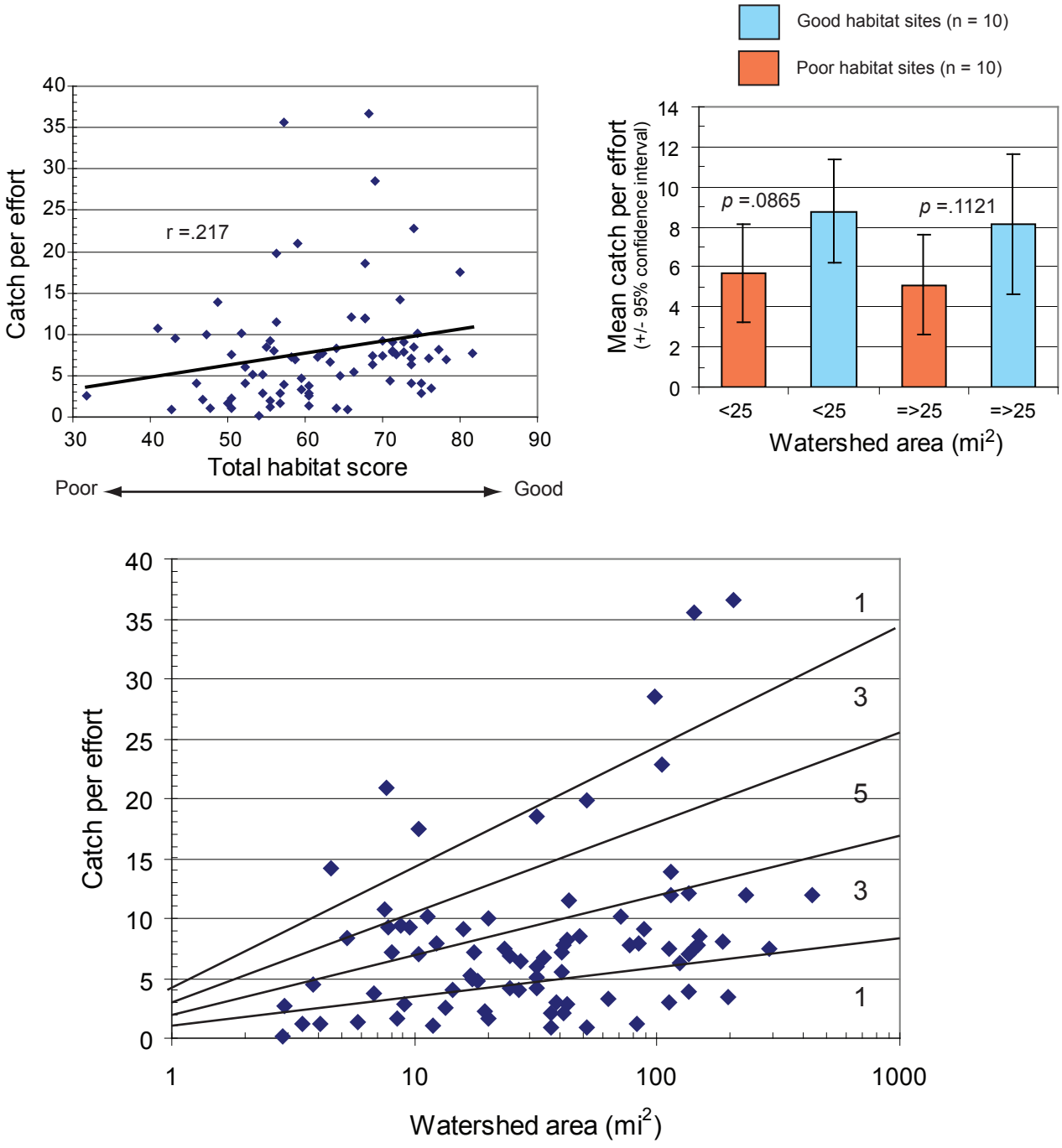


Figure 14. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - catch per effort.

complexly by manipulating substrate, building gravel or sand nests, or broadcasting eggs over rock and mineral substrates. This metric includes a host of species such as stonerollers, several genera of cyprinids, suckers, selected sunfish, and some darter species. It was significantly related to habitat quality with more species found in habitats of good quality. Fewer species were found in poor versus good habitats in both small and large streams, and both comparisons were statistically significant (fig. 15). Other reproduction metrics were substituted for number of lithophilic spawners but did not perform as well.

12. PROPORTION WITH DELT+HYBRIDS

Incidence of unhealthy individuals in a fish community in the form of deformities, eroded fins, lesions, and tumors (DELT) is frequently used as a metric to reflect the health and condition of the fish community. These conditions, however, are relatively rare except in all but the most highly degraded streams (Karr and others, 1986). Similarly, hybridization between species is indicative of highly disturbed habitats but it is usually rare in moderately disturbed streams. Proportion of individuals with DELTs and as hybrids are treated as two separate metrics in the original IBI (Karr and others, 1986). Since both conditions are rare, except in highly degraded habitats, we have combined the two as a single metric to help distinguish highly degraded sites affected by chemical and discharged pollutants from moderately degraded ones and adjusted the scoring criteria accordingly. Very few hybrid individuals or individuals with DELTs were found in the samples collected in the Southern Plains during 2008. Scoring criteria proposed by Karr and others (1986) were adopted for this metric; <0.2 percent (5), 0.2-0.5. percent (3), >0.5 percent (1).

IBI DEVELOPMENT FOR THE SOUTHERN PLAINS ICHTHYOREGION

The 12 selected metrics were used to calculate IBI scores for the sampled sites (tables 8, 9). Biotic integrity classes were derived by evaluating the percentile distribution of the 81 calculated IBI values (10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles), and comparing these values with integrity classes established for the Ridge and Valley/Piedmont ichthyoregion (O'Neil and others, 2006). The percentile marks were used as guides to place integrity class endpoints which were then adjusted (table 10) to

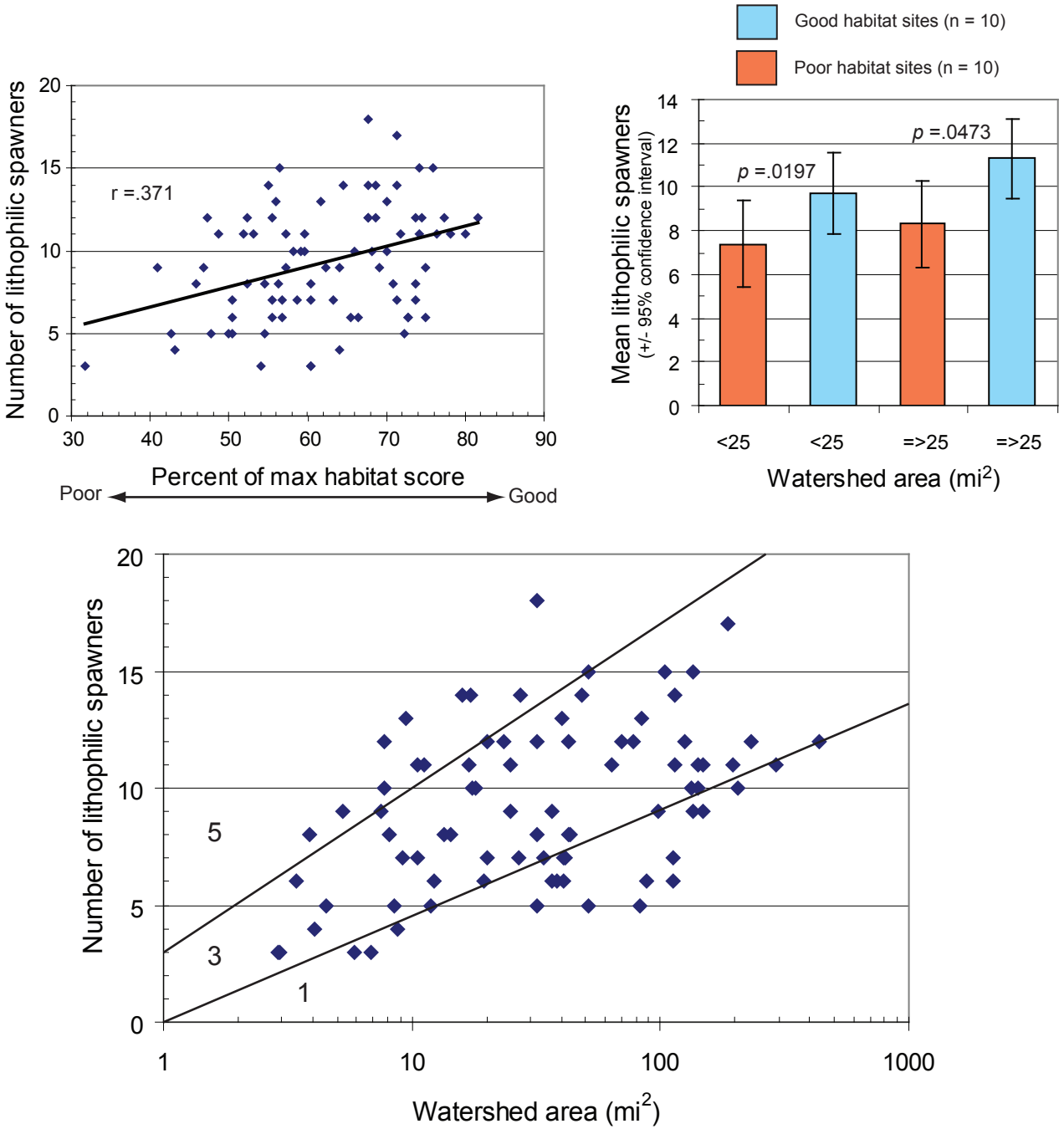


Figure 15. Scoring criteria, relation of metric value to habitat quality, and a comparison of most to least disturbed sites for small and large watersheds for the IBI metric - number of lithophilic spawners.

Table 8. Actual fish community scores for the Southern Plains ichthyoregion.

Stream sites	IBI metrics											
	1	2	3	4	5	6	7	8	9	10	11	12
	TOTSP	CYP	CENT	DARMD	TOL	GSFYB	INSEC	INVER	TC	CATCH	DELHY	LITHO
ABBH-6	15	4	4	2	3.66	2.44	47.15	52.44	0.41	7.69	0.41	9
BCRE-1	23	5	8	6	1.17	0.39	57.59	68.09	1.17	8.03	0	17
BCRE-4	21	4	5	6	3.47	0	53.96	37.13	1.98	6.31	0	12
BECE-1	16	7	5	3	1.83	0	37.61	17.43	1.83	3.41	0	11
BFCB-2	18	3	5	4	11.35	2.13	47.52	23.4	2.84	4.41	0	8
BGC-1	16	6	3	4	0.77	0.22	88.39	5.26	0.77	28.53	0.11	9
BIGP-1A	11	1	5	1	16.67	3.7	9.26	62.96	18.52	1.69	0	5
BKCC-2	14	6	2	2	3.79	0	68.94	23.48	0.76	4.13	0	8
BKRE-1	12	2	2	3	0.34	0	81.16	2.4	0.68	9.13	0	6
BMCH-1	4	2	1	1	0	0	14.88	1.65	0	3.78	0	3
BMCP-2	22	6	5	4	6.78	4.41	55.93	40.68	4.07	9.22	0	12
BOTC-1	21	5	7	5	3.91	0.87	55.65	58.26	3.48	7.19	0	13
BOTC-1	12	2	5	2	3.41	0	50.57	63.64	2.84	5.5	0	6
BRC-2	16	8	3	2	1.88	0.31	83.07	2.82	0.63	9.97	0	12
BRSC-1	22	4	8	6	4.22	0.84	32.91	60.34	1.69	7.41	0	12
BVC-2	13	0	6	2	31.43	15.71	0	35.71	4.29	2.19	0	6
CH2U5-20	18	7	3	3	3.31	0	63.58	14.57	0	4.72	0	10
CHCB-1	15	7	3	2	6.54	0	77.11	14.99	1.91	11.47	0	8
CLC-1	13	2	5	1	9.23	6.15	56.92	27.69	7.69	2.03	0	7
CNRG-1	20	6	4	5	12.74	1.91	63.69	50.32	0.64	4.91	0	14
DBCC-8	20	7	5	4	2.59	0.52	79.27	18.13	1.55	6.03	0	12
DBCG-2	17	6	5	3	5.91	0	63.29	12.24	1.69	7.41	0	10
DNMH-1	24	7	7	5	2.02	2.02	64.31	45.45	2.69	9.28	0	13
EMCG-1	19	7	2	6	0	0	62.5	38.46	2.88	3.25	0	11
FGNC-1	24	7	5	7	14.53	1.04	48.44	32.53	2.42	9.03	0	14
FRME-1	19	3	6	4	1.16	0.87	63.95	10.47	2.33	10.75	0	9
FTCG-4	22	5	9	5	0.39	0	56.08	43.53	2.75	7.97	0	13
FVRC-2	22	6	6	5	0	0	75.69	25.85	2.77	10.16	0	12
FYCE-1	8	1	4	2	13.16	2.63	0	13.16	0	1.19	0	6
HACL-1	12	2	4	1	52.17	27.17	18.48	58.7	0	2.88	0	8
HACL-2	17	4	7	1	13.31	0.4	18.15	62.9	2.42	7.75	0	12
HDC-1	12	5	2	2	11.11	1.85	29.63	9.26	0	1.69	0	7
HECR-1	23	8	6	2	4.88	2.2	69.92	32.44	0.16	19.84	0	15
HFCC-1	18	6	4	4	0.45	0	65.45	15.45	4.09	6.88	0	11
HRCH-1	23	7	5	3	7.8	1.95	31.71	44.39	2.93	6.41	0	14
HURG-2	18	4	3	5	1.06	0	48.94	23.4	3.19	2.94	0	6
IHGR-1	13	3	4	2	7.63	3.82	6.11	19.08	0	4.09	0	7
INC-1	18	6	5	4	14.46	4.82	51.2	39.76	3.01	5.19	0	11
IRMC-1	22	4	6	4	8.57	0.18	39.29	10.54	3.57	17.5	0	11
JDYD-1	8	1	4	2	11.11	2.78	8.33	41.67	0	1.13	0	5

TOTSP-num. native species; CYP-num. cyprinid species; CENT-num. centrarchid species; DARMAD-num. darter+madtom species; TOL-proportion of tolerant species; GSFYB-proportion of green sunfish+yellow bullheads; INSEC-proportion of insectivorous cyprinids; INVER-proportion of invertivores; TC-proportion of top carnivores; CATCH-catch per effort; DELHY-proportion with DELT+hybrids; LITHO-num. lithophilic spawners.

Table 8. Actual fish community scores for the Southern Plains ichthyoregion--continued.

Stream sites	IBI metrics											
	1	2	3	4	5	6	7	8	9	10	11	12
	TOTSP	CYP	CENT	DARMD	TOL	GSFYB	INSEC	INVER	TC	CATCH	DELHY	LITHO
JDYD-2	10	2	3	2	3.7	0	25.93	59.26	3.7	0.84	0	5
JRME-3	15	4	3	2	2.62	0.44	59.83	17.47	5.24	7.16	0	8
LCHH-1	20	6	4	5	2.27	0	43.94	27.27	1.52	4.13	0	9
LCHH-4	12	1	6	2	26.6	22.34	22.34	39.36	2.13	2.94	0	6
LEC-1	22	5	5	5	3.1	0	40.27	50.44	5.31	7.06	0	15
LUCR-1	24	6	7	3	1.3	0.26	53.65	35.94	3.91	12	0	14
MDRC-1	20	7	3	6	1.15	0	71.76	27.1	1.15	8.19	0	12
MDRE-1	22	5	5	5	3.94	0	48.03	54.07	4.99	11.91	0	12
MDRE-2	22	4	6	5	4.98	0	55.6	47.72	2.07	7.53	0	11
MFCB-1	21	8	6	2	0.7	0.35	84.81	48.99	0.44	35.59	0	11
MYCE-1	8	0	2	2	11.11	11.11	0	19.44	11.11	1.13	0	4
NFCAU01	22	6	5	5	20.72	1.35	30.86	61.71	0	13.88	0	11
OLUM-1	17	4	5	0	33.73	2.41	24.1	48.19	8.43	2.59	0	8
PALC-3	20	3	6	1	31.75	0.79	7.14	42.86	4.76	3.94	0	9
PATC-1	14	2	5	2	42.86	1.1	10.99	78.02	3.3	2.84	0	7
PDBB-5	18	5	4	3	0.68	0	88.05	44.71	0.43	36.63	0	10
PDCC-1	16	4	4	2	14.5	14.5	38.93	48.09	4.58	4.09	0	8
PGNB-7	20	5	5	7	0.78	0	45.95	38.64	1.83	11.97	0	12
PONC-1	7	1	1	2	7.14	7.14	59.52	2.38	9.52	1.31	0	3
PONC-2	9	2	1	3	0.22	0.22	88.35	1.54	0.88	14.22	0	5
PRCH-1	10	1	5	0	12.5	3.13	0	43.75	15.63	1	0	5
PRDE-1	15	3	4	5	1.2	0	73.09	9.64	2.01	7.78	0	7
PRSB-3	23	7	6	6	1.23	0	57.59	48.29	1.09	22.84	0	15
PRWC-1	12	2	2	4	1.32	0.99	39.74	1.32	0.33	9.44	0	4
PTRH-1	9	4	0	2	0.62	0.62	35.8	0	0.62	5.06	0	5
RYC-5	12	1	6	1	20	13.33	3.33	40	6.67	0.94	0	6
SECE-3	29	11	5	4	3.37	0.34	9.76	8.25	2.53	18.56	0	18
SFCB-1	12	4	3	2	29.46	14.94	41.91	37.76	0	7.53	0	7
SIMC-1	19	5	4	5	2.82	0.94	29.58	53.99	7.04	6.66	0	7
SPRG-4	23	8	6	4	2.22	0.37	81.11	65.19	1.48	8.44	0	14
SSCD-1	21	8	2	6	0.75	0.15	70.79	19.52	0.3	20.97	0	10
SSCE-1	3	1	1	1	0	0	0	16.67	0	0.19	0	3
TECG-2	15	5	4	4	6.06	0	46.97	46.97	0	2.06	0	9
TELC-1	17	6	3	4	1.88	0.38	64.66	33.83	0.38	8.31	0	9
TMEB-1	14	3	3	3	5.18	1.59	74.5	8.76	0.4	7.84	0	6
UCCR-2	19	4	6	2	6.48	0.78	15.28	70.21	8.03	12.06	0.52	10
UTHC-1	11	1	2	2	41.67	7.14	0	4.76	2.38	2.63	0	3
WACL-1	13	8	2	1	5.56	0.93	74.38	2.47	0	10.13	0	11
WCP-4	17	4	5	3	20.63	0.45	40.81	27.8	11.66	6.97	0	7
WRIG-2	20	5	4	7	5.65	0	74.35	19.57	0.43	7.19	0	10
WWCC-2	20	6	6	4	10.74	2.22	33.33	62.96	2.96	8.44	0	11

TOTSP-num. native species; CYP-num. cyprinid species; CENT-num. centrarchid species; DARMAD-num. darter+madtom species; TOL-proportion of tolerant species; GSFYB-proportion of green sunfish+yellow bullheads; INSEC-proportion of insectivorous cyprinids; INVER-proportion of invertivores; TC-proportion of top carnivores; CATCH-catch per effort; DELHY-proportion with DELT+hybrids; LITHO-num. lithophilic spawners.

Table 9. IBI scores for the Southern Plains ichthyoregion.

Stream sites	IBI metrics												Final IBI	Biological condition
	1 TOTSP	2 CYP	3 CENT	4 DARMD	5 TOL	6 GSFYB	7 INSEC	8 INVER	9 TC	10 CATCH	11 DELHY	12 LITHO		
ABBH-6	3	1	1	1	5	1	3	5	1	3	3	1	28	Poor
BCRE-1	3	3	3	3	5	5	3	5	3	3	5	3	44	Good
BCRE-4	3	1	3	3	5	5	3	3	3	3	5	3	40	Fair
BECE-1	3	3	3	1	5	5	3	1	3	1	5	3	36	Fair
BFCB-2	5	3	5	5	3	1	3	1	3	3	5	5	42	Fair
BGC-1	3	3	1	3	5	5	5	1	1	1	5	3	36	Fair
BIGP-1A	3	1	5	1	1	1	1	5	5	1	5	3	32	Poor
BKCC-2	3	3	1	1	5	5	5	1	1	1	5	3	34	Poor
BKRE-1	1	1	1	3	5	5	5	1	1	3	5	1	32	Poor
BMCH-1	1	1	1	1	5	5	1	1	1	3	5	1	26	Poor
BMCP-2	5	5	5	5	3	1	3	3	5	5	5	5	50	Good
BOTC-1	3	3	5	3	5	3	3	5	5	3	5	3	46	Good
BOTC-1	1	1	3	1	5	5	3	5	3	3	5	1	36	Fair
BRC-2	3	5	3	1	5	5	5	1	1	5	5	3	42	Fair
BRSC-1	5	3	5	5	5	3	3	5	3	3	5	3	48	Good
BVC-2	3	1	5	1	1	1	1	3	5	1	5	3	30	Poor
CH2U5-20	3	5	3	3	5	5	5	1	1	3	5	3	42	Fair
CHCB-1	3	5	1	1	3	5	5	1	3	5	5	3	40	Fair
CLC-1	3	1	3	1	3	1	3	3	5	1	5	1	30	Poor
CNRG-1	3	5	3	5	3	3	5	5	1	3	5	5	46	Good
DBCC-8	3	5	3	3	5	3	5	1	3	3	5	3	42	Fair
DBCG-2	3	3	3	1	3	5	5	1	3	3	5	3	38	Fair
DNMH-1	5	5	5	5	5	1	5	3	3	5	5	5	52	Excellent
EMCG-1	3	3	1	5	5	5	5	3	3	1	5	3	42	Fair
FGNC-1	5	5	3	5	3	3	3	3	3	5	5	5	48	Good
FRME-1	5	3	5	5	5	3	5	1	3	3	5	3	46	Good
FTCG-4	3	3	5	3	5	5	3	3	3	3	5	3	44	Good
FVRC-2	3	3	3	3	5	5	5	3	3	3	5	3	44	Good
FYCE-1	3	1	5	3	3	1	1	1	1	1	5	3	28	Poor
HACL-1	1	1	3	1	1	1	1	5	1	1	5	3	24	Very Poor
HACL-2	3	3	3	1	3	5	1	5	3	3	5	3	38	Fair
HDC-1	3	3	1	1	3	3	1	1	1	1	5	3	26	Poor
HECR-1	3	5	3	1	5	1	5	3	1	3	5	5	40	Fair
HFCC-1	3	3	3	3	5	5	5	1	5	3	5	3	44	Good
HRCH-1	5	5	3	3	3	3	3	3	3	3	5	5	44	Good
HURG-2	3	3	1	3	5	5	3	1	5	1	5	1	36	Fair
IHGR-1	3	1	3	1	3	1	1	1	1	1	5	3	24	Very Poor
INC-1	3	5	3	3	3	1	3	3	5	3	5	3	40	Fair
IRMC-1	5	3	5	3	3	5	3	1	5	1	5	5	44	Good
JDYD-1	1	1	3	1	3	1	1	3	1	1	5	1	22	Very Poor

TOTSP-num. native species; CYP-num. cyprinid species; CENT-num. centrarchid species; DARMAD-num. darter+madtom species; TOL-proportion of tolerant species; GSFYB-proportion of green sunfish+yellow bullheads; INSEC-proportion of insectivorous cyprinids; INVER-proportion of invertivores; TC-proportion of top carnivores; CATCH-catch per effort; DELHY-proportion with DELT+hybrids; LITHO-num. lithophilic spawners.

Table 9. IBI scores for the Southern Plains ichthyoregion--continued.

Stream sites	IBI metrics												Final IBI	Biological condition
	1 TOTSP	2 CYP	3 CENT	4 DARMD	5 TOL	6 GSFYB	7 INSEC	8 INVER	9 TC	10 CATCH	11 DELHY	12 LITHO		
JDYD-2	1	1	1	1	5	5	1	5	5	1	5	1	32	Poor
JRME-3	3	3	3	3	5	5	3	1	5	5	5	3	44	Good
LCHH-1	3	3	3	5	5	5	3	3	3	1	5	3	42	Fair
LCHH-4	1	1	3	1	1	1	1	3	3	1	5	1	22	Very Poor
LEC-1	3	3	3	3	5	5	3	5	5	3	5	3	46	Good
LUCR-1	3	3	3	1	5	5	3	3	5	3	5	3	42	Fair
MDRC-1	3	5	1	5	5	5	5	3	3	3	5	3	46	Good
MDRE-1	3	3	1	3	5	5	3	5	5	3	5	3	44	Good
MDRE-2	3	1	3	3	5	5	3	3	3	3	5	1	38	Fair
MFCB-1	3	3	3	1	5	5	5	3	1	1	5	3	38	Fair
MYCE-1	3	1	3	3	3	1	1	1	5	1	5	3	30	Poor
NFCAU01	3	3	3	3	1	3	3	5	1	5	5	3	38	Fair
OLUM-1	3	3	3	1	1	1	1	3	5	1	5	3	30	Poor
PALC-3	3	1	3	1	1	3	1	3	5	1	5	1	28	Poor
PATC-1	3	1	5	3	1	3	1	5	5	1	5	3	36	Fair
PDBB-5	3	3	1	1	5	5	5	3	1	1	5	1	34	Poor
PDCC-1	3	3	3	1	3	1	3	3	5	3	5	3	36	Fair
PGNB-7	3	3	3	5	5	5	3	3	3	3	5	3	44	Good
PONC-1	1	1	1	3	3	1	3	1	5	1	5	1	26	Poor
PONC-2	3	3	1	3	5	5	5	1	1	1	5	3	36	Fair
PRCH-1	3	1	3	1	3	1	1	3	5	1	5	3	30	Poor
PRDE-1	3	1	3	3	5	5	5	1	3	3	5	1	38	Fair
PRSB-3	3	3	3	3	5	5	3	3	3	3	5	3	42	Fair
PRWC-1	3	1	3	5	5	3	3	1	1	5	5	1	36	Fair
PTRH-1	1	3	1	1	5	3	3	1	1	3	5	1	28	Poor
RYC-5	3	1	3	1	1	1	1	3	5	1	5	1	26	Poor
SECE-3	5	5	3	3	5	5	1	1	3	3	5	5	44	Good
SFCB-1	1	1	1	1	1	1	3	3	1	3	5	1	22	Very Poor
SIMC-1	3	3	3	3	5	3	1	5	5	3	5	3	42	Fair
SPRG-4	3	5	3	3	5	5	5	5	3	3	5	3	48	Good
SSCD-1	5	5	3	5	5	5	5	1	1	1	5	5	46	Good
SSCE-1	1	1	3	1	5	5	1	1	1	1	5	3	28	Poor
TECG-2	3	3	3	3	3	5	3	3	1	1	5	3	36	Fair
TELC-1	5	5	3	5	5	5	5	3	1	5	5	5	52	Excellent
TMEB-1	3	3	3	3	3	3	5	1	1	5	5	3	38	Fair
UCCR-2	3	1	3	1	3	3	1	5	5	3	1	3	32	Poor
UTHC-1	3	1	3	3	1	1	1	1	3	3	5	3	28	Poor
WACL-1	3	5	1	1	3	3	5	1	1	5	5	5	38	Fair
WCP-4	3	3	3	3	1	5	3	3	5	3	5	3	40	Fair
WRIG-2	3	3	3	5	3	5	5	1	1	3	5	3	40	Fair
WWCC-2	3	3	3	3	3	1	3	5	3	3	5	3	38	Fair

TOTSP-num. native species; CYP-num. cyprinid species; CENT-num. centrarchid species; DARMAD-num. darter+madtom species; TOL-proportion of tolerant species; GSFYB-proportion of green sunfish+yellow bullheads; INSEC-proportion of insectivorous cyprinids; INVER-proportion of invertivores; TC-proportion of top carnivores; CATCH-catch per effort; DELHY-proportion with DELT+hybrids; LITHO-num. lithophilic spawners.

Table 10. IBI integrity classes for the Southern Plains and Ridge and Valley/Piedmont ichthyoregions.

Integrity classes	Ridge and Valley/Piedmont	Southern Plains
Very Poor	<=25	<=25
Poor	26-37	26-35
Fair	38-46	36-43
Good	47-55	44-50
Excellent	>55	>50

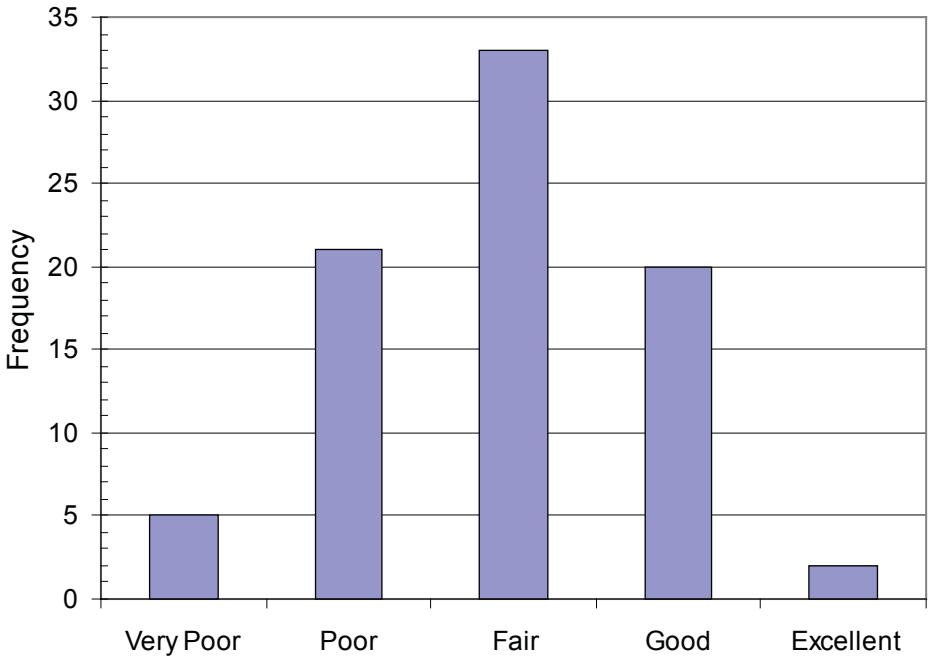


Figure 16. Frequency distribution of IBI integrity classes for sites in the Southern Plains ichthyoregion.

create a balanced distribution of values across the range of the IBI (fig.16). Approximately 41 percent of the IBIs scored in the fair class, 32 percent scored in the very poor and poor classes, and 27 percent scored in the good to excellent classes. The IBI was significantly correlated with percent maximum habitat scores and performed well at statistically segregating poor habitat from good habitat sites in small and large watersheds (fig. 17).

The Southern Plains IBI has been developed as a regional tool for evaluating biological condition in streams of southeast Alabama. For this tool to be regionally useful it should be reasonably independent of local faunal influences such as river system and ecoregion. The relationship depicted in figure 17 between the IBI and habitat was further evaluated by identifying the ecoregion and river system of each IBI site and determining if there were relationships or groupings of IBIs according to these two specifications (fig. 18). These bivariate plots show no apparent groupings or relationships and indicate that the Southern Plains IBI as specified does appear to be independent of river system and ecoregion.

The concept of biologically based tiered aquatic-life uses (TALU) is emerging as a tool to incorporate ecologically relevant information into water-quality management decisions, biologically quantify water-quality improvements, and to merge the practice of biological monitoring and assessment with the implementation of water-quality standards (USEPA, 2005). Implementation of aquatic-life uses into water-quality management is developing around a scientific model known as the Biological Condition Gradient (BCG), which describes how certain attributes of aquatic ecosystems such as community structure, condition of organisms, and ecosystem function respond to increasing levels of stressors (USEPA, 2005). The BCG can be considered an instream-based aquatic community analog of the classical laboratory-based dose-response toxicity relationship for single species. In the BCG model dose (*x*-axis) equals increasing levels of stressors and response (*y*-axis) equals some measure of biological condition, such as the IBI.

The BCG model can be directly applied to the calibrated IBI for the Southern Plains ichthyoregion with the IBI serving as the measure of biological condition and

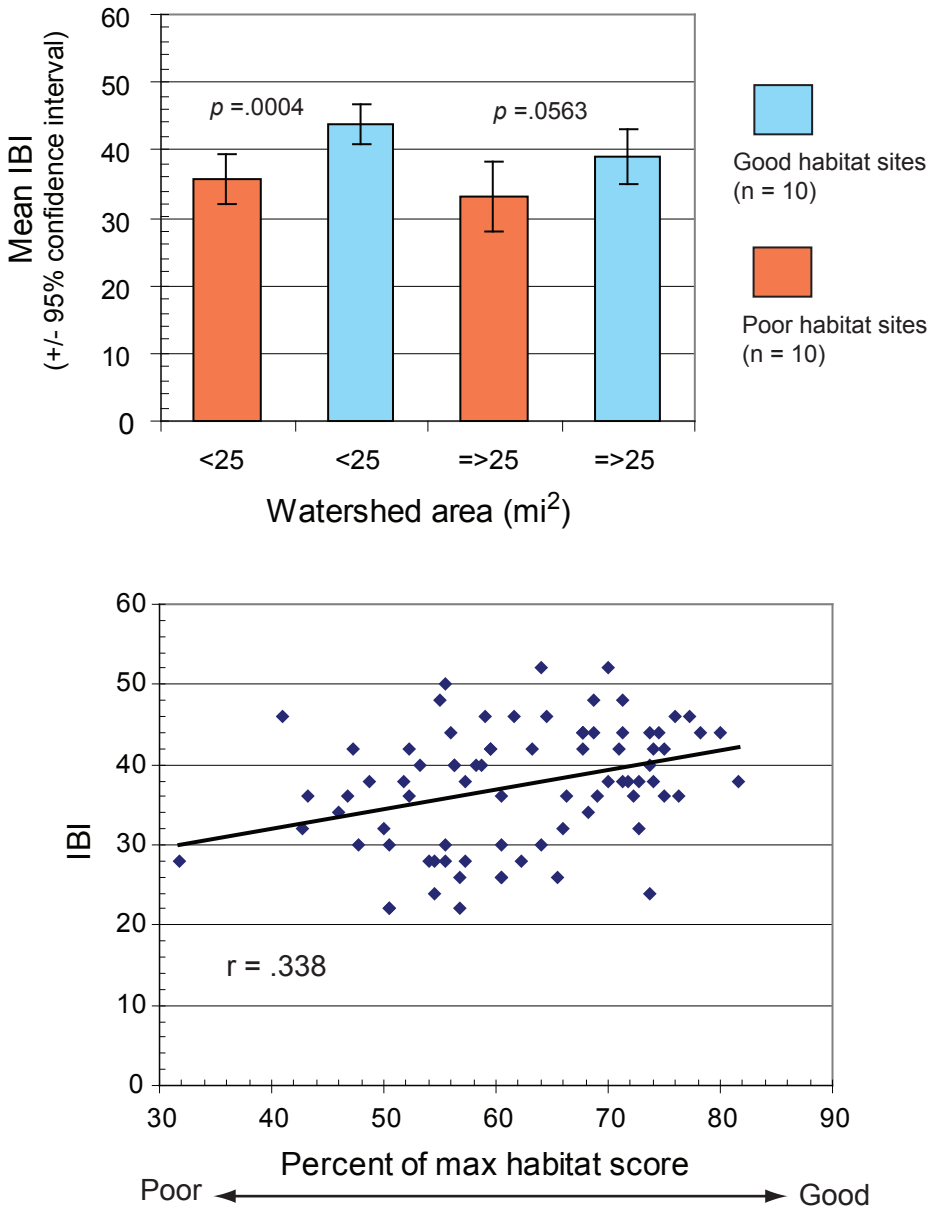


Figure 17. Relationship between the IBI and habitat quality and a comparison of sites with poor and good habitat quality for small and large watersheds.

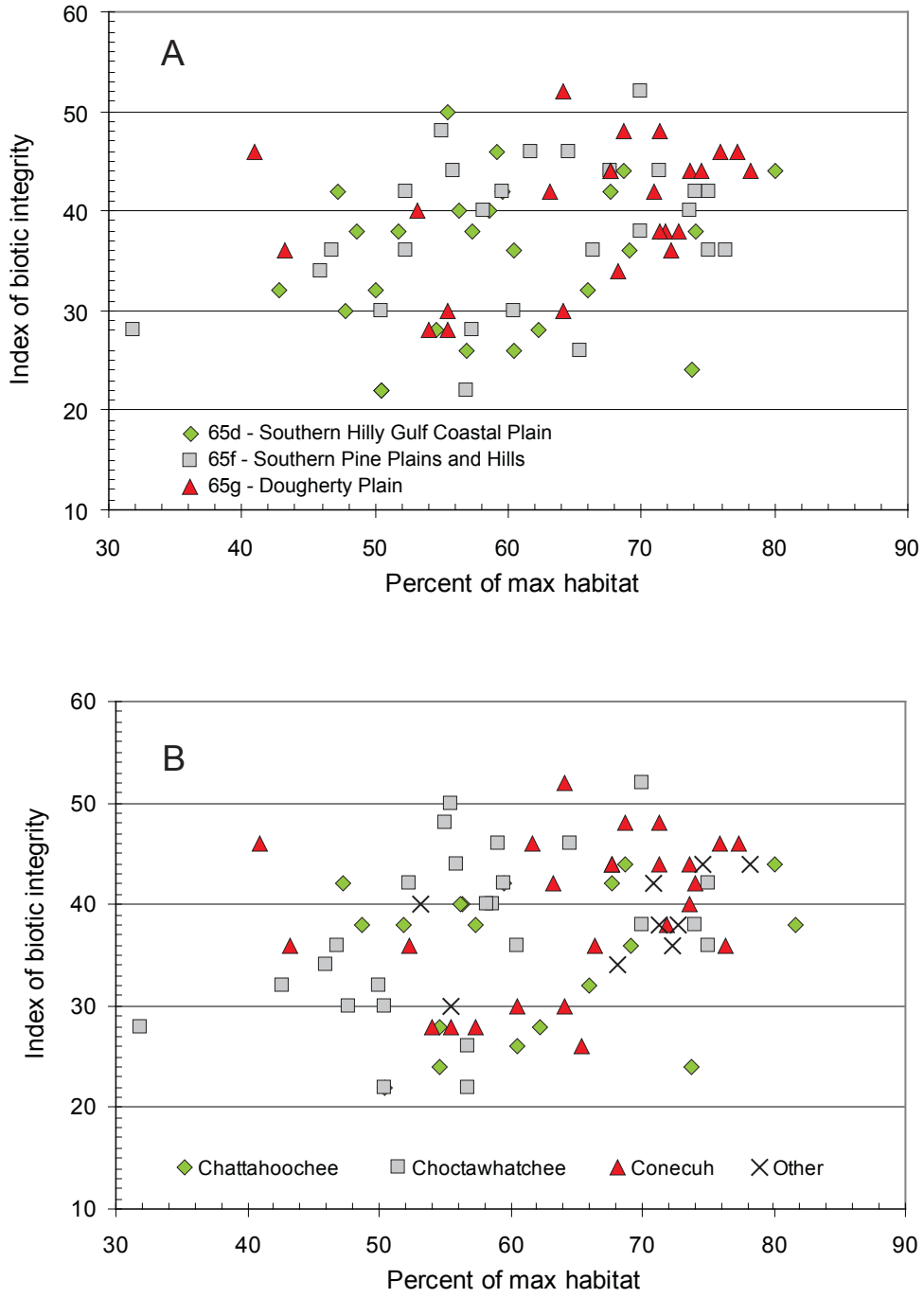


Figure 18. Comparison of the IBI and percent maximum habitat scores for ecoregions (A) and river systems (B) in the Southern Plains ichthyoregion.

habitat quality (percent of maximum attainable habitat) serving as the measure of increasing level of ecosystem stress (fig. 19). The Southern Plains IBI was integrated with the BCG model by using the IBI integrity classes (table 10) as tiers and the IBI endpoints within each tier to define a data subset for statistical limitation and graphical description. Several curves were fitted to these biological integrity tiers (fig. 20, top) ranging from a more gradually declining logistic relationship, curve A, that adequately captures the middle tiers (good, fair, poor), to the very steep relationship depicted in curve C that appears to describe a threshold "all-or-none" relationship where biological condition degrades precipitously when habitat degradation reaches a critical threshold. If curve A best represents the BCG model, then further sampling in habitats representing the two end tiers may result in their migration to a better position along curve A as depicted in the bottom of figure 20. This would result in a relationship in the Southern Plains ichthyoregion that better represents the BCG model as theorized (USEPA, 2005). Additional sampling, however, may demonstrate that either, or both, of these tiers do not exist in reality. Should the relationship between biological condition and habitat quality be closer to curve C, then it can be estimated from the curve that when habitat scores decline to 62 to 65 percent of the maximum then biological condition will decline abruptly to poor scores. The form of BCG relationships in southeast Alabama can only be theorized at this time. Further sampling in streams with very poor habitat and streams that are the very least disturbed will be required before the true form of this relationship can be determined.

CONCLUSIONS

The IBI has been demonstrated in many states to correspond negatively to increasing levels of human disturbance. We found this also to be true for the Southern Plains ichthyoregion. Fish communities inhabiting streams in this region have for many years been impacted by widespread agricultural practices. The eastern part of this region is extensively and, in some areas, heavily farmed resulting in stream degradation due to sediment which results in degraded fish communities. The western part of the region is extensively used for growing timber, and streams in this part of the region were also degraded by excessive sediment. Based on observations of fish communities

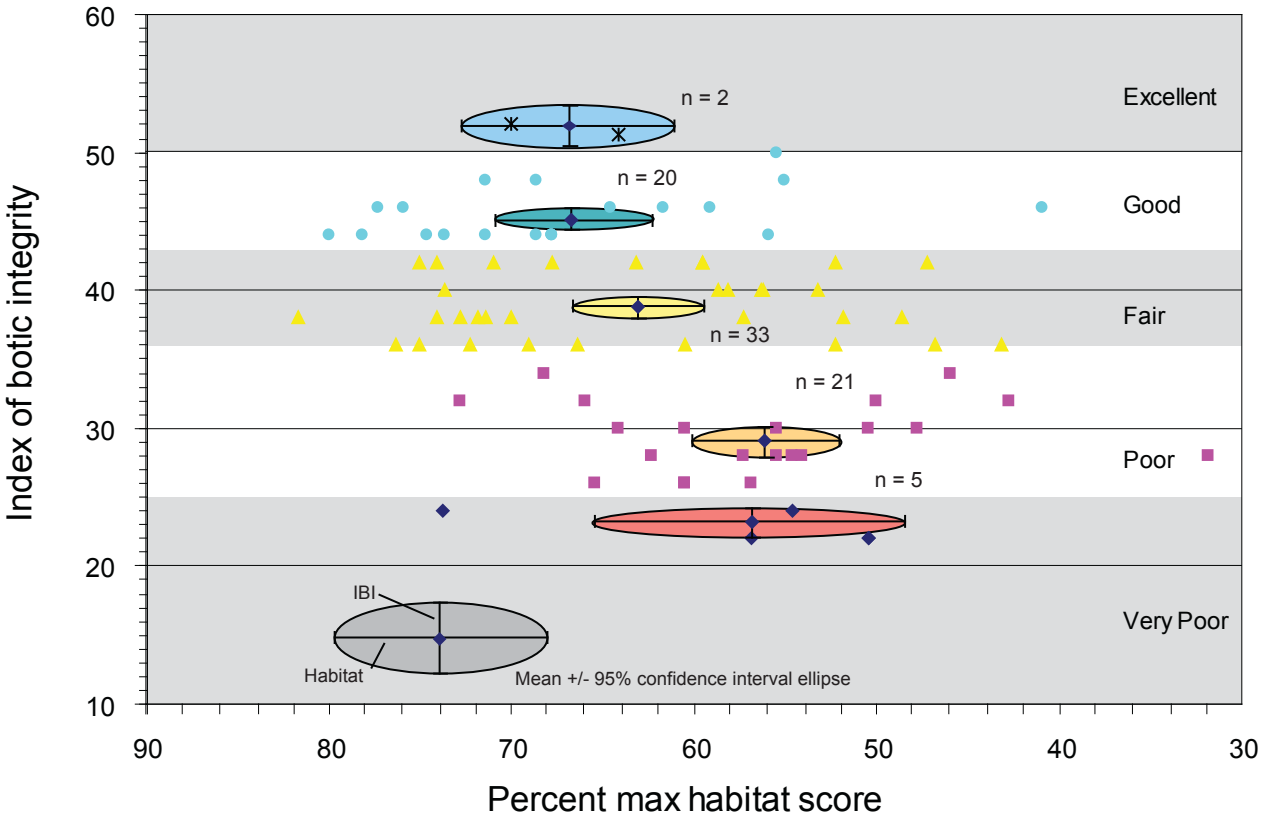


Figure 19. Tiered aquatic life use relationship between the IBI and habitat quality for sites in the Southern Plains ichthyoregion.

(Note: only two sites represented the **Excellent** tier with each having an IBI score = 52. To generate a confidence interval, the scores from these two sites were theoretically set at 51 and 52.)

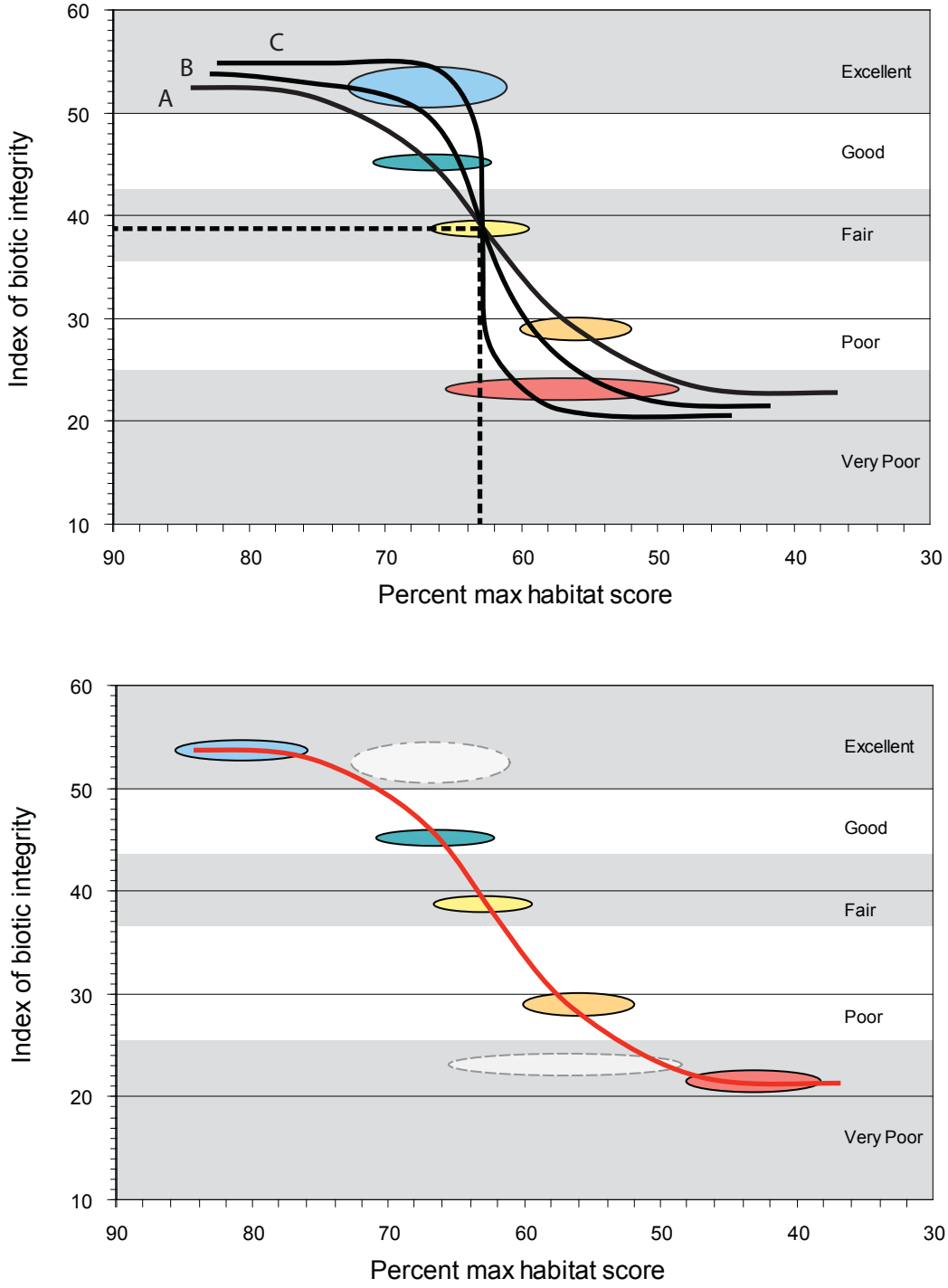


Figure 20. Biological condition gradient models for the Southern Plains ichthyoregion.

made over a 30-year period in this region, we believe that stream habitats have degraded substantially, resulting in many streams that score only in the poor to fair biological condition range. Minimally disturbed streams are very hard to find in the Southern Plains ichthyoregion making development of the IBI difficult because of the absence of adequate reference, or least disturbed, watersheds. The reach level stream habitat evaluation was found to be better related to the IBI as compared to the catchment level human disturbance measures. Sedimentation has a very localized impact to streams and stream fish communities and once it has been stopped or reduced, stream habitats will stabilize and become biologically productive and supportive again. Because of the localized and fine-scale nature of sediment degradation, its effects are not easily captured using traditional GIS technology which may describe, in part, why the IBI metrics were poorly correlated with catchment level human disturbance parameters and why the highly localized habitat evaluations were correlated with reach level habitat parameters.

Calibration of the Southern Plains IBI is a good start at developing a tool for evaluating biological stream quality for the region. It will need to be reevaluated and, if needed, refined as new sampling data are collected in the near future. Other metrics should also be devised and evaluated, particularly with respect to fish community trophic structure because of the poor relationships observed in these metrics.

REFERENCES CITED

Angermeier, P.L., and Karr, J.R., 1986, Applying an index of biotic integrity based on stream fish communities: considerations in sampling and interpretation: North American Journal of Fisheries Management, v. 6, p. 418-429.

Barbour, M.T., Gerritsen, J., Snyder, B.D., and Stribling, J.B., 1999, Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish, second edition: U.S. Environmental Protection Agency, Office of Water, Washington, D.C., EPA 841-B-99-002.

Boschung, H.T., and Mayden R.L., 2004, Fishes of Alabama: Smithsonian Books, 736 p.

Brown, M.T., and Vivas, M.B., 2003, A landscape development intensity index: Tallahassee, Florida, Florida Department of Environmental Protection, 21 p.

Dauwalter, D.C., Pert, E.J., and Keith, W.E., 2003, An index of biotic integrity for fish assemblages in Ozark Highland streams of Arkansas: Southeastern Naturalist, v. 2, no. 3, p. 447-468.

Etnier, D.A., and Starnes, W.C., 1993, The fishes of Tennessee: Knoxville, Tennessee, The University of Tennessee Press, 681 p.

Fore, L.S., 2004, Development and testing of biomonitoring tools for macroinvertebrates in Florida streams: Tallahassee, Florida, Florida Department of Environmental Protection, 70 p.

Goldstein, R.M., and Simon, T.P., 1999, Toward a unified definition of guild structure for feeding ecology of North American freshwater fishes, *in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Florida, CRC Press, p. 123-202.

Griffith, G.E., Omernik, J.M., Comstock, J.A., Lawrence, S., Martin, G., Goddard, A., Hulcher, V.J., and Foster, T., 2001, Ecoregions of Alabama and Georgia, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,700,000).

Hughes, R.M., and Oberdorff, Thierry, 1999, Applications of IBI concepts and metrics to waters outside the United States and Canada, *in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Florida, CRC Press, p. 79-93.

Karr, J.R., 1981, Assessment of biotic integrity using fish communities: Fisheries, v. 6, no. 6, p. 21-26.

Karr, J.P., and Chu, E.W., 1997, Biological monitoring and assessment using multimetric indexes effectively: Seattle, Washington, EPA 235-297-001.

___1999, Restoring life in running waters: better biological monitoring: Washington D.C., Island Press, 206 p.

Karr, J.R., and Dudley, D.R., 1981, Ecological perspective on water-quality goals: Environmental Management, v. 5, p. 55-68.

Karr, J.R., Fausch, K.D., Angermeier, P.L., Yant, P.R., and Schlosser, I.J., 1986, Assessing biological integrity in running waters, a method and its rationale: Urbana, Illinois, Illinois Natural History Survey Special Publication 5, 28 p.

Mettee, M.F., O'Neil, P.E., and Pierson, J.M., 1996, Fishes of Alabama and the Mobile basin: Oxmoor House, Birmingham, Alabama, 820 p.

Miller, D.L., Leonard, P.M., Hughes, R.M., Karr, J.R., Moyle, P.B., Schrader, L.H., Thompson, B.A., Daniels, R.A., Fausch, K.D., Fitzhugh, G.A., Gammon, J.R., Halliwell, D.B., Angermeier, P.L., and Orth, D.J., 1988, Regional applications of an index of biotic integrity for use in water resource management: Fisheries, v. 13, p. 12-20.

Mirarchi, R.E., ed., 2004, Alabama wildlife. Volume 1. A checklist of vertebrates and selected invertebrates: aquatic mollusks, fishes, amphibians, reptiles, birds, and mammals: Tuscaloosa, Alabama, The University of Alabama Press, 209 p.

Ohio EPA, 1987a, Biological criteria for the protection of aquatic life: Volume II: Users manual for biological field assessment of Ohio surface waters: State of Ohio Environmental Protection Agency, Division of Water Quality Planning and Assessment, Columbus, Ohio.

Ohio EPA, 1987b, Biological criteria for the protection of aquatic life: Volume III: Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities: State of Ohio Environmental Protection Agency, Division of Water Quality Planning and Assessment, Columbus, Ohio.

O'Neil, P.E., 2002, A biological assessment of selected sites in the Cahaba River system, Alabama: Alabama Geological Survey contract report to the U.S. Environmental Protection Agency, Atlanta, Georgia, Contract no. 2R-0117-NAGF, 48 p.

O'Neil, P.E., and Shepard, T.E., 2000a, Water-quality assessment of the lower Cahaba River watershed, Alabama: Alabama Geological Survey Bulletin 167, 135 p.

___2000b, Application of the index of biotic integrity for assessing biological condition of wadeable streams in the Black Warrior River system, Alabama: Alabama Geological Survey Bulletin 169, 71 p.

___2004, Hatchet Creek regional reference watershed study: Alabama Geological Survey Open-File Report 0509, 48 p.

___2007, Delineation of ichthyoregions in Alabama for use with the index of biotic integrity: Alabama Geological Survey Open-File Report 0711, 34 p.

O'Neil, P.E., Shepard, T.E., and Cook, M.R., 2006, Habitat and biological assessment of the Terrapin Creek watershed and development of the Index of Biotic Integrity for the Coosa and Tallapoosa River systems: Alabama Geological Survey Open-File Report 0601, 210 p.

Paller, M.H., Reichert, M.J.M., and Dean, J.M., 1996, Use of fish communities to assess environmental impacts in South Carolina Coastal Plain streams: Transactions of the American Fisheries Society, v. 125, p. 633-644.

Plafkin, J.L., Barbour, M.T., Porter, K.D., Gross, S.K., and Hughes, R.M., 1989, Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish: U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C., EPA 440-4-89-001.

Rankin, E.T., 1989, The Qualitative Habitat Evaluation Index (QHEI); rationale, methods, and application: Columbus, Ohio, State of Ohio EPA, Ecological Assessment Section, Division of Water, 6 p.

Ross, S.T., 2001, The inland fishes of Mississippi: Jackson, Mississippi, Mississippi Department of Wildlife, Fisheries, and Parks, 624 p.

Schleiger, S.L., 2000, Use of an index of biotic integrity to detect effects of land uses on stream fish communities in west-central Georgia: Transactions of the American Fisheries Society, v. 129, p. 1118-1133.

Shepard, T.E., O'Neil, P.E., McGregor, S.W., and Henderson, W.P., Jr., 2002, Biomonitoring in the Mulberry Fork watershed, 1999-2002: Alabama Geological Survey unpublished section 6 contract report to the Alabama Department of Conservation of Natural Resources, Wildlife and Freshwater Fisheries Division, 65 p.

Shepard, T.E., O'Neil, P.E., McGregor, S.W., and Mettee, M.F., 2004, Biomonitoring in the Locust Fork watershed, Alabama, 1997-98: Alabama Geological Survey Bulletin 175, 61 p.

Shepard, T.E., O'Neil, P.E., McGregor, S.W., Mettee, M.F., and Harris, S.C.,1997, Biomonitoring and water-quality studies in the upper Cahaba River drainage of Alabama, 1989-94: Alabama Geological Survey Bulletin 165, 255 p.

Simon, T.P., 1999a, Assessment of Balon's reproductive guilds with application to midwestern North American freshwater fishes*, in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Florida, CRC Press, p. 97-121.

___1999b, Introduction: Biological integrity and use of ecological health concepts for application to water resource characterizations, *in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Florida, CRC Press, p. 3-16.

Smogor, R.A., and Angermeier, P.L., 1999a, Relations between fish metrics and measures of anthropogenic disturbance in three IBI regions in Virginia, *in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Florida, CRC Press, p. 585-610.

___1999b, Effects of drainage basin and anthropogenic disturbance on relations between stream size and IBI metrics in Virginia, *in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Florida, CRC Press, p. 249-272.

Teels, B.M., and Danielson, T.J., 2001, Using a regional index of biotic integrity (IBI) to characterize the condition of northern Virginia streams, with emphasis on the Occoquan watershed: a case study: Laurel Maryland, U.S. Department of Agriculture, Natural Resources Conservation Service, Wetland Science Center, Technical Note 190-13-1, 92 p.

U.S. Environmental Protection Agency, 2000, Stressor identification guidance document: Washington D.C., U.S. EPA Office of Water, EPA-822-B-00-025.

___2005, Use of biological information to better define designated aquatic life uses in state and tribal water quality standards: tiered aquatic life uses, DRAFT: Washington D.C., U.S. EPA Office of Water, EPA-822-R-05-001, August 2005, 188 p.

Warren, M.L., Jr., Burr, B.M., Walsh, S.J., Bart, H.L., Jr., Cashner, R.C., Etnier, D.A., Freeman, B.J., Kuhajda, B.R., Mayden, R.L., Robison, H.W., Ross, S.T., and Starnes, W.C., 2000, Diversity, distribution, and conservation status of the native freshwater fishes of the southern United States: Fisheries, 25, no. 10, p. 7-29.

Appendix A

Habitat evaluation forms

ADEM-FIELD OPERATIONS-MONTGOMERY BRANCH
RIFFLE/RUN HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody _____ Date: _____

Station Number _____ Investigators _____

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 **Instream Cover**	>50% mix of boulder, cobble, submerged logs, undercut banks, or other stable habitat.	50-30% mix of boulder, cobble, or other stable habitat; adequate habitat.	30-10% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable.	<10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2 **Epifaunal surface**	Well developed riffle and run; riffles as wide as stream and length is 2x the width of stream; abundance of cobble.	Riffle is as wide as stream, but length is <2 times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is <2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or run virtually non existent; large boulders and bedrock prevalent; cobble lacking.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3 **Embeddedness**	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are >75% surrounded by fine sediment.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 **Velocity/Depth Regimes**	All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-shallow, fast-deep).	Only 3 of 4 regimes present. (if fast-shallow is missing, score lower.)	Only 2 of 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 **Man-made Channel Alteration**	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; and 40 - 80% of stream reach is channelized and disrupted.	Banks shored with gabion or cement; >80% of the stream reach channelized and disrupted.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6 **Sediment Deposition**	Little or no enlargement of islands or point bars and less than 5 % of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; > 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7 **Frequency of Riffles** (Distance between riffles/ stream width)	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥ 35
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 **Channel flow Status**	Water reaches base of both lower banks.	Water fills >75% of the available channel.	Water fills 75 - 25% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
9 **Condition of Banks**	Banks stable; no evidence (<5%) of erosion or bank failure.	Moderately stable; infrequent, small areas (5-30%) of erosion mostly healed over.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent Along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
10 **Bank Vegetative Protection**	>90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB) _____	10 9 8	7 6	5 4 3	2 1 0
Score (RB) _____	10 9 8	7 6	5 4 3	2 1 0
11 **Grazing or other disruptive pressure**	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; < 1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB) _____	10 9 8	7 6	5 4 3	2 1 0
Score (RB) _____	10 9 8	7 6	5 4 3	2 1 0
12 **Riparian vegetative zone (each bank)**	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB) _____	10 9 8	7 6	5 4 3	2 1 0
Score (RB) _____	10 9 8	7 6	5 4 3	2 1 0

ADEM-FIELD OPERATIONS-MONTGOMERY BRANCH
GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody _____ Date: _____
Station Number _____ Investigators _____

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 **Instream Cover**	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2 **Pool Substrate Characterization**	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3 **Pool Variability**	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 **Man-made Channel Alteration**	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 **Sediment Deposition**	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6 **Channel Sinuosity**	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7 **Channel flow Status**	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 **Condition of Banks**	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
Score _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
9 **Bank Vegetative Protection (each bank)**	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB) _____	10 9 8	7 6	5 4 3	2 1 0
Score (RB) _____	10 9 8	7 6	5 4 3	2 1 0
10 **Grazing or other disruptive pressure (each bank)**	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB) _____	10 9 8	7 6	5 4 3	2 1 0
Score (RB) _____	10 9 8	7 6	5 4 3	2 1 0
11 **Riparian vegetative zone Width (each bank)**	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB) _____	10 9 8	7 6	5 4 3	2 1 0
Score (RB) _____	10 9 8	7 6	5 4 3	2 1 0

Appendix B

Reproduction and trophic guild classifications for Alabama fishes

Explanation

Conservation status (Cons. Status)
(from Mirarchi, 2004)
- P1-highest concern
- P2-high concern
- P3-moderate concern
- P4-low concern
- P5-lowest concern
- E-endangered
- T-threatened

Vulnerability (Vulner.)
(From Warren and others, 2000)
- CS-currently stable
- V-vulnerable

Habitat
- I-impoundment
- R-river
- S-stream
- H-headwater
- Sp-spring
- Ca-cave
- Sw-swamp
- E-estuarine

Distribution (Dist.)
- W-widespread
- R-restricted
- D-disjunct
- Ex-extirpated
- I-introduced

Abundance (Abund.)
- C-common
- O-occasional
- U-uncommon
- R-rare
- Unk-unknown

Reproduction guild (Repro. guild)
- 1-simple lithophils
- 2-manipulative lithophils
- 3-simple miscellaneous spawners
- 4- manipulative misc. spawners

Feeding guild
- DAH-detritovore-algivore-herbivore
- AHI-algivore-herbivore-invertivore
- INV-invertivore
- INS-insectivore
- PIS-piscivore
- PAR-parasite
- IP-invertivore, piscivore

Tolerance
- INT-intolerant
- TOL-tolerant

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
PETROMYZONTIDAE- LAMPREYS								
Ichthyomyzon bdellium- Ohio lamprey	P5	CS	R, S	R	O	2	PAR	--
I. castaneus- chestnut lamprey	P5	CS	I, R, S	W	O	2	PAR	--
I. gagei- southern brook lamprey	P5	CS	R, S	W	O	2	DAH	--
I. greeleyi- mountain brook lamprey	P3	CS	S, H	R	U	2	DAH	INT
Lampetra aepyptera- least brook lamprey	P5	CS	S, H	W	O	2	DAH	--
L. appendix- American brook lamprey	P3	CS	S	R	U	2	DAH	--
CARCHARHINIDAE- REQUIEM SHARKS								
Carcharhinus leucas- bull shark	P5	CS	E, R	R	R	3	PIS	--
ACIPENSERIDAE- STURGEONS								
Acipenser fulvescens- lake sturgeon	Ex	T	R	Ex	Unk	1	INV	--
A. oxyrhinchus desotoi- Atlantic sturgeon	P2, T	T	R	R	U	1	INV	INT
Scaphirhynchus platorynchus- shovelnose sturgeon	Ex	CS	R	Ex	Unk	1	INV	--
S. suttkusi- Alabama sturgeon	P1, E	E	R	R	R	1	INV	INT
POLYODONTIDAE- PADDLEFISH								
Polyodon spathula- paddlefish	P4	V	R, I	W	O	3	AHI	--
LEPISOSTEIDAE- GARS								
Atractosteus spatula- alligator gar	P3	V	R	R	O	3	IP	--
Lepisosteus oculatus- spotted gar	P5	CS	R, I, Sw	W	C	3	IP	--
L. osseus- longnose gar	P5	CS	R, I	W	C	3	IP	TOL
L. platostomus- shortnose gar	Ex	CS	R, I	Ex	Unk	3	IP	TOL
AMIIDAE- BOWFIN								
Amia calva- bowfin	P5	CS	R, I, Sw	W	O	4	IP	--
HIODONTIDAE- MOONEYES								
Hiodon alosoides- goldeye	Ex	CS	R, I	Ex	Unk	1	IP	--
H. tergisus- mooneye	P4	CS	R, I	W	O	1	IP	--
ANGUILLIDAE- FRESHWATER EELS								
Anguilla rostrata- American eel	P4	CS	R, I	W	O	3	IP	--
CLUPEIDAE-HERRINGS								
Alosa alabamae- Alabama shad	P2	V	R	W	R	3	INV	INT
A. chrysochloris- skipjack herring	P3	CS	R	W	C	3	INV	--
Dorosoma cepedianum- gizzard shad	P5	CS	I, R, S	W	C	3	AHI	TOL
D. petenense- threadfin shad	P5	CS	I, R, S	W	C	3	AHI	--
ENGRAULIDAE- ANCHOVIES								
Anchoa mitchilli- bay anchovy	P5	CS	E, R	R	C	3	INV	--

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
CYPRINIDAE- CARPS AND MINNOWS								
Campostoma oligolepis- largescale stoneroller	P5	CS	S, H	W	C	2	DAH	--
C. pauciradii- bluefin stoneroller	P3	CS	S, H	R	C	2	DAH	--
Carassius auratus- goldfish	P5	CS	I	I, R	U	3	AHI	TOL
Clinostomus funduloides- rosyside dace	P5	CS	S, H	R	O	1	INV	--
Ctenopharyngodon idella- grass carp	Exotic	CS	R, I	I, W	U	3	AHI	TOL
Cyprinella caerulea- blue shiner	P2, T	E	S	R, D	R	3	INS	INT
C. callistia- Alabama shiner	P5	CS	R, S	W	C	3	INV	--
C. callitaenia- bluestripe shiner	P3	V	R, S	R	U	3	INS	INT
C. galactura- whitetail shiner	P5	CS	S	R	C	3	INS	--
C. gibbsi- Tallapoosa shiner	P4	CS	S, H	R	C	3	INS	--
C. lutrensis- red shiner	Exotic	CS	I, S	R	R	3	INS	TOL
C. spiloptera- spotfin shiner	P5	CS	I, R, S	R	C	3	INS	--
C. trichroistia- tricolor shiner	P5	CS	R, S	R	C	3	INS	--
C. venusta- blacktail shiner	P5	CS	I, R, S	W	C	3	INV	--
C. whipplei- steelcolor shiner	P5	CS	I, R, S	W	C	3	INV	TOL
Cyprinus carpio- carp	Exotic	CS	I, R	I, W	C	3	INV,DAH	TOL
Erimonax monachus- spotfin chub	T	E	S	Ex	R	3	INS	INT
Erimystax dissimilis- streamline chub	P2	CS	S	R	U	1	INS	INT
E. insignis- blotched chub	P3	CS	S	R	U	1	INS	--
Hemitremia flammea- flame chub	P4	V	Sp, H	R	O	3	INV	--
Hybognathus hayi- cypress minnow	P4	CS	R, I, Sw	W	U	1	DAH	--
H. nuchalis- Mississippi silvery minnow	P4	CS	R, I	W	C	1	DAH	--
Hybopsis amblops- bigeye chub	P5	CS	S	R	O	1	INS,INV	INT
H. lineapunctata- lined chub	P5	V	S, H	R	C	1	INS	INT
H. winchelli-clear chub	P5	CS	R, S, I	W	C	1	INS	--
H. sp. cf winchelli-	P5	CS	R, S	W	C	1	INS	--
Hypophthalmichthys molitrix- silver carp	Exotic	CS	I, R	I	U	3	DAH	TOL
H. nobilis- bighead carp	Exotic	CS	I, R	I	U	3	DAH,INV	TOL
Luxilus chrysocephalus- striped shiner	P5	CS	S, H	W	C	2	INS,DAH	TOL
L. coccogenis- warpaint shiner	P4	CS	S, H	R	O	1	INS,INV	--
L. zonistius- bandfin shiner	P5	CS	S, H	R	O	1	INS,DAH	--
Lythrurus alegnotus- Warrior shiner	P5	CS	S, H	R	O	1	INS	--
L. atrapiculus- blacktip shiner	P5	CS	S, H	R	C	1	INS	--
L. bellus- pretty shiner	P5	CS	S, H	W	C	1	INS	--

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
L. fasciolaris- scarlet shiner	P5	CS	S, H	R	C	1	INS	--
L. fumeus- ribbon shiner	P3	CS	S	R	U	1	INS	--
L. lirus- mountain shiner	P4	CS	S, H	R	O	1	INS	INT
L. roseipinnis- cherryfin shiner	P5	CS	S, H	R	C	1	INS	--
Macrhybopsis a. hyostoma- shoal chub	P2	CS	R, S	R	R	1	INS	INT
M. sp cf aestivalis- undescribed chubs	P4	V	R, S	W	O	1	INS	INT
M. sp. cf aestivalis- Florida chub	P4	V	R, S	W	O	1	INS	INT
M. storeriana- silver chub	P5	CS	I, R, S	W	O	1	INS,INV	--
Nocomis leptocephalus- bluehead chub	P5	CS	S, H	W	C	2	INS,AHI	--
N. micropogon- river chub	P4	CS	S, C	W	U	2	INV	--
Notemigonus crysoleucas- golden shiner	P5	CS	I, R, S	W	O	3	INS,AHI	TOL
Notropis albizonatus- palezone shiner	P1, E	E	S, H	R	R	1	INS,AHI	INT
N. ammophilus- orangefin shiner	P5	CS	R, S	W	C	1	INS,DAH	--
N. ariommus- popeye shiner	Ex	V	S	Ex	Unk	1	INS,DAH	--
N. asperifrons- burrhead shiner	P5	CS	S	W, D	O	1	INS,DAH	INT
N. atherinoides- emerald shiner	P5	CS	I, R, S	W	C	1	INS,AHI	--
N. baileyi- rough shiner	P5	CS	S, H	W	C	2	INS,DAH	--
N. boops- bigeye shiner	P5	CS	S, H	R	U	1	INS,DAH	INT
N. buccatus- silverjaw minnow	P5	CS	R, S	W	C	1	INS,AHI	--
N. buchanani- ghost shiner	P2	CS	I, R	R	U	1	INS,DAH	INT
N. cahabae- Cahaba shiner	P1, E	E	R	R	R	3	INS,DAH	INT
N. candidus- silverside shiner	P5	CS	I, R	W	C	1	INS,DAH	--
N. chalybaeus- ironcolor shiner	P1	V	S, Sp	W	U	1	INS,DAH	INT
N. chrosomus- rainbow shiner	P5	CS	H	W, D	O	2	INS,DAH	INT
N. cummingsae- dusky shiner	P2	CS	H, Sw	R	U	1	INS,DAH	INT
N. edwardraneyi- fluvial shiner	P5	CS	I, R	W	C	1	INS,AHI	--
N. harperi- redeye chub	P5	CS	H, Sp	R	U	1	INS,DAH	INT
N. hypsilepis- highscale shiner	P3	CS	S, H	R	O	1	INS,DAH	INT
N. leuciodus- Tennessee shiner	P4	CS	S, H	R	O	2	INS,DAH	INT
N. longirostris- longnose shiner	P5	CS	R, S	W	C	1	INS,DAH	--
N. maculatus- taillight shiner	P4	CS	S, Sw	W	U	3	INS,AHI	--
N. melanostomus- blackmouth shiner	P1	V	S	R	R	2	INS	INT
N. micropteryx- highlands shiner	P3	CS	S	R	U	1	INS,DAH	INT
N. petersoni- coastal shiner	P5	CS	S	R	O	1	INS,DAH	--
N. photogenis- silver minnow	P3	CS	S	R	U	1	INS,AHI	INT

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
N. stilbius- silverstripe shiner	P5	CS	S	W	C	1	INS,DAH	--
N. telescopus- telescope shiner	P5	CS	S, H	R	O	1	INS,DAH	--
N. texanus- weed shiner	P5	CS	I, R, S	W	C	1	INS,DAH	--
N. uranoscopus- skygazer shiner	P3	CS	R	R	C	1	INS,DAH	INT
N. volucellus- mimic shiner	P5	CS	R, S	W	C	3	INS,AHI	--
N. sp cf volucellus- Mobile basin form	P5	CS	R, S	W	C	3	INS,AHI	--
N. wickliffi- channel shiner	P5	CS	I, R	R	U	3	INS,DAH	--
N. xaenocephalus- Coosa shiner	P5	CS	S, H	R	C	1	INS,DAH	--
N. sp cf spectrunculus (sawfin shiner)	P4	CS	S, H	R	U	1	INS,DAH	INT
Opsopoeodus emiliae- pugnose minnow	P5	CS	I, R, S	W	O	4	AHI	--
Phenacobius catostomus- riffle minnow	P5	CS	R, S	W	O	1	INS	--
P. mirabilis- suckermouth minnow	P1	CS	S	R	U	1	INS	INT
P. uranops- stargazing minnow	P2	CS	S	R	U	1	INS	INT
Phoxinus erythrogaster- southern redbelly dace	P5	CS	S, H	R	O	1	AHI	--
Pimephales notatus- bluntnose minnow	P5	CS	R, S, H	W	C	4	DAH,INV	TOL
P. promelas- fathead minnow	P5	CS	I, R, S	I	U	4	DAH,INV	TOL
P. vigilax- bullhead minnow	P5	CS	I, R, S	W	C	4	DAH,INV	TOL
Pteronotropis euryzonus- broadstripe shiner	P2	V	S, Sw	R	O	1	INS,DAH	INT
P. grandipinnis- Apalachee shiner	P3	CS	S, H	W	C	1	INS,DAH	--
P. hypselopterus- sailfin shiner	P5	CS	S, H	W	C	1	INS,DAH	--
P. merlini- orangetail shiner	P4	CS	S, H	W	C	1	INS,DAH	--
P. signipinnis- flagfin shiner	P5	CS	S, Sw	R	O	1	INS,DAH	--
P. welaka- bluenose shiner	P2	V	S, Sw	W	U	1	INS,DAH	INT
Rhinichthys atratulus- blacknose dace	P5	CS	S, H, Sp	R	O	1	INS	TOL
Semotilus atromaculatus- creek chub	P5	CS	S, H, Sp	W	C	2	IP,INS	TOL
S. thoreauianus- Dixie chub	P5	CS	S, H, Sp	W	O	2	IP,INS	--
CATOSTOMIDAE- SUCKERS								
Carpiodes carpio- river carpsucker	P5	CS	I, R	R	O	3	DAH,INV	--
C. cyprinus- quillback	P5	CS	I, R	W	C	3	DAH,INV	--
C. velifer- highfin carpsucker	P5	CS	I, R	W	C	3	DAH,INV	--
Catostomus commersoni- white sucker	P5	CS	S, H, Sp	R	O	1	INV,AH	--
Cycleptus elongatus- blue sucker	P3	V	I, R	R	U	1	AHI	INT
Cycleptus meridionalis- southeastern blue sucker	P4	V	I,R	W	C	1	AHI	--
Erimyzon oblongus- creek chubsucker	P5	CS	S, H	W	C	2	INV,AH	--
E. sucetta- lake chubsucker	P5	CS	S, Sw	W	O	2	AHI	--
E. tenuis- sharpfin chubsucker	P5	CS	S, Sw	W	O	2	AHI	--

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
Hypentelium etowanum- Alabama hog sucker	P5	CS	R, S	W	C	1	AHI	--
H. nigricans- northern hog sucker	P5	CS	R, S	R	C	1	AHI	--
Ictiobus bubalus- smallmouth buffalo	P5	CS	I, R	W	C	3	INV	--
I. cyprinellus- bigmouth buffalo	P5	CS	I, R	R	O	3	INV	--
I. niger- black buffalo	P5	CS	I, R	R	O	3	INV	--
Minytrema melanops- spotted sucker	P5	CS	I, R, S	W	C	1	INV,DAH	TOL
Moxostoma anisurum- silver redhorse	P5	CS	I, R, S	R	O	1	INV	--
M. breviceps- smallmouth redhorse	P5	CS	I, R, S	R	O	1	INV	--
M. carinatum- river redhorse	P5	CS	I, R	W	O	1	INV	INT
M. duquesnei- black redhorse	P5	CS	I, R, S	W	C	1	INV	--
M. erythrurum- golden redhorse	P5	CS	I, R, S	W	C	1	INV	--
M. lacerum- harelip sucker	Extinct	X	--	Extinct	--	1	INV	--
M. poecilurum- blacktail redhorse	P5	CS	I, R, S	W	C	1	INV	--
M. sp cf poecilurum- Apalachicola redhorse	P4	CS	I, R, S	R	O	1	INV	--
Scartomyzon lachneri- greater jumprock	P5	CS	I, R, S	R	C	1	INV	--
ICTALURIDAE- BULLHEAD CATFISHES								
Ameiurus brunneus- snail bullhead	P4	V	I, R, S	R	O	4	IP,DAH	--
A. catus- white catfish	P4	CS	I, R, S	W	U	4	IP,DAH	--
A. melas- black bullhead	P5	CS	R, S	W	O	4	AHI,PIS	TOL
A. natalis- yellow bullhead	P5	CS	I, R, S	W	C	4	AHI,PIS	TOL
A. nebulosus- brown bullhead	P5	CS	I, R, S, Sw	W	U	4	IP,DAH	TOL
A. serracanthus- spotted bullhead	P3	V	I, R	R	U	4	AHI,PIS	--
Ictalurus furcatus- blue catfish	P5	CS	I, R	W	C	4	INV	--
I. punctatus- channel catfish	P5	CS	I, R, S	W	C	4	INV	--
Noturus sp cf elegans- Chucky madtom	Ex	T	R, S	Ex	Unk	4	INS,INV	INT
N. eleutherus- mountain madtom	P2	CS	R, S	R	R	4	INS,INV	INT
N. exilis- slender madtom	P5	CS	S	R	U	4	INS,AH	--
N. funebris- black madtom	P5	CS	S, H	W	C	4	INV	--
N. gyrinus- tadpole madtom	P5	CS	S, H	W	C	4	INS,INV	--
N. leptacanthus- speckled madtom	P5	CS	S, H	W	C	4	INS	--
N. miurus- brindled madtom	P2	CS	S	R	U	4	INS,INV	INT
N. munitus- frecklebelly madtom	P2	T	R, S	D	R	4	INS,INV	INT
N. nocturnus- freckled madtom	P5	CS	S	W	U	4	INS,INV	--
N. sp. cf flavus- highlands stonecat	P2	CS	R, S	R	U	4	INS,AH,PIS	INT
Pylodictis olivaris- flathead catfish	P5	CS	I, R	W	O	4	IP	--

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
ESOCIDAE-PIKES								
Esox americanus- redfin pickerel	P5	CS	S, H, Sw	W	O	3	IP	--
E. masquinongy - muskellunge	Exotic	CS	I, R, S	I, R	R	3	IP	--
E. niger- chain pickerel	P5	CS	I, R, S, Sw	W	O	3	IP	--
SALMONIDAE- TROUTS								
Oncorhynchus mykiss- rainbow trout	Exotic	CS	S	I, R	U	1	IP	INT
Salmo trutta- brown trout	Exotic	CS	S	I, R	R	1	IP	INT
APREDODERIDAE- PIRATE PERCH								
Aphredoderus sayanus- pirate perch	P5	CS	S, H, Sw	W	O	4	INS, PIS	--
AMBLYOPSIDAE- CAVEFISHES								
Speoplatyrhinos poulsoni- Alabama cavefish	P1, E	E	Ca	R	R	4	DAH,INV	INT
Typhlichthys subterraneus- southern cavefish	P3	V	Ca	R	U	4	DAH,INV	INT
MUGILIDAE								
Mugil cephalus- striped mullet	P5	CS	E, I, R	W	O	3	DAH,INV	--
ATHERINOPSIDAE- NEW WORLD SILVERSIDES								
Labidesthes sicculus- brook silverside	P5	CS	I, R, S	W	C	3	INV	--
Menidia audens- Mississippi silverside	P5	CS	E, R	R	O	3	INV	--
M. beryllina- inland silverside	P5	CS	E, R	R	O	3	INV	--
BELONIDAE- NEEDLEFISHES								
Strongylura marina- Atlantic needlefish	P5	CS	I, R	W	O	3	PIS	--
FUNDULIDAE- TOPMINNOWS AND KILLIFISHES								
Fundulus albolineatus- whiteline topminnow	Extinct	X	--	Extinct	Unk		INV	--
F. bifax- stippled topminnow	P3	V	R, S, Sw	R	O	1	INV	--
F. blairae- western starhead topminnow	P4	CS	S, Sw	W	U	3	INV	--
F. catenatus- northern studfish	P5	CS	S, H	R	O	1	INV	--
F. chrysotus- golden topminnow	P4	CS	Sw	R	U	3	INS,INV	--
F. cingulatus- banded topminnow	P4	CS	S, Sp, Sw	R	U	3	INV	--
F. confluentus- marsh killifish	P3	CS	S, Sw	R	R	3	INV	--
F. dispar- starhead topminnow	P3	CS	I, S, Sw	W	O	3	INV	--
F. escambiae- russetfin topminnow	P5	CS	R, S, Sw	W	C	3	INV	--
F. jenkinsi- saltmarsh topminnow	P3	CS	S, Sw	R	R	3	INV	--
F. notatus- blackstripe topminnow	P5	CS	I, R, S, Sw	W	O	3	AHI	--
F. nottii- bayou topminnow	P5	CS	I, R, S, Sw	W	C	3	AHI	--
F. olivaceus- blackspotted topminnow	P5	CS	R, S, Sw, H	W	C	3	INV	--
F. pulvereus- bayou killifish	P3	CS	R, Sw	R	U	3	INV	--
F. stellifer- southern studfish	P5	CS	R, S	W	O	1	INV	--

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
Leptolucania ommata- pygmy killifish	P4	CS	Sw	R	U	3	INS	--
Lucania goodei- bluefin killifish	P3	CS	Sw, Sp	R	O	3	INS	--
L. parva- rainwater killifish	P4	CS	E, Sw	R	O	3	INS	--
POECILIIDAE- LIVEBEARERS								
Gambusia affinis- western mosquitofish	P5	CS	I, R, S, Sw, H	W	C	4	INS,AHI	TOL
G. holbrooki- eastern mosquitofish	P5	CS	I, R, S, Sw	W	C	4	INS,AHI	TOL
Heterandria formosa- least killifish	P4	CS	Sw	R	U	4	INS,AHI	--
Poecilia latipinna- sailfin molly	P5	CS	Sw	R	O	4	INV	--
CYPRINODONTIDAE- PUPFISHES								
Cyprinodon variegatus	P5	CS	Brackish	R	C	2	INV	--
COTTIDAE- SCULPINS								
Cottus bairdi- mottled sculpin	P5	CS	S, H	R	O	2	INS,IP	--
C. carolinae- banded sculpin	P5	CS	S, H, Sp	W	C	2	INS,IP	--
C. sp. cf carolinae- Tallapoosa sculpin	P3	CS	S, H, Sp	W	C	2	IP	--
C. paulus- pygmy sculpin	P1, T	E	Sp	R	R	2	INV	INT
MORONIDAE- TEMPERATE BASSES								
Morone chrysops- white bass	P5	CS	I, R	W	O	3	IP	--
M. mississippiensis- yellow bass	P5	CS	I, R	W	O	3	IP	--
M. saxatilis- striped bass	P3	CS	I, R	W	O	3	IP	--
M. chrysops x saxatilis	--		I, R	W	O		IP	--
CENTRARCHIDAE- SUNFISHES								
Ambloplites ariommus- shadow bass	P5	CS	R, S	W	O	2	IP	INT
A. rupestris- rock bass	P5	CS	R, S	R	O	2	IP	INT
Centrarchus macropterus- flier	P5	CS	R, S, Sw	W	U	4	INV	--
Enneacanthus gloriosus- bluespotted sunfish	P4	CS	Sw	R	U	4	INV	--
E. obesus- banded sunfish	P3	CS	Sw	R	U	4	INV	--
Lepomis auritus- redbreast sunfish	P5	CS	I, R, S	W	C	2	INV	--
L. cyanellus- green sunfish	P5	CS	R, S, H	W	C	2	IP	TOL
L. gulosus- warmouth	P5	CS	R, S. H	W	O	4	IP	--
L. humilis- orangespotted sunfish	P5	CS	R, S	W	O	2	INV	--
L. macrochirus- bluegill	P5	CS	I, R, S, H	W	C	2	INV	TOL
L. marginatus- dollar sunfish	P5	CS	R, S	W	O	2	INV	--
L. megalotis- longear sunfish	P5	CS	I, R, S, H	W	C	2	INV	--
L. microlophus- redear sunfish	P5	CS	I, R, S	W	C	2	INV	--
L. miniatus- redspotted sunfish	P5	CS	R, S, H, Sw	W	C	2	INV	--

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
Micropterus cataractae- shoal bass	P2	V	I, R, S	R	O	2	IP	INT
M. coosae- redeye bass	P5	CS	R, S	R	C	2	IP	--
M. dolomieui- smallmouth bass	P5	CS	I, R, S	R	C	2	IP	--
M. punctulatus- spotted bass	P5	CS	I, R, S, H	W	C	4	IP	--
M. salmoides- largemouth bass	P5	CS	I, R, S, Sw	W	C	4	IP	--
Pomoxis annularis- white crappie	P5	CS	I, R, S	W	O	4	IP	--
P. nigromaculatus- black crappie	P5	CS	I, R, S	W	O	4	IP	--
PERCIDAE- DARTERS AND PERCHES								
Ammocrypta beanii- naked sand darter	P5	CS	R, S	W	O	1	INS	--
A. bifascia- Florida sand darter	P5	CS	R, S	R	O	1	INS	--
A. meridiana- southern sand darter	P5	CS	R, S	W	O	1	INS	--
Crystallaria asprella- crystal darter	P3	V	R	W	U	1	INS	INT
Etheostoma artesiae- redspot darter	P5	CS	S, H	W	C	3	INS	--
E. bellator- Warrior darter	P3	CS	S, H	R	U	3	INS	INT
E. sp. cf bellator- Locust Fork darter	P2	T	S, H	R	U	3	INS	INT
E. sp. cf bellator- Sipsey darter	P2	V	S, H	R	U	3	INS	INT
E. blennioides- greenside darter	P5	CS	R, S, H	R	O	3	INS	--
E. blennius- blenny darter	P4	CS	S	R	U	1	INS	INT
E. boschungi- slackwater darter	P1, T	T	S, H	R	U	3	INS	INT
E. brevirostrum- holiday darter	P1	T	S, H	R	U	3	INS	INT
E. caeruleum- rainbow darter	P5	CS	S, H, Sp	R	C	1	INS	--
E. camurum- bluebreast darter	P2	CS	R, S	R	U	1	INS	INT
E. chermocki- vermilion darter	P1, E	E	S, H, Sp	R	U	3	INS	INT
E. chlorosomum- bluntnose darter	P5	CS	S, H	W	O	3	INS	--
E. chuckwachatte- lipstick darter	P2	V	S, H	R	O	1	INS	INT
E. cinereum- ashy darter	Ex	T	S	Ex	Unk	3	INS	INT
E. colorosum- coastal darter	P5	CS	S, H	R	C	3	INS	--
E. coosae- Coosa darter	P5	CS	S, H	R	C	3	INS	--
E. corona- crown darter	P5	V	S, H	R	C	4	INS	--
E. crossopterum- fringed darter	P3	CS	S, H	R	O	4	INS	--
E. davisoni- Choctawhatchee darter	P5	CS	S, H	R	O	4	INS	--
E. ditrema- coldwater darter	P2	T	S, H, Sp	R	U	3	INS	INT
E. douglasi- Tuskaloosa darter	P3	CS	S, H	R	O	1	INS	INT
E. duryi- black darter	P5	CS	S, H	R	C	3	INS	--
E. edwini- brown darter	P5	CS	S, H, Sw	W	O	3	INS	INT

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
E. flabellare- fantail darter	P5	CS	S, H	R	C	4	INS	--
E. fusiforme- swamp darter	P5	CS	Sw, H	W	U	3	INS	--
E. histrio- harlequin darter	P5	CS	R, S	W	U	3	INS	--
E. jessiae- blueside darter	P4	CS	S, H	R	U	1	INS	--
E. jordani- greenbreast darter	P5	CS	R, S, H	W	O	1	INS	INT
E. kennicotti- stripetail darter	P5	CS	S, H	R	O	4	INS	--
E. lachneri- Tombigbee darter	P5	CS	S, H	W	C	3	INS	--
E. lynceum- brighteye darter	P1	CS	S	R	U	3	INS	INT
E. neopterum- lollipop darter	P1	V	H	R	U	4	INS	INT
E. nigripinne- blackfin darter	P5	CS	S, H	R	C	4	INS	--
E. nigrum- johnny darter	P5	CS	S, H	W	C	4	INS	--
E. nuchale- watercress darter	P1, E	E	Sp	R	R	3	INS	INT
E. parvipinne- goldstripe darter	P5	CS	S, H	W	U	3	INS	--
E. phytophilum- rush darter	P1	E	S, H	R	R	3	INS	INT
E. proeliare- cypress darter	P5	CS	H, Sw	W	O	3	INS	--
E. ramseyi- Alabama darter	P5	CS	S, H	W	C	3	INS	--
E. rufilineatum- redline darter	P5	CS	R, S	R	C	1	INS	--
E. rupestre- rock darter	P5	CS	R, S	W	O	1	INS	--
E. simoterum- snubnose darter	P5	CS	S, H	R	O	3	INS	--
E. stigmaeum- speckled darter	P5	CS	S, H	W	C	1	INS	--
E. swaini- gulf darter	P5	CS	S, H	W	O	3	INS	--
E. tallapoosae- Tallapoosa darter	P4	CS	S, H	R	C	3	INS	--
E. trisella- trispot darter	P1	E	S,H	R	U	3	INS	INT
E. tuscumbia- Tuscumbia darter	P2	V	Sp	R	O	1	INS	INT
E. wapiti- boulder darter	P1, E	E	R, S	R	R	1	INS	INT
E. zonale- banded darter	P4	CS	R, S	R	O	3	INS	--
E. zonifer- backwater darter	P5	CS	H, Sw	W	U	3	INS	--
E. zonistium- bandfin darter	P2	CS	S, H	R	O	3	INS	INT
E. sp. cf zonistium- blueface darter	P2	T	S, H	R	U	3	INS	INT
Perca flavescens- yellow perch	P4	CS	I, R, S	W	O	3	IP	--
P. aurolineata- goldline darter	P1, T	T	R, S	R-D	R	1	INS	INT
P. austroperca- southern logperch	P3	CS	R, S	R	U	1	INS	--
P. brevicauda- coal darter	P2	T	R, S	R	U	1	INS	INT
P. burtoni- blotchside logperch	P1	V	R, S	R	R	1	INS	INT
P. caprodes- logperch	P5	CS	R, S	R	C	1	INS	--
P. crypta- halloween darter	P1	V	R, S	R	U	1	INS	INT
P. evides- gilt darter	P2	CS	R, S	R	U	1	INS	INT

FAMILY NAME Scientific name - common name	Cons. status	Vulner.	Habitat	Dist.	Abund.	Reprod. guild	Feeding guild	Tolerance
P. kathae- Mobile logperch	P5	CS	R, S	W	O	1	INS	--
P. lenticula- freckled darter	P3	T	R, S	W	U	1	INS	--
P. maculata- blackside darter	P5	CS	S, H	W	U	1	INS	INT
P. nigrofasciata- blackbanded darter	P5	CS	R, S, H	W	C	1	INS	--
P. palmaris- bronze darter	P5	CS	R, S	R	C	1	INS	--
P. phoxocephala- slenderhead darter	P1	CS	R, S	R	U	1	INS	INT
P. sciera- dusky darter	P5	CS	R, S	W	O	1	INS	--
P. shumardi- river darter	P5	CS	R, S	W	O	1	INS	--
P. sipsi- Bankhead darter	P1	V	R, S	R	R	1	INS	INT
P. smithvanizi- muscadine darter	P3	V	R, S	R	U	1	INS	--
P. suttkusi- Gulf logperch	P5	CS	R, S	W	U	1	INS	--
P. tanasi- snail darter	P1, T	T	R, S	R	R	1	INS,INV	INT
P. vigil- saddleback darter	P5	CS	R, S	W	O	1	INS	INT
Sander canadense- sauger	P5	CS	I, R	R	O	1	IP	--
S. vitreus- walleye	P3	CS	I, R	W	U	1	IP	--
SCIAENIDAE- DRUMS								
Aplodinotus grunniens- freshwater drum	P5	CS	I, R	W	C	3	INV	--
ELASSOMATIDAE- PYGMY SUNFISHES								
Elassoma alabamae- spring pygmy sunfish	P1	E	Sw, Sp	R	R	4	INV,INS	INT
E. evergladei- Everglades pygmy sunfish	P4	CS	H, Sp	R	O	4	INV,INS	--
E. zonatum- banded pygmy sunfish	P4	CS	S, H, Sw	W	C	4	INV,INS	--
PARALICHTHYIDAE- SAND FLOUNDERS								
Paralichthys lethostigma- southern flounder	P5	CS	E, I, R	R	O	1	IP	--
ACHIRIDAE- SOLES								
Trinectes maculatus- hogchoker	P5	CS	E, I, R	R	O	1	IP	--

Appendix C

Southern Plains ichthyoregion fish community sampling data

	River system	Perdido River				Conecuh River				
	Site	BFCB-2	PDBB-5	PRDE-1	TMEB-1	BCRE-1	BCRE-4	BECE-1	BOTC-1	BOTC-1
	Date	25-Jun-08	25-Jun-08	26-Jun-08	25-Jun-08	19-Jun-08	17-Jul-08	24-Jun-08	20-May-08	18-Jun-08
Species name	Common name									
Petromyzontidae - lampreys										
Ichthyomyzon gagei	southern brook lamprey	--	--	--	--	--	1	--	1	--
Lepisosteidae - gars										
Lepisosteus oculatus	spotted gar	--	--	--	--	--	--	--	--	--
Anguillidae - eels										
Anguilla rostrata	American eel	--	--	--	7	--	--	--	--	1
Cyprinidae - minnows and carps										
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	2	--	--
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	--	450	7	--	113	31	9	95	87
Hybopsis sp cf winchelli	coastal clear chub	--	--	--	--	4	13	1	11	--
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	1	--	--
Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--	--
Lythrurus atrapiculus	blacktip shiner	--	--	--	--	--	--	--	--	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--	--
Notemigonus crysoleucas	golden shiner	--	--	--	--	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	--	76	--	--	3	1	3	2	2
Notropis harperi	redeye chub	3	--	--	--	--	--	--	--	--
Notropis longirostris	longnose shiner	--	79	--	--	10	--	7	5	--
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	--	--	--	--
Notropis texanus	weed shiner	--	404	16	30	18	64	20	15	--
Opsopoeodus emiliae	pugnose minnow	--	--	--	--	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--	--
Pteronotropis hypselopterus	sailfin shiner	7	23	159	154	--	--	--	--	--
Pteronotropis merlini	orangetail shiner	--	--	--	--	--	--	--	--	--
Pteronotropis signipinnis	flagfin shiner	57	--	--	3	--	--	--	--	--
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--	--
Semotilus thoreauianus	Dixie chub	--	--	--	--	--	--	--	--	--

	River system	Perdido River				Conecuh River				
	Site	BFCB-2	PDBB-5	PRDE-1	TMEB-1	BCRE-1	BCRE-4	BECE-1	BOTC-1	BOTC-1
	Date	25-Jun-08	25-Jun-08	26-Jun-08	25-Jun-08	19-Jun-08	17-Jul-08	24-Jun-08	20-May-08	18-Jun-08
Species name	Common name									
Catostomidae - suckers										
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	10	--	--	--	--	--	--	--	--
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	--	--	1	2	--	--	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	--	7	--	--	4	--	--	--	--
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms										
Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--	--
Ameiurus natalis	yellow bullhead	3	--	--	4	--	--	--	2	--
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	--	--	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	--	--	--
Noturus funebris	black madtom	5	--	--	--	--	--	--	--	--
Noturus gyrinus	tadpole madtom	--	--	1	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	1	12	--	2	3	3	9	7	23
Esocidae - pickerels										
Esox americanus	redfin pickerel	3	2	2	--	--	--	--	1	--
Esox niger	chain pickerel	--	--	--	--	--	--	--	--	--
Aphredodreidae - pirate perch										
Aphredoderus sayanus	pirate perch	3	2	2	4	--	2	--	--	3
Atherinopsidae - new world silversides										
Labidesthes sicculus	brook silverside	--	15	--	--	--	7	--	--	--
Fundulidae - topminnows										
Fundulus escambiae	russetfin topminnow	4	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	--	6	3	--	6	6	4	5	4
Poeciliidae - livebearers										
Gambusia holbrooki	eastern mosquitofish	9	--	--	6	--	5	--	--	--

	River system	Perdido River				Conecuh River				
	Site	BFCB-2	PDBB-5	PRDE-1	TMEB-1	BCRE-1	BCRE-4	BECE-1	BOTC-1	BOTC-1
	Date	25-Jun-08	25-Jun-08	26-Jun-08	25-Jun-08	19-Jun-08	17-Jul-08	24-Jun-08	20-May-08	18-Jun-08
Species name	Common name									
Centrarchidae - sunfishes										
Ambloplites ariommus	shadow bass	--	--	1	--	1	2	--	2	1
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	--	--	--	--	--	--	--	--
Lepomis cyanellus	green sunfish	--	--	--	--	1	--	--	--	--
Lepomis gulosus	warmouth	5	--	--	--	--	1	--	1	--
Lepomis macrochirus	bluegill	4	8	3	3	1	--	1	7	6
Lepomis marginatus	dollar sunfish	4	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	--	37	--	--	40	22	4	14	5
Lepomis microlophus	redear sunfish	--	--	--	--	2	--	--	5	--
Lepomis miniatus	redspotted sunfish	16	1	11	12	8	7	1	8	9
Micropterus punctulatus	spotted bass	--	3	--	1	1	2	1	5	4
Micropterus salmoides	largemouth bass	1	--	2	--	1	--	1	--	--
Percidae - perches and darters										
Ammocrypta bifascia	Florida sand darter	--	2	--	--	4	2	--	2	--
Etheostoma colorosum	coastal darter	--	--	--	--	2	8	--	3	--
Etheostoma davisoni	Choctawhatchee darter	--	--	--	--	--	--	--	--	--
Etheostoma edwini	brown darter	5	--	3	1	--	--	--	--	--
Etheostoma fusiforme	swamp darter	1	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	--	--	--	--	--	--	--
Etheostoma stigmaeum	speckled darter	--	--	4	--	--	6	--	--	--
Etheostoma swaini	gulf darter	--	--	1	--	--	6	--	2	--
Percina austroperca	southern logperch	--	--	--	--	1	--	--	--	--
Percina nigrofasciata	blackbanded darter	--	43	34	22	21	11	38	37	31
Percina vigil	saddleback darter	--	--	--	--	7	--	7	--	--
Elassomatidae - pygmy sunfishes										
Elassoma zonatum	banded pygmy sunfish	--	2	--	2	--	--	--	--	--
Soleidae - soles										
Trinectes maculatus	hogchoker	--	--	--	--	5	--	--	--	--
	Species	18	18	15	14	23	21	16	21	12
	Individuals	141	1172	249	251	257	202	109	230	176

	River system	Conecuh River								
	Site	BRSC-1	FGNC-1	FRME-1	FYCE-1	JRME-3	LEC-1	MDRC-1	MDRE-1	MDRE-2
	Date	18-Jul-08	17-Jun-08	19-Jun-08	20-May-08	19-Jun-08	17-Jul-04	18-Jul-08	19-Jun-08	19-Jun-08
Species name	Common name									
Petromyzontidae - lampreys										
Ichthyomyzon gagei	southern brook lamprey	--	1	--	--	1	--	--	--	--
Lepisosteidae - gars										
Lepisosteus oculatus	spotted gar	--	--	--	--	--	--	--	--	--
Anguillidae - eels										
Anguilla rostrata	American eel	--	--	--	--	--	--	--	1	--
Cyprinidae - minnows and carps										
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--	--
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	62	34	--	--	--	39	33	103	76
Hybopsis sp cf winchelli	coastal clear chub	2	1	--	--	--	--	2	11	8
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--	--
Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--	--
Lythrurus atrapiculus	blacktip shiner	1	11	--	--	--	--	31	--	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--	--
Notemigonus crysoleucas	golden shiner	--	--	--	--	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	--	12	--	--	18	2	19	2	8
Notropis harperi	redeye chub	--	1	--	--	--	--	--	--	--
Notropis longirostris	longnose shiner	--	13	--	--	--	13	3	53	--
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	--	--	--	--
Notropis texanus	weed shiner	13	68	--	--	82	33	43	14	42
Opsopoeodus emiliae	pugnose minnow	--	--	--	--	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--	--
Pteronotropis hypselopterus	sailfin shiner	--	--	183	--	--	4	57	--	--
Pteronotropis merlini	orangetail shiner	--	--	--	--	37	--	--	--	--
Pteronotropis signipinnis	flagfin shiner	--	--	37	--	--	--	--	--	--
Semotilus atromaculatus	creek chub	--	--	--	--	1	--	--	--	--
Semotilus thoreauianus	Dixie chub	--	--	4	23	--	--	--	--	--

	River system	Conecuh River								
	Site	BRSC-1	FGNC-1	FRME-1	FYCE-1	JRME-3	LEC-1	MDRC-1	MDRE-1	MDRE-2
	Date	18-Jul-08	17-Jun-08	19-Jun-08	20-May-08	19-Jun-08	17-Jul-04	18-Jul-08	19-Jun-08	19-Jun-08
Species name	Common name									
Catostomidae - suckers										
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	--	1	--	--	--	--	--	--
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	1	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	--	--	--	1	--	--	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	3	--	--	--	--	1	--	5	4
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms										
Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--	--
Ameiurus natalis	yellow bullhead	--	3	1	--	1	--	--	--	--
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	--	--	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	--	--	--
Noturus funebris	black madtom	--	--	4	--	--	--	--	--	--
Noturus gyrinus	tadpole madtom	--	--	--	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	11	13	4	4	9	--	1	4	2
Esocidae - pickerels										
Esox americanus	redfin pickerel	--	2	4	--	10	7	3	4	2
Esox niger	chain pickerel	--	--	--	--	--	1	--	--	--
Aphredodreidae - pirate perch										
Aphredoderus sayanus	pirate perch	2	--	1	2	1	--	4	1	1
Atherinopsidae - new world silversides										
Labidesthes sicculus	brook silverside	19	--	--	--	--	3	--	--	--
Fundulidae - topminnows										
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	12	2	8	--	9	30	25	33	9
Poeciliidae - livebearers										
Gambusia holbrooki	eastern mosquitofish	--	5	1	--	4	--	3	8	10

	River system	Conecuh River								
	Site	BRSC-1	FGNC-1	FRME-1	FYCE-1	JRME-3	LEC-1	MDRC-1	MDRE-1	MDRE-2
	Date	18-Jul-08	17-Jun-08	19-Jun-08	20-May-08	19-Jun-08	17-Jul-04	18-Jul-08	19-Jun-08	19-Jun-08
Species name	Common name									
Centrarchidae - sunfishes										
Ambloplites ariommus	shadow bass	--	--	--	--	--	--	--	--	1
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	--	--	--	--	--	--	--	--
Lepomis cyanellus	green sunfish	2	--	2	1	--	--	--	--	--
Lepomis gulosus	warmouth	1	1	1	1	--	4	1	--	--
Lepomis macrochirus	bluegill	8	34	--	4	--	6	--	7	2
Lepomis marginatus	dollar sunfish	1	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	29	23	20	1	20	33	10	41	13
Lepomis microlophus	redear sunfish	--	1	--	--	--	--	--	--	--
Lepomis miniatus	redspotted sunfish	9	--	4	--	11	1	3	16	11
Micropterus punctulatus	spotted bass	3	5	1	--	--	4	--	14	1
Micropterus salmoides	largemouth bass	1	--	3	--	2	--	--	1	1
Percidae - perches and darters										
Ammocrypta bifascia	Florida sand darter	--	--	--	--	--	5	1	8	--
Etheostoma colorosum	coastal darter	10	23	--	--	--	1	2	--	11
Etheostoma davisoni	Choctawhatchee darter	1	1	--	--	--	--	--	--	--
Etheostoma edwini	brown darter	--	--	2	--	--	--	--	--	--
Etheostoma fusiforme	swamp darter	--	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	--	--	--	--	--	1	--
Etheostoma stigmaeum	speckled darter	5	5	--	--	--	4	1	--	--
Etheostoma swaini	gulf darter	1	8	--	--	--	--	1	--	1
Percina austroperca	southern logperch	--	3	--	--	--	--	--	--	--
Percina nigrofasciata	blackbanded darter	41	19	63	2	23	23	19	24	28
Percina vigil	saddleback darter	--	--	--	--	--	10	--	7	7
Elassomatidae - pygmy sunfishes										
Elassoma zonatum	banded pygmy sunfish	--	--	--	--	--	--	--	--	1
Soleidae - soles										
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	23	2
	Species	22	24	19	8	15	22	20	22	22
	Individuals	237	289	344	38	229	226	262	381	241

	River system	Conecuh River								
	Site	MYCE-1	OLUM-1	PALC-3	PDCC-1	PGNB-7	PRSB-3	PRWC-1	RYC-5	SECE-3
	Date	20-May-08	25-Jun-08	25-Jun-08	4-Jun-08	25-Jun-08	20-Jun-08	16-Jun-08	14-May-08	24-Jun-08
Species name	Common name									
Petromyzontidae - lampreys										
Ichthyomyzon gagei	southern brook lamprey	2	--	--	6	1	--	--	--	--
Lepisosteidae - gars										
Lepisosteus oculatus	spotted gar	--	--	1	--	--	--	--	--	--
Anguillidae - eels										
Anguilla rostrata	American eel	--	--	--	--	--	--	1	--	--
Cyprinidae - minnows and carps										
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--	323
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	--	--	--	32	3	140	--	1	13
Hybopsis sp cf winchelli	coastal clear chub	--	--	1	--	101	89	--	--	7
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--	9
Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--	--
Lythrurus atrapiculus	blacktip shiner	--	4	--	--	--	26	--	--	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--	11
Notemigonus crysoleucas	golden shiner	--	13	--	--	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--	7
Notropis amplamala	longjaw minnow	--	--	--	8	3	97	120	--	6
Notropis harperi	redeye chub	--	--	--	--	--	--	--	--	--
Notropis longirostris	longnose shiner	--	--	--	--	6	10	--	--	3
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	5	--	--	--
Notropis texanus	weed shiner	--	2	2	--	63	54	--	--	1
Opsopoeodus emiliae	pugnose minnow	--	1	6	--	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--	--
Pteronotropis hypselopterus	sailfin shiner	--	--	--	--	--	--	--	--	10
Pteronotropis merlini	orangetail shiner	--	--	--	--	--	--	--	--	--
Pteronotropis signipinnis	flagfin shiner	--	--	--	11	--	--	--	--	2
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--	--
Semotilus thoreauianus	Dixie chub	--	--	--	6	--	--	147	--	--

	River system	Conecuh River								
	Site	MYCE-1	OLUM-1	PALC-3	PDCC-1	PGNB-7	PRSB-3	PRWC-1	RYC-5	SECE-3
	Date	20-May-08	25-Jun-08	25-Jun-08	4-Jun-08	25-Jun-08	20-Jun-08	16-Jun-08	14-May-08	24-Jun-08
Species name	Common name									
Catostomidae - suckers										
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	2	--	--	--	--	--	--	--
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--	1
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	1	--	--	--	--	--	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	--	--	3	--	--	4	--	--	5
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms										
Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--	--
Ameiurus natalis	yellow bullhead	4	1	1	2	--	--	3	3	2
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	--	--	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	--	--	--
Noturus funebris	black madtom	--	--	--	--	--	--	--	--	--
Noturus gyrinus	tadpole madtom	--	--	--	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	4	--	--	2	5	7	5	8	5
Esocidae - pickerels										
Esox americanus	redfin pickerel	--	6	--	4	--	3	--	--	3
Esox niger	chain pickerel	4	1	1	1	--	--	--	2	--
Aphredodreidae - pirate perch										
Aphredoderus sayanus	pirate perch	1	3	5	7	--	--	--	2	6
Atherinopsidae - new world silversides										
Labidesthes sicculus	brook silverside	--	--	3	--	--	--	--	--	--
Fundulidae - topminnows										
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--	1
Fundulus olivaceus	blackspotted topminnow	--	21	2	2	63	46	1	1	13
Poeciliidae - livebearers										
Gambusia holbrooki	eastern mosquitofish	--	5	32	--	2	3	1	--	4

	River system	Conecuh River								
	Site	MYCE-1	OLUM-1	PALC-3	PDCC-1	PGNB-7	PRSB-3	PRWC-1	RYC-5	SECE-3
	Date	20-May-08	25-Jun-08	25-Jun-08	4-Jun-08	25-Jun-08	20-Jun-08	16-Jun-08	14-May-08	24-Jun-08
Species name	Common name									
Centrarchidae - sunfishes										
Ambloplites ariommus	shadow bass	--	--	--	--	3	--	--	--	6
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	--	--	--	--	--	--	--	--
Lepomis cyanellus	green sunfish	--	1	--	17	--	--	--	1	--
Lepomis gulosus	warmouth	--	3	3	--	--	1	--	2	--
Lepomis macrochirus	bluegill	--	8	6	--	1	6	--	2	5
Lepomis marginatus	dollar sunfish	--	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	2	7	31	15	76	123	--	3	2
Lepomis microlophus	redear sunfish	--	--	2	--	--	1	--	1	--
Lepomis miniatus	redspotted sunfish	5	4	6	14	5	33	2	4	10
Micropterus punctulatus	spotted bass	--	--	--	1	4	5	--	--	6
Micropterus salmoides	largemouth bass	--	--	4	--	--	--	1	--	--
Percidae - perches and darters										
Ammocrypta bifascia	Florida sand darter	--	--	--	--	22	7	--	--	--
Etheostoma colorosum	coastal darter	--	--	--	--	3	32	5	--	33
Etheostoma davisoni	Choctawhatchee darter	--	--	--	--	--	--	--	--	--
Etheostoma edwini	brown darter	--	--	--	--	--	--	--	--	--
Etheostoma fusiforme	swamp darter	--	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	2	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	--	--	--	--	14	--	--
Etheostoma stigmaeum	speckled darter	--	--	--	--	2	9	--	--	--
Etheostoma swaini	gulf darter	--	--	4	--	2	7	--	--	--
Percina austroperca	southern logperch	--	--	--	--	--	--	--	--	1
Percina nigrofasciata	blackbanded darter	14	--	--	3	16	23	2	--	98
Percina vigil	saddleback darter	--	--	--	--	--	--	--	--	--
Elassomatidae - pygmy sunfishes										
Elassoma zonatum	banded pygmy sunfish	--	1	12	--	--	--	--	--	1
Soleidae - soles										
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	--	--
	Species	8	17	20	16	20	23	12	12	29
	Individuals	36	83	126	131	383	731	302	30	594

	River system	Conecuh River			Blackwater/Yellow River						
	Site	SIMC-1	SSCE-1	TELC-1	BKRE-1	CLC-1	FVRC-2	HFCC-1	INC-1	PONC-1	PONC-2
	Date	19-Jun-08	20-May-08	16-Jun-08	18-Jun-08	21-May-08	18-Jun-08	18-Jun-08	18-Jun-08	21-May-08	18-Jun-08
Species name	Common name										
Petromyzontidae - lampreys											
Ichthyomyzon gagei	southern brook lamprey	--	--	--	--	--	--	--	--	--	--
Lepisosteidae - gars											
Lepisosteus oculatus	spotted gar	--	--	--	--	--	--	--	--	--	--
Anguillidae - eels											
Anguilla rostrata	American eel	--	--	--	--	--	--	--	--	--	--
Cyprinidae - minnows and carps											
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--	--	--
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--	--	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	32	--	61	--	4	36	14	24	--	--
Hybopsis sp cf winchelli	coastal clear chub	2	--	--	--	--	3	--	--	--	--
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--	--	--
Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--	--	--
Lythrurus atrapiculus	blacktip shiner	--	--	--	--	--	34	17	2	--	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--	--	--
Notemigonus crysoleucas	golden shiner	--	--	--	--	--	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	22	--	21	--	--	115	16	22	--	--
Notropis harperi	redeye chub	--	--	--	--	--	--	--	--	--	1
Notropis longirostris	longnose shiner	2	--	26	--	--	12	14	28	--	--
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	--	--	--	--	--
Notropis texanus	weed shiner	5	--	1	--	--	46	1	7	--	--
Opsopoeodus emiliae	pugnose minnow	--	--	--	--	--	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--	--	--
Pteronotropis hypselopterus	sailfin shiner	--	--	63	118	--	--	82	2	--	--
Pteronotropis merlini	orangetail shiner	--	--	--	--	--	--	--	--	--	--
Pteronotropis signipinnis	flagfin shiner	--	--	--	119	33	--	--	--	25	401
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--	--	--
Semotilus thoreauianus	Dixie chub	--	3	18	--	--	--	--	--	--	--

	River system	Conecuh River			Blackwater/Yellow River						
	Site	SIMC-1	SSCE-1	TELC-1	BKRE-1	CLC-1	FVRC-2	HFCC-1	INC-1	PONC-1	PONC-2
	Date	19-Jun-08	20-May-08	16-Jun-08	18-Jun-08	21-May-08	18-Jun-08	18-Jun-08	18-Jun-08	21-May-08	18-Jun-08
Species name	Common name										
Catostomidae - suckers											
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	--	--	--	--	--	--	--	--	1
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	--	1	--	--	--	--	--	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	--	--	--	1	1	2	1	--	--	--
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms											
Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--	--	--
Ameiurus natalis	yellow bullhead	2	--	--	--	3	--	--	--	3	1
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	--	--	--	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	--	--	--	--
Noturus funebris	black madtom	--	--	--	1	--	--	--	--	--	3
Noturus gyrinus	tadpole madtom	--	--	--	--	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	1	--	4	5	--	1	3	1	6	3
Esocidae - pickerels											
Esox americanus	redfin pickerel	4	--	1	1	--	3	8	3	--	4
Esox niger	chain pickerel	--	--	--	--	4	--	--	--	4	--
Aphredodreidae - pirate perch											
Aphredoderus sayanus	pirate perch	9	--	4	1	2	7	5	8	1	--
Atherinopsidae - new world silversides											
Labidesthes sicculus	brook silverside	--	--	--	3	--	1	--	--	--	--
Fundulidae - topminnows											
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	8	--	15	--	3	38	9	14	--	--
Poeciliidae - livebearers											
Gambusia holbrooki	eastern mosquitofish	4	--	4	--	--	--	--	--	--	--

	River system	Conecuh River			Blackwater/Yellow River						
	Site	SIMC-1	SSCE-1	TELC-1	BKRE-1	CLC-1	FVRC-2	HFCC-1	INC-1	PONC-1	PONC-2
	Date	19-Jun-08	20-May-08	16-Jun-08	18-Jun-08	21-May-08	18-Jun-08	18-Jun-08	18-Jun-08	21-May-08	18-Jun-08
Species name	Common name										
Centrarchidae - sunfishes											
Ambloplites ariommus	shadow bass	--	--	--	--	--	--	--	--	--	--
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	--	--	--	--	1	--	--	--	--
Lepomis cyanellus	green sunfish	--	--	1	--	1	--	--	8	--	--
Lepomis gulosus	warmouth	--	--	--	--	--	1	--	--	--	--
Lepomis macrochirus	bluegill	--	--	--	--	2	--	1	16	--	--
Lepomis marginatus	dollar sunfish	--	--	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	40	1	5	--	3	2	2	6	--	--
Lepomis microlophus	redear sunfish	--	--	--	--	--	--	--	--	--	--
Lepomis miniatus	redspotted sunfish	35	--	9	1	5	4	7	6	1	4
Micropterus punctulatus	spotted bass	9	--	--	1	1	4	--	2	--	--
Micropterus salmoides	largemouth bass	2	--	--	--	--	2	1	--	--	--
Percidae - perches and darters											
Ammocrypta bifascia	Florida sand darter	--	--	--	--	--	3	13	--	--	--
Etheostoma colorosum	coastal darter	21	--	7	--	--	5	7	6	--	--
Etheostoma davisoni	Choctawhatchee darter	--	--	--	--	--	--	--	--	--	--
Etheostoma edwini	brown darter	--	--	--	--	--	--	--	--	--	--
Etheostoma fusiforme	swamp darter	--	--	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	2	--	1	--	--	--	--	--	--	--
Etheostoma stigmaeum	speckled darter	--	--	--	--	--	--	--	1	--	--
Etheostoma swaini	gulf darter	4	--	--	--	--	1	--	--	--	--
Percina austroperca	southern logperch	--	--	--	--	--	--	--	--	--	--
Percina nigrofasciata	blackbanded darter	9	2	25	40	3	4	19	10	2	37
Percina vigil	saddleback darter	--	--	--	--	--	--	--	--	--	--
Elassomatidae - pygmy sunfishes											
Elassoma zonatum	banded pygmy sunfish	--	--	--	--	--	--	--	--	--	--
Soleidae - soles											
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	--	--	--
	Species	19	3	17	12	13	22	18	18	7	9
	Individuals	213	6	266	292	65	325	220	166	42	455

	River system	Choctawhatchee/Pea River							
	Site	BIGP-1A	BKCC-2	BMCP-2	BVC-2	CNRG-1	DBCC-8	DBCG-2	DNMH-1
	Date	29-May-08	11-Jun-08	9-Jun-08	28-May-08	17-Jun-08	11-Jun-08	12-Jun-08	12-Jun-08
Species name	Common name								
Petromyzontidae - lampreys									
Ichthyomyzon gagei	southern brook lamprey	--	--	--	--	--	--	--	--
Lepisosteidae - gars									
Lepisosteus oculatus	spotted gar	--	--	--	--	--	--	--	--
Anguillidae - eels									
Anguilla rostrata	American eel	--	--	--	--	--	--	--	--
Cyprinidae - minnows and carps									
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	5	20	43	--	53	24	13	108
Hybopsis sp cf winchelli	coastal clear chub	--	1	15	--	12	6	53	8
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--
Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--
Lythrurus atrapiculus	blacktip shiner	--	--	13	--	--	15	44	3
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--
Notemigonus crysoleucas	golden shiner	--	--	--	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	--	14	35	--	10	56	29	19
Notropis harperi	redeye chub	--	--	--	--	--	--	--	--
Notropis longirostris	longnose shiner	--	2	13	--	3	13	5	4
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	--	--	--
Notropis texanus	weed shiner	--	30	46	--	6	31	6	9
Opsopoeodus emiliae	pugnose minnow	--	--	--	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--
Pteronotropis hypselopterus	sailfin shiner	--	--	--	--	--	--	--	--
Pteronotropis merlini	orangetail shiner	--	24	--	--	16	8	--	40
Pteronotropis signipinnis	flagfin shiner	--	--	--	--	--	--	--	--
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--
Semotilus thoreauianus	Dixie chub	--	--	--	--	--	--	--	--

	River system	Choctawhatchee/Pea River							
	Site	BIGP-1A	BKCC-2	BMCP-2	BVC-2	CNRG-1	DBCC-8	DBCG-2	DNMH-1
	Date	29-May-08	11-Jun-08	9-Jun-08	28-May-08	17-Jun-08	11-Jun-08	12-Jun-08	12-Jun-08
Species name	Common name								
Catostomidae - suckers									
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	--	6	--	--	--	--	--
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	--	--	1	--	--	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	--	--	--	--	1	--	--	5
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms									
Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--
Ameiurus natalis	yellow bullhead	--	--	9	1	--	1	--	1
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	3	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	1	--
Noturus funebris	black madtom	--	--	--	--	--	--	--	--
Noturus gyrinus	tadpole madtom	--	--	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	--	8	2	2	8	6	5	14
Esocidae - pickerels									
Esox americanus	redfin pickerel	5	1	12	--	1	1	--	3
Esox niger	chain pickerel	4	--	--	2	--	--	--	--
Aphredodreidae - pirate perch									
Aphredoderus sayanus	pirate perch	6	2	4	19	1	1	1	6
Atherinopsidae - new world silversides									
Labidesthes sicculus	brook silverside	--	--	1	--	--	--	--	--
Fundulidae - topminnows									
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	2	3	17	1	2	2	--	6
Poeciliidae - livebearers									
Gambusia holbrooki	eastern mosquitofish	--	1	5	2	--	--	--	--

	River system	Choctawhatchee/Pea River							
	Site	BIGP-1A	BKCC-2	BMCP-2	BVC-2	CNRG-1	DBCC-8	DBCG-2	DNMH-1
	Date	29-May-08	11-Jun-08	9-Jun-08	28-May-08	17-Jun-08	11-Jun-08	12-Jun-08	12-Jun-08
Species name	Common name								
Centrarchidae - sunfishes									
Ambloplites ariommus	shadow bass	--	--	--	--	--	1	1	1
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	--	14	--	2	--	--	6
Lepomis cyanellus	green sunfish	2	--	4	10	3	--	--	5
Lepomis gulosus	warmouth	--	--	--	2	--	--	--	--
Lepomis macrochirus	bluegill	7	4	2	9	16	4	11	--
Lepomis marginatus	dollar sunfish	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	8	--	28	2	--	4	1	6
Lepomis microlophus	redear sunfish	--	--	--	--	--	--	--	--
Lepomis miniatus	redspotted sunfish	12	4	15	13	4	1	3	4
Micropterus punctulatus	spotted bass	1	--	--	1	--	--	3	3
Micropterus salmoides	largemouth bass	--	--	--	--	--	1	--	1
Percidae - perches and darters									
Ammocrypta bifascia	Florida sand darter	--	--	--	--	5	2	--	--
Etheostoma colorosum	coastal darter	--	--	--	--	1	--	--	9
Etheostoma davisoni	Choctawhatchee darter	--	--	2	--	--	--	--	2
Etheostoma edwini	brown darter	--	--	--	--	--	--	--	--
Etheostoma fusiforme	swamp darter	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	--	--	--	--	--	--
Etheostoma stigmaeum	speckled darter	--	--	--	--	--	--	--	--
Etheostoma swaini	gulf darter	--	--	3	--	--	2	1	4
Percina austroperca	southern logperch	--	--	--	--	1	--	--	--
Percina nigrofasciata	blackbanded darter	2	18	6	6	11	14	57	30
Percina vigil	saddleback darter	--	--	--	--	--	--	--	--
Elassomatidae - pygmy sunfishes									
Elassoma zonatum	banded pygmy sunfish	--	--	--	--	--	--	--	--
Soleidae - soles									
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	--
	Species	11	14	22	13	20	20	17	24
	Individuals	54	132	295	70	157	193	237	297

	River system	Choctawhatchee/Pea River								
	Site	EMCG-1	FTCG-4	HDC-1	HURG-2	JDYD-1	JDYD-2	LCHH-1	LCHH-4	PATC-1
	Date	17-Jun-08	17-Jun-08	22-May-08	10-Jun-08	29-May-08	29-May-08	13-Jun-08	28-May-08	22-May-08
Species name	Common name									
Petromyzontidae - lampreys										
Ichthyomyzon gagei	southern brook lamprey	--	--	--	--	--	--	--	--	--
Lepisosteidae - gars										
Lepisosteus oculatus	spotted gar	--	--	--	--	--	--	--	--	--
Anguillidae - eels										
Anguilla rostrata	American eel	--	--	--	1	--	--	2	--	--
Cyprinidae - minnows and carps										
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--	--
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	30	34	2	--	3	3	15	21	9
Hybopsis sp cf winchelli	coastal clear chub	2	46	--	--	--	--	1	--	--
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--	--
Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--	--
Lythrurus atrapiculus	blacktip shiner	--	--	--	--	--	--	10	--	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--	--
Notemigonus crysoleucas	golden shiner	--	--	2	--	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	1	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	3	13	11	--	--	4	1	--	1
Notropis harperi	redeye chub	1	--	--	--	--	--	--	--	--
Notropis longirostris	longnose shiner	5	26	--	--	--	--	--	--	--
Notropis maculatus	taillight shiner	--	--	--	1	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	--	--	--	--
Notropis texanus	weed shiner	6	24	--	25	--	--	7	--	--
Opsopoeodus emiliae	pugnose minnow	--	--	--	3	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--	--
Pteronotropis hypselopterus	sailfin shiner	--	--	--	--	--	--	--	--	--
Pteronotropis merlini	orangetail shiner	18	--	--	17	--	--	24	--	--
Pteronotropis signipinnis	flagfin shiner	--	--	--	--	--	--	--	--	--
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--	--
Semotilus thoreauianus	Dixie chub	--	--	3	--	--	--	--	--	--

	River system	Choctawhatchee/Pea River								
	Site	EMCG-1	FTCG-4	HDC-1	HURG-2	JDYD-1	JDYD-2	LCHH-1	LCHH-4	PATC-1
	Date	17-Jun-08	17-Jun-08	22-May-08	10-Jun-08	29-May-08	29-May-08	13-Jun-08	28-May-08	22-May-08
Species name	Common name									
Catostomidae - suckers										
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	--	--	--	--	--	--	--	--
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	--	--	--	--	--	--	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	1	--	1	--	--	--	--	--	1
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms										
Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--	--
Ameiurus natalis	yellow bullhead	--	--	--	--	--	--	--	--	1
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	--	--	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	--	--	--
Noturus funebris	black madtom	--	--	--	--	--	--	--	--	--
Noturus gyrinus	tadpole madtom	--	--	--	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	2	2	3	1	6	1	9	4	1
Esocidae - pickerels										
Esox americanus	redfin pickerel	2	1	--	3	--	--	1	--	--
Esox niger	chain pickerel	--	--	--	--	--	1	--	1	--
Aphredodreidae - pirate perch										
Aphredoderus sayanus	pirate perch	2	--	--	7	9	3	3	12	1
Atherinopsidae - new world silversides										
Labidesthes sicculus	brook silverside	--	14	--	7	--	--	--	--	--
Fundulidae - topminnows										
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	5	35	1	1	--	8	3	5	11
Poeciliidae - livebearers										
Gambusia holbrooki	eastern mosquitofish	--	--	2	1	--	--	3	--	1

	River system	Choctawhatchee/Pea River								
	Site	EMCG-1	FTCG-4	HDC-1	HURG-2	JDYD-1	JDYD-2	LCHH-1	LCHH-4	PATC-1
	Date	17-Jun-08	17-Jun-08	22-May-08	10-Jun-08	29-May-08	29-May-08	13-Jun-08	28-May-08	22-May-08
Species name	Common name									
Centrarchidae - sunfishes										
Ambloplites ariommus	shadow bass	1	1	--	--	--	--	--	--	--
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	3	--	--	--	--	6	--	--
Lepomis cyanellus	green sunfish	--	--	1	--	1	--	--	21	--
Lepomis gulosus	warmouth	--	1	--	--	--	--	--	5	4
Lepomis macrochirus	bluegill	--	1	1	--	3	1	--	4	37
Lepomis marginatus	dollar sunfish	--	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	--	15	--	7	8	3	2	1	8
Lepomis microlophus	redear sunfish	--	2	--	2	1	--	--	--	--
Lepomis miniatus	redspotted sunfish	4	7	--	4	--	1	8	6	5
Micropterus punctulatus	spotted bass	--	3	--	--	--	--	--	1	--
Micropterus salmoides	largemouth bass	--	2	--	--	--	--	1	--	3
Percidae - perches and darters										
Ammocrypta bifascia	Florida sand darter	4	9	--	--	--	--	--	--	--
Etheostoma colorosum	coastal darter	6	3	--	--	--	--	3	--	--
Etheostoma davisoni	Choctawhatchee darter	--	--	--	1	--	--	--	--	--
Etheostoma edwini	brown darter	2	--	--	3	--	--	3	--	--
Etheostoma fusiforme	swamp darter	--	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	--	--	--	--	--	--	--
Etheostoma stigmaeum	speckled darter	--	--	--	--	--	--	--	--	--
Etheostoma swaini	gulf darter	1	2	--	2	--	--	7	--	--
Percina austroperca	southern logperch	--	--	--	--	--	--	--	--	--
Percina nigrofasciata	blackbanded darter	9	11	26	8	5	2	23	13	8
Percina vigil	saddleback darter	--	--	--	--	--	--	--	--	--
Elassomatidae - pygmy sunfishes										
Elassoma zonatum	banded pygmy sunfish	--	--	--	--	--	--	--	--	--
Soleidae - soles										
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	--	--
	Species	19	22	12	18	8	10	20	12	14
	Individuals	104	255	54	94	36	27	132	94	91

	River system	Choctawhatchee/Pea River							
	Site	PRCH-1	SPRG-4	SSCD-1	TECG-2	UTHC-1	WCP-4	WRIG-2	WWCC-2
	Date	4-Jun-08	12-Jun-08	12-Jun-08	12-Jun-08	21-May-08	9-Jun-08	10-Jun-08	17-Jun-08
Species name	Common name								
Petromyzontidae - lampreys									
Ichthyomyzon gagei	southern brook lamprey	--	--	--	--	--	--	--	--
Lepisosteidae - gars									
Lepisosteus oculatus	spotted gar	1	1	--	--	--	--	--	--
Anguillidae - eels									
Anguilla rostrata	American eel	--	1	--	2	--	--	--	--
Cyprinidae - minnows and carps									
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	--	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	--	165	24	7	--	3	26	76
Hybopsis sp cf winchelli	coastal clear chub	--	3	1	--	--	--	--	2
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--
Luxilus zonistius	bandfin shiner	--	--	--	--	--	--	--	--
Lythrurus atrapiculus	blacktip shiner	--	1	39	6	--	53	--	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--
Notemigonus crysoleucas	golden shiner	--	--	--	--	--	6	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	--	2	19	5	--	--	2	2
Notropis harperi	redeye chub	--	1	--	--	--	--	--	--
Notropis longirostris	longnose shiner	--	9	205	3	--	--	14	3
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	--	--	--
Notropis texanus	weed shiner	--	31	16	10	--	29	19	6
Opsopoeodus emiliae	pugnose minnow	--	--	--	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	--	--	--	--
Pteronotropis hypselopterus	sailfin shiner	--	7	--	--	--	--	--	1
Pteronotropis merlini	orangetail shiner	--	--	171	--	--	--	110	--
Pteronotropis signipinnis	flagfin shiner	--	--	--	--	--	--	--	--
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--
Semotilus thoreauianus	Dixie chub	1	--	23	--	18	--	--	--

	River system	Choctawhatchee/Pea River							
	Site	PRCH-1	SPRG-4	SSCD-1	TECG-2	UTHC-1	WCP-4	WRIG-2	WWCC-2
	Date	4-Jun-08	12-Jun-08	12-Jun-08	12-Jun-08	21-May-08	9-Jun-08	10-Jun-08	17-Jun-08
Species name	Common name								
Catostomidae - suckers									
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	--	--	--	--	--	--	--
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	--	--	--	--	--	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	--	--	--	--	--	--	--	--
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms									
Ameiurus brunneus	snail bullhead	--	--	--	--	--	--	--	--
Ameiurus natalis	yellow bullhead	--	--	1	--	5	1	--	--
Ameiurus nebulosus	brown bullhead	--	--	--	--	1	--	--	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	--	--
Noturus funebris	black madtom	--	--	--	1	--	--	--	--
Noturus gyrinus	tadpole madtom	--	--	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	--	4	16	1	19	--	2	3
Esocidae - pickerels									
Esox americanus	redfin pickerel	--	1	2	--	--	23	1	4
Esox niger	chain pickerel	2	--	--	--	2	--	--	--
Aphredodreidae - pirate perch									
Aphredoderus sayanus	pirate perch	11	1	8	--	5	4	5	1
Atherinopsidae - new world silversides									
Labidesthes sicculus	brook silverside	--	--	--	--	--	--	--	2
Fundulidae - topminnows									
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	4	4	34	6	3	17	2	12
Poeciliidae - livebearers									
Gambusia holbrooki	eastern mosquitofish	--	--	4	--	28	22	3	--

	River system	Choctawhatchee/Pea River							
	Site	PRCH-1	SPRG-4	SSCD-1	TECG-2	UTHC-1	WCP-4	WRIG-2	WWCC-2
	Date	4-Jun-08	12-Jun-08	12-Jun-08	12-Jun-08	21-May-08	9-Jun-08	10-Jun-08	17-Jun-08
Species name	Common name								
Centrarchidae - sunfishes									
Ambloplites ariommus	shadow bass	--	1	--	--	--	--	--	--
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	--	--	1	--	--	1	--
Lepomis cyanellus	green sunfish	1	1	--	--	1	--	--	6
Lepomis gulosus	warmouth	--	1	--	--	--	4	--	--
Lepomis macrochirus	bluegill	3	5	--	4	--	17	10	23
Lepomis marginatus	dollar sunfish	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	6	1	45	1	--	9	5	47
Lepomis microlophus	redear sunfish	--	--	--	--	--	--	--	1
Lepomis miniatus	redspotted sunfish	1	--	28	9	1	16	1	9
Micropterus punctulatus	spotted bass	2	1	--	--	--	--	--	4
Micropterus salmoides	largemouth bass	--	--	--	--	--	3	--	--
Percidae - perches and darters									
Ammocrypta bifascia	Florida sand darter	--	8	--	--	--	--	1	--
Etheostoma colorosum	coastal darter	--	--	8	--	--	--	2	11
Etheostoma davisoni	Choctawhatchee darter	--	--	2	--	--	12	1	--
Etheostoma edwini	brown darter	--	--	2	--	1	--	2	--
Etheostoma fusiforme	swamp darter	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	4	--	--	--	--	--
Etheostoma stigmaeum	speckled darter	--	--	--	--	--	--	--	--
Etheostoma swaini	gulf darter	--	2	--	1	--	2	6	7
Percina austroperca	southern logperch	--	--	--	--	--	--	--	--
Percina nigrofasciata	blackbanded darter	--	19	19	9	--	2	17	50
Percina vigil	saddleback darter	--	--	--	--	--	--	--	--
Elassomatidae - pygmy sunfishes									
Elassoma zonatum	banded pygmy sunfish	--	--	--	--	--	--	--	--
Soleidae - soles									
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	--
	Species	10	23	21	15	11	17	20	20
	Individuals	32	270	671	66	84	223	230	270

	River system	Chattahoochee/Chipola River									
	Site	ABBH-6	BGC-1	BMCH-1	BRC-2	CH2U5-20	CHCB-1	HACL-1	HACL-2	HECR-1	HRCH-1
	Date	11-Jun-08	10-Jun-08	4-Jun-08	4-Jun-08	11-Jun-08	4-Jun-08	10-Jun-08	3-Jun-08	5-Jun-08	11-Jun-08
Species name	Common name										
Petromyzontidae - lampreys											
Ichthyomyzon gagei	southern brook lamprey	--	--	--	--	--	--	--	--	--	--
Lepisosteidae - gars											
Lepisosteus oculatus	spotted gar	--	--	--	--	--	--	--	--	--	--
Anguillidae - eels											
Anguilla rostrata	American eel	--	--	--	--	--	--	--	--	--	--
Cyprinidae - minnows and carps											
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--	--	--
Campostoma pauciradii	bluefin stoneroller	--	--	--	--	--	--	1	14	8	--
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	1	--	--	--	--
Cyprinella venusta	blacktail shiner	97	30	--	--	4	10	17	3	65	16
Hybopsis sp cf winchelli	coastal clear chub	--	--	--	1	--	16	--	34	67	--
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--	--	--
Luxilus zonistius	bandfin shiner	1	--	--	18	1	--	--	--	--	7
Lythrurus atrapiculus	blacktip shiner	--	--	--	4	--	--	--	--	86	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--	--	--
Notemigonus crysoleucas	golden shiner	--	--	--	--	--	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	--	2	18	11	1	20	--	--	121	22
Notropis harperi	redeye chub	--	61	--	--	--	--	--	--	--	--
Notropis longirostris	longnose shiner	11	--	--	214	--	129	--	--	58	10
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	--	--	--	--	--	--	--	--	--
Notropis texanus	weed shiner	7	155	--	2	35	106	--	8	39	4
Opsopoeodus emiliae	pugnose minnow	--	3	--	--	4	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	15	--	1	--	--	8	--
Pteronotropis grandipinnis	Apalachee shiner	--	--	--	--	51	--	--	--	--	6
Pteronotropis hypselopterus	sailfin shiner	--	--	--	--	--	--	--	--	--	--
Pteronotropis merlini	orangetail shiner	--	556	--	--	--	--	--	--	--	--
Pteronotropis signipinnis	flagfin shiner	--	--	--	--	--	--	--	--	--	--
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--	--	--
Semotilus thoreauianus	Dixie chub	--	--	98	14	1	--	--	--	--	1

	River system	Chattahoochee/Chipola River									
	Site	ABBH-6	BGC-1	BMCH-1	BRC-2	CH2U5-20	CHCB-1	HACL-1	HACL-2	HECR-1	HRCH-1
	Date	11-Jun-08	10-Jun-08	4-Jun-08	4-Jun-08	11-Jun-08	4-Jun-08	10-Jun-08	3-Jun-08	5-Jun-08	11-Jun-08
Species name	Common name										
Catostomidae - suckers											
Erimyzon oblongus	creek chubsucker	--	--	--	--	--	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	--	--	--	--	--	--	--	--	1
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	--	--	--	--	2	5	--	--
Minytrema melanops	spotted sucker	--	5	--	--	1	--	--	--	1	4
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	2	--	--	--
Moxostoma poecilurum	blacktail redhorse	--	--	--	--	--	--	--	--	--	--
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	11	--	--
Scartomyzon lachneri	greater jumprock	6	--	--	--	--	--	--	18	5	12
Ictaluridae - bullheads and madtoms											
Ameiurus brunneus	snail bullhead	19	--	--	--	--	5	--	15	11	4
Ameiurus natalis	yellow bullhead	6	--	--	1	--	--	4	--	9	3
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	--	--	--	--
Ameiurus serracanthus	spotted bullhead	--	--	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	5	--	--	--	--	1	--	--	--	--
Noturus funebris	black madtom	--	--	--	--	--	--	--	--	--	--
Noturus gyrinus	tadpole madtom	--	--	--	--	--	--	--	--	--	--
Noturus leptacanthus	speckled madtom	1	7	3	6	2	4	--	--	1	4
Esocidae - pickerels											
Esox americanus	redfin pickerel	1	7	--	2	--	--	--	--	--	2
Esox niger	chain pickerel	--	--	--	--	--	--	--	--	--	--
Aphredodreidae - pirate perch											
Aphredoderus sayanus	pirate perch	--	11	--	8	4	2	--	--	6	7
Atherinopsidae - new world silversides											
Labidesthes sicculus	brook silverside	--	--	--	--	1	--	--	2	--	--
Fundulidae - topminnows											
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	--	--	--	--	1	--	9	--	6	12
Poeciliidae - livebearers											
Gambusia holbrooki	eastern mosquitofish	--	--	--	--	4	--	1	--	1	--

	River system	Chattahoochee/Chipola River									
	Site	ABBH-6	BGC-1	BMCH-1	BRC-2	CH2U5-20	CHCB-1	HACL-1	HACL-2	HECR-1	HRCH-1
	Date	11-Jun-08	10-Jun-08	4-Jun-08	4-Jun-08	11-Jun-08	4-Jun-08	10-Jun-08	3-Jun-08	5-Jun-08	11-Jun-08
Species name	Common name										
Centrarchidae - sunfishes											
Ambloplites ariommus	shadow bass	--	--	--	--	--	--	--	--	--	--
Centrarchus macropterus	flier	--	--	--	--	--	--	--	--	--	--
Lepomis auritus	redbreast sunfish	13	4	2	2	10	20	--	87	62	28
Lepomis cyanellus	green sunfish	--	2	--	--	--	--	21	1	5	1
Lepomis gulosus	warmouth	--	--	--	--	2	--	4	1	2	--
Lepomis macrochirus	bluegill	3	--	--	5	--	24	22	32	15	8
Lepomis marginatus	dollar sunfish	--	--	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	1	--	--	--	--	--	4	3	52	--
Lepomis microlophus	redear sunfish	--	--	--	--	--	--	--	--	--	--
Lepomis miniatus	redspotted sunfish	4	9	--	2	5	--	--	--	--	11
Micropterus punctulatus	spotted bass	--	--	--	--	--	--	--	5	--	--
Micropterus salmoides	largemouth bass	--	--	--	--	--	7	--	1	1	4
Percidae - perches and darters											
Ammocrypta bifascia	Florida sand darter	--	--	--	--	--	--	--	--	--	--
Etheostoma colorosum	coastal darter	--	--	--	--	--	--	--	--	--	--
Etheostoma davisoni	Choctawhatchee darter	--	--	--	--	--	--	--	--	--	--
Etheostoma edwini	brown darter	--	3	--	--	1	--	--	--	--	2
Etheostoma fusiforme	swamp darter	--	--	--	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	--	--	--	--	--	--	--	--
Etheostoma stigmaeum	speckled darter	--	--	--	--	--	--	--	--	--	--
Etheostoma swaini	gulf darter	--	32	--	--	--	--	--	--	--	--
Percina austroperca	southern logperch	--	--	--	--	--	--	--	--	--	--
Percina nigrofasciata	blackbanded darter	70	25	--	14	23	21	5	8	6	36
Percina vigil	saddleback darter	--	--	--	--	--	--	--	--	--	--
Elassomatidae - pygmy sunfishes											
Elassoma zonatum	banded pygmy sunfish	--	--	--	--	--	--	--	--	--	--
Soleidae - soles											
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	--	--	--
	Species	15	16	4	16	18	15	12	17	23	23
	Individuals	245	912	121	319	151	367	92	248	635	205

	River system	Chattahoochee/Chipola River								
	Site	IHGR-1	IRMC-1	LUCR-1	MFCB-1	NFCAU01	PTRH-1	SFCB-1	UCCR-2	WACL-1
	Date	5-Jun-08	10-Jun-08	6-Jun-08	4-Jun-08	5-Jun-08	11-Jun-08	5-Jun-08	5-Jun-08	3-Jun-08
Species name	Common name									
Petromyzontidae - lampreys										
Ichthyomyzon gagei	southern brook lamprey	--	--	--	--	--	--	--	--	--
Lepisosteidae - gars										
Lepisosteus oculatus	spotted gar	--	--	--	--	--	--	--	--	--
Anguillidae - eels										
Anguilla rostrata	American eel	--	--	--	--	--	--	--	--	--
Cyprinidae - minnows and carps										
Campostoma oligolepis	largescale stoneroller	--	--	--	--	--	--	--	--	--
Campostoma pauciradii	bluefin stoneroller	49	--	2	6	--	--	28	--	21
Cyprinella callitaenia	bluestripe shiner	--	--	--	--	--	--	--	--	--
Cyprinella venusta	blacktail shiner	8	--	47	442	32	--	60	46	--
Hybopsis sp cf winchelli	coastal clear chub	--	--	88	19	17	--	--	1	1
Luxilus chrysocephalus	striped shiner	--	--	--	--	--	--	--	--	--
Luxilus zonistius	bandfin shiner	--	--	--	--	--	34	--	--	75
Lythrurus atrapiculus	blacktip shiner	--	--	--	1	6	--	--	--	--
Nocomis leptocephalus	bluehead chub	--	--	--	--	--	--	--	--	5
Notemigonus crysoleucas	golden shiner	--	--	--	1	--	--	--	--	--
Notropis baileyi	rough shiner	--	--	--	--	--	--	--	--	--
Notropis amplamala	longjaw minnow	--	--	1	27	38	--	27	--	21
Notropis harperi	redeye chub	--	141	--	--	--	--	--	--	--
Notropis longirostris	longnose shiner	--	--	11	390	22	22	--	7	144
Notropis maculatus	taillight shiner	--	--	--	--	--	--	--	--	--
Notropis petersoni	coastal shiner	--	7	--	--	--	--	--	--	--
Notropis texanus	weed shiner	--	6	59	86	22	--	14	5	--
Opsopoeodus emiliae	pugnose minnow	--	--	--	--	--	--	--	--	--
Pteronotropis euryzonus	broadstripe shiner	--	--	--	--	--	--	--	--	--
Pteronotropis grandipinnis	Apalachee shiner	--	66	--	--	--	2	--	--	--
Pteronotropis hypselopterus	sailfin shiner	--	--	--	--	--	--	--	--	--
Pteronotropis merlini	orangetail shiner	--	--	--	--	--	--	--	--	--
Pteronotropis signipinnis	flagfin shiner	--	--	--	--	--	--	--	--	--
Semotilus atromaculatus	creek chub	--	--	--	--	--	--	--	--	9
Semotilus thoreauianus	Dixie chub	4	--	--	--	--	89	--	--	15

	River system	Chattahoochee/Chipola River								
	Site	IHGR-1	IRMC-1	LUCR-1	MFCB-1	NFCAU01	PTRH-1	SFCB-1	UCCR-2	WACL-1
	Date	5-Jun-08	10-Jun-08	6-Jun-08	4-Jun-08	5-Jun-08	11-Jun-08	5-Jun-08	5-Jun-08	3-Jun-08
Species name	Common name									
Catostomidae - suckers										
Erimyzon oblongus	creek chubsucker	--	--	--	1	--	--	--	--	--
Erimyzon sucetta	lake chubsucker	--	1	--	--	--	--	--	--	--
Erimyzon tenuis	sharpfin chubsucker	--	--	--	--	--	--	--	--	--
Hypentelium etowanum	Alabama hog sucker	--	--	5	--	--	--	--	--	--
Minytrema melanops	spotted sucker	--	--	1	--	--	--	--	1	--
Moxostoma erythrurum	golden redhorse	--	--	--	--	--	--	--	--	--
Moxostoma poecilurum	blacktail redhorse	--	--	--	--	--	--	--	--	--
Moxostoma sp cf poecilurum	Apalachicola redhorse	--	--	--	--	--	--	--	--	--
Scartomyzon lachneri	greater jumprock	--	--	3	--	--	--	--	--	--
Ictaluridae - bullheads and madtoms										
Ameiurus brunneus	snail bullhead	--	--	--	--	14	--	--	--	5
Ameiurus natalis	yellow bullhead	4	1	1	4	6	1	3	2	--
Ameiurus nebulosus	brown bullhead	--	--	--	--	--	--	--	--	--
Ameiurus serracanthus	spotted bullhead	10	--	--	--	--	--	--	--	--
Ictalurus punctatus	channel catfish	--	--	--	--	--	--	--	--	--
Noturus funebris	black madtom	--	--	--	--	--	--	--	--	--
Noturus gyrinus	tadpole madtom	--	1	--	--	12	--	--	--	--
Noturus leptacanthus	speckled madtom	21	--	1	2	4	3	30	--	--
Esocidae - pickerels										
Esox americanus	redfin pickerel	--	9	--	1	--	1	--	--	--
Esox niger	chain pickerel	--	10	12	--	--	--	--	29	--
Aphredodreidae - pirate perch										
Aphredoderus sayanus	pirate perch	1	98	1	--	4	5	1	7	--
Atherinopsidae - new world silversides										
Labidesthes sicculus	brook silverside	--	35	1	--	1	--	--	9	--
Fundulidae - topminnows										
Fundulus escambiae	russetfin topminnow	--	--	--	--	--	--	--	--	--
Fundulus olivaceus	blackspotted topminnow	9	--	10	1	17	--	--	35	--
Poeciliidae - livebearers										
Gambusia holbrooki	eastern mosquitofish	--	37	--	2	2	--	7	14	6

	River system	Chattahoochee/Chipola River								
	Site	IHGR-1	IRMC-1	LUCR-1	MFCB-1	NFCAU01	PTRH-1	SFCB-1	UCCR-2	WACL-1
	Date	5-Jun-08	10-Jun-08	6-Jun-08	4-Jun-08	5-Jun-08	11-Jun-08	5-Jun-08	5-Jun-08	3-Jun-08
Species name	Common name									
Centrarchidae - sunfishes										
Ambloplites ariommus	shadow bass	--	--	--	--	--	--	--	--	--
Centrarchus macropterus	flier	--	--	--	1	--	--	--	--	--
Lepomis auritus	redbreast sunfish	--	5	22	80	75	--	3	67	8
Lepomis cyanellus	green sunfish	1	--	--	--	--	--	33	1	3
Lepomis gulosus	warmouth	--	--	1	--	1	--	--	--	--
Lepomis macrochirus	bluegill	5	10	3	1	84	--	28	7	--
Lepomis marginatus	dollar sunfish	--	--	--	--	--	--	--	--	--
Lepomis megalotis	longear sunfish	2	1	50	32	62	--	--	88	--
Lepomis microlophus	redear sunfish	1	1	--	--	--	--	--	--	--
Lepomis miniatus	redspotted sunfish	--	7	1	--	3	--	--	18	--
Micropterus punctulatus	spotted bass	--	--	1	1	--	--	--	2	--
Micropterus salmoides	largemouth bass	--	1	2	3	--	--	--	--	--
Percidae - perches and darters										
Ammocrypta bifascia	Florida sand darter	--	--	--	--	--	--	--	--	--
Etheostoma colorosum	coastal darter	--	--	--	--	--	--	--	--	--
Etheostoma davisoni	Choctawhatchee darter	--	--	--	--	--	--	--	--	--
Etheostoma edwini	brown darter	--	7	--	--	2	--	--	--	--
Etheostoma fusiforme	swamp darter	--	45	--	--	--	--	--	--	--
Etheostoma histrio	harlequin darter	--	--	--	--	--	--	--	--	--
Etheostoma parvipinne	goldstripe darter	--	--	--	--	2	--	--	--	--
Etheostoma stigmaeum	speckled darter	--	--	--	--	--	--	--	--	--
Etheostoma swaini	gulf darter	--	--	11	--	--	--	--	15	--
Percina austroperca	southern logperch	--	--	--	--	--	--	--	--	--
Percina nigrofasciata	blackbanded darter	16	1	50	38	18	5	7	30	11
Percina vigil	saddleback darter	--	--	--	--	--	--	--	--	--
Elassomatidae - pygmy sunfishes										
Elassoma zonatum	banded pygmy sunfish	--	70	--	--	--	--	--	--	--
Soleidae - soles										
Trinectes maculatus	hogchoker	--	--	--	--	--	--	--	--	--
	Species	13	22	24	21	22	9	12	19	13
	Individuals	131	560	384	1139	444	162	241	384	324

GEOLOGICAL SURVEY OF ALABAMA
P.O. Box 869999
420 Hackberry Lane
Tuscaloosa, Alabama 35486-6999
205/349-2852

Berry H. (Nick) Tew, Jr., State Geologist

A list of the printed publications by the Geological Survey of Alabama can be obtained from the Publications Sales Office (205/247-3636) or through our web site at http://www.gsa.state.al.us/.

E-mail: pubsales@gsa.state.al.us

Serving Alabama since 1848

Project 3

Protocol for Fish Data Collection to Develop a
Tailwater Fish Index on the Coosa River, Alabama

developed by
Michael J. Maceina and Ryan W. Hunter
Department of Fisheries
Auburn University, Alabama 36849

October 2009

Background:

Fish are useful biological indicators of water quality conditions because fish are relatively long-lived aquatic animals and reflect physical and chemical conditions in rivers where they reside. Over the past century, rivers throughout the southeastern United States including Alabama have been impounded to provide flood control, navigation, power generation, water supply, and recreational opportunities. However, erratic releases from dams at times can result in poor water quality including low dissolved oxygen that can negatively impact downstream fish communities.

On the Coosa River, below Lay and Logan Martin Dams, future alterations to releases below these two dams are anticipated in an attempt in part to improve the fish community. In order to determine if these flow modifications will improve fish populations, base line data is necessary to document current conditions prior to implementation of these improved discharges.

Objectives:

The objectives of this project are to collect fish and create spreadsheets of these data to provide Alabama Department of Wildlife and Freshwater Fisheries (ADWFF) data in the development of a Tailwater Fish Index (TFI) that will assess fish communities prior to and after implementation of improved discharges from these two Coosa River impoundments.

Study sites:

Below Logan Martin dam, sampling took place in five equidistance zones (about 3 km apart) from the tailrace to the US Highway 280 bridge. Below the dam at Lay Lake, sampling occurred from the tailrace to another zone abut 4 km downstream from the dam. Detailed maps of each tailrace and site were made to assist in replication of transects used for collecting fish (see attached maps). Hand held global positioning system (GPS) units were used to locate transects using waypoint coordinates (listed in decimal degrees). In addition, digital ortho quarter quadrant (DOQQ) aerial photographs were used to allow landmarks to be used to locate transects.

Schedule:

Sample 1- May-July 2008: Exploratory sampling was done to determine what gears would be most effective and best meet objectives and constraints of the project.

Sample 2 - August-September 2008

Sample 3 - October 2008

Sample 4 - March-April 2009

Sample 5 - May 2009

Sample 6 - August 2009

Fish collection and processing protocol for three sampling types:

Shoreline fish community collections

Standard electrofishing transects consisted of 600 seconds of 1000 V direct current electrofishing using a 7.5 GPP Smith Root electrofishing boat during daylight hours. Four replicate 10-minute (or 600 seconds) electrofishing transects along the shoreline were conducted in each zone, below each tailrace. Thus, 20 electrofishing transects were conducted below Logan Martin dam and 8 electrofishing transects were conducted below Lay Lake dam. Anodes were attached to two fixed booms extending 2 m from the bow of the boat. The voltage range was adjusted until output was about 6 amps. Fish were dipped from the water using one dipper only and were placed in a 150 L live-well until the 600 second transect was completed. Electrofishing

transects were conducted with the flow (upstream to downstream) of the river if there was flow. At transects located at Zone 1 just below each tail race, no attempts were made to sample when 2 or more turbines were generating below Logan Martin Dam (> 20,000 cubic feet per second) or 4 or more turbines below Lay Dam (> 20,000 cubic feet per second). At Zones 2 to 5 on the Coosa River below Logan Martin Dam and Zone 2 below Lay Dam, sampling at times did occur when discharges were greater than 20,000 cubic feet per second as the impact of high discharges were dampened as the distance below the dams increased. However, at times, discharge was nil when sampling occurred below these two tail races. Specific discharges during sampling times can be found in an Excel data base (Logan Lay discharge May 2008 to Aug 2009). Finally, in an attempt to reduce holding and handling stress, some species were dipped counted and returned to the water without being placed in the live-well.

After each transect, all sport fish (Centrarchidae, Ictaluridae, Morinidae; see sportfish list) were identified to species, measured (total length) to the nearest mm, weighed to the nearest g, and released alive. Fish greater than 6 kg were weighed to the nearest 10 g. All non-game fish (see non-game species list) were identified to species, counted, and released. At times, threadfin shad were extremely abundant (>1,000 per transect) and visual estimates of total numbers of these fish were recorded. Thus, caution should be used when including threadfin shad abundance data to developed the TFI with the data we collected.

Some larger non-game fish were counted without being brought into the boat. When this counting technique was used, larger non game fish such as freshwater drum, gar, carp and gizzard shad, were captured in the net by the dipper who then called out the number and species to another crew member. This information was then recorded on the transect data sheet. All non-game fish that could not be easily and immediately identified by the dipper were placed in the live-well for processing. This technique was used to reduce the biomass being placed in the live-well to minimize fish stress, handling, and processing time.

Catfish electrofishing transects:

In an attempt to collect blue catfish, channel catfish, and flathead catfish, mid-river electrofishing was conducted in each zone and below each tailrace. In each zone, three replicated

collection efforts were made (one additional collection station was included below Logan Martin Dam) that consisted of no less than 300 seconds of 1000 V direct current electrofishing using a 7.5 GPP Smith Root electofisher set on 15 pps (about 2.5 amps of output). Thus, collections were made at 16 and 6 stations below Logan Martin and Lay dams, respectively. Anodes were attached to two fixed booms extending 2 m from the bow of the boat. At each station, the electrofishing boat remained stationary and shocked until catfish began appearing on the surface of the water, and continued until no fish remained at the surface. Thus, electrofishing effort at times exceeded 300 seconds and this time was recorded for each station. In addition to the electrofishing boat, a chase boat was also used to dip fish from the water. Criteria for catfish sampling during low and high flows followed the same protocol as shoreline electrofishing. Only one dipper per boat was used. Once fish were dipped, they were placed in a 150 L live-well until the completion of the station. Each catfish collected was identified, weighed to the nearest g (to 10 g for fish > 6 kg), measured (TL) to the nearest mm, and released alive.

Prod Pole and backpack electrofishing

In order to collect primarily small fish (< 125 mm) that inhabit extremely shallow water (< 1 m) normally not accessible to boat electrofishing, prod plole and backpack electrofishing were utilized below both tailraces. Backpack electrofishing transects (3 in the Lay Lake tailrace and 5 in Logan Martin tail race) were done in Zone 1 of each tail race to sample shallow areas just below the dams. Transects consisted of 600 seconds of 450V DC electrofishing with a Smith Root LR-24 backpack electrofisher outfitted with a prod-pole (anode) and whip-tail (cathode). Collected fish were held in a bucket until the end of the transect and were then identified, counted, and released alive. Backpack electrofishing was conducted in Zone 1 when discharge was 0 cubic feet per second below Lay Dam and about 760 cubic feet per second (leakage) below Logan Martin Dam.

Three prod-pole electrofishing transects each were conducted in each zone (including Site 1). Prod-pole electrofishing consisted of 300 seconds of 1000V DC electrofishing using a 7.5 GPP Smith Root electrofishing boat. The anode consisted of a 254 mm diameter aluminum ring, covered in mesh netting, attached to a 3 m fiberglass pole. The pole attached to the anode was

held by one person near the bow of the boat while a second person used a net to bring the stunned fish into the boat. To collect fish, the anode was placed in the water and moved slowly along the shoreline and around rocks and woody debris. Criteria for prod-pole sampling during low and high flows followed the same protocol as shoreline electrofishing. Collected fish were held in a live-well until end the of the transect and were then identified, counted, and released alive.

Oxygen and temperature:

Dissolved oxygen (mg/L) and temperature (°C) profiles were taken at each zone using a YSI 55 dissolved oxygen meter over the six sampling periods. Temperature and dissolved oxygen were recorded at 1 m increments from the surface to the bottom. These data supplement any water quality data collected by other agencies and Auburn University data were provided to ADWFF in an excel spreadsheet.

Discharge:

Discharge data from each dam were provided to ADWFF. Hourly discharge data that included turbine, spill, leakage, and total discharge were obtained from 1 May 2008 to 31 August 2009.

Data:

All data was converted from hard data sheets to digital form in Microsoft Excel spreadsheet software. The Excel database includes 6 spreadsheets titled:

Standard Trans-Sport: includes the length-weight data for all sportfish captured during standard boat electrofishing transects. Sportfish are listed by codes (see species code list).

Standard Trans-Species: includes species and abundance of all fish captured during standard boat electrofishing, including counts of sportfish, Species listed by common names.

Prod-Pole-Species: includes species and abundances of all fish captured during prod-pole and back pack electrofishing transects. Species listed by common names.

Low Pulse EF-Catfish: Includes data collected from low-pules catfish electrofishing

transects. Sport fish codes used to identify species (see sportfish codes).

DO: includes data from dissolved oxygen and temperature profiles taken at each site during each sample.

In addition, another Microsoft Excel spreadsheet was provided for this project that contained average hourly discharges from May 1, 2008 to August 31, 2009.

Logan Lay discharge May 2008 to Aug 2009: includes two files (Logan, Lay) for discharges from each tail race.

Potential fish species that may be collected.

Non-Game Species

Amiidae

Amia calva- bowfin

Atherinopsidae

Labidesthes sicculus- brook silverside

Catostomidae

Carpiodes velifer- highfin carpsucker

Cycleptus meridionalis- southern blue sucker

Erimyzon oblongus- creek chubsucker

Erimyzon sucetta- lake chubsucker

Hypentelium etowanum- Alabama hog sucker

Ictiobus bubalus- smallmouth buffalo

Minytrema melanops- spotted sucker

Moxostoma carinatum- river redhorse

Moxostoma duquesnei- black redhorse

Moxostoma erythrurum- golden redhorse

Moxostoma poecilurum- blacktail redhorse

Cottidae

Cottus carolinae- banded sculpin

Clupeidae

Alosa chrysochloris- skipjack herring

Dorosoma cepedianum- gizzard shad

Dorosoma petenense- threadfin shad

Cyprinidae

Campostoma oligolepis- largescale stoneroller

Ctenopharyngodon idella- grass carp

Cyprinella callistia- Alabama shiner

Cyprinella trichroistia- tricolor shiner

Fundulidae

Fundulus olivaceus- blackspotted topminnow

Fundulus stellifer- southern studfish

Hiodontidae

Hiodon tergisus- mooneye

Ictaluridae

Ameiurus melas- black bullhead

Ameiurus natalis- yellow bullhead

Ameiurus nebulosus- brown bullhead

Noturus funebris- black madtom

Noturus leptacanthus- speckled madtom

Lepisosteidae

Lepisosteus oculatus- spotted gar

Lepisosteus osseus- longnose gar

Percidae

Etheostoma artesiae- redspot darter

Etheostoma coosae- Coosa darter

Etheostoma histrio- harequin darter

Etheostoma jordani- greenbreast darter

Etheostoma stigmaeum- speckled darter

Etheostoma swaini- gulf darter

Percina kathae- Mobile logperch

Percina lenticula- freckled darter

Percina nigrofasciata- blackbanded darter

Percina palmaris- bronze darter

Percina shumardi- river darter

Potential fish species that may be collected.

Non-Game Species

Cyprinidae (cont.)

Cyprinella venusta- blacktail shiner

Cyprinus carpio- common carp

Hybopsis winchelli- clear chub

Luxilus chrysocephalus- striped shiner

Lythrurus bellus- pretty shiner

Lythrurus lirus- mountain shiner

Macrhybopsis storeriana- silver chub

Nocomis leptocephalus- bluehead chub

Notemigonus crysoleucas- golden shiner

Notropis asperifrons- burrhead shiner

Notropis atherinoides- emerald shiner

Notropis amplamala- longjaw minnow

Notropis chrosomus- rainbow shiner

Notropis stilbius- silverstripe shiner

Notropis texanus- weed shiner

Notropis xaenocephalus- Coosa shiner

Pimephales vigilax- bullhead minnow

Semotilus atromaculatus- creek chub

Petromyzontidae

Ichthyomyzon castaneus- chestnut lamprey

Ichthyomyzon gagei- southern brook lamprey

Lampetra aepyptera- least brook lamprey

Poeciliidae

Gambusia affinis- western mosquitofish

Polyodontidae

Polyodon spathula- paddlefish

Sciaenidae

Aplodinotus grunniens- freshwater drum

Potential fish species that may be collected.

Sport Fish

Centrachidae

Ambloplites ariommus- shadow bass

Lepomis auritus- redbreast sunfish

Lepomis cyanellus- green sunfish

Lepomis gulosus- warmouth

Lepomis humilis- orangespotted sunfish

Lepomis macrochirus- bluegill

Lepomis megalotis- longear sunfish

Lepomis microlophus- redear sunfish

Micropterus punctulatus- spotted bass

Micropterus coosae- redeye bass

Pomoxis annularis- white crappie

Pomoxis nigromaculatus- black crappie

Esocidae

Esox americanus- redfin pickerel

Esox niger- chain pickerel

Ictaluridae

Ictalurus furcatus- blue catfish

Ictalurus punctatus- channel catfish

Pylodictis olivaris- flathead catfish

Moronidae

Morone chrysops- white bass

Morone mississippiensis- yellow bass

Morone saxatilis- striped bass

Micropterus salmoides- largemouth bass

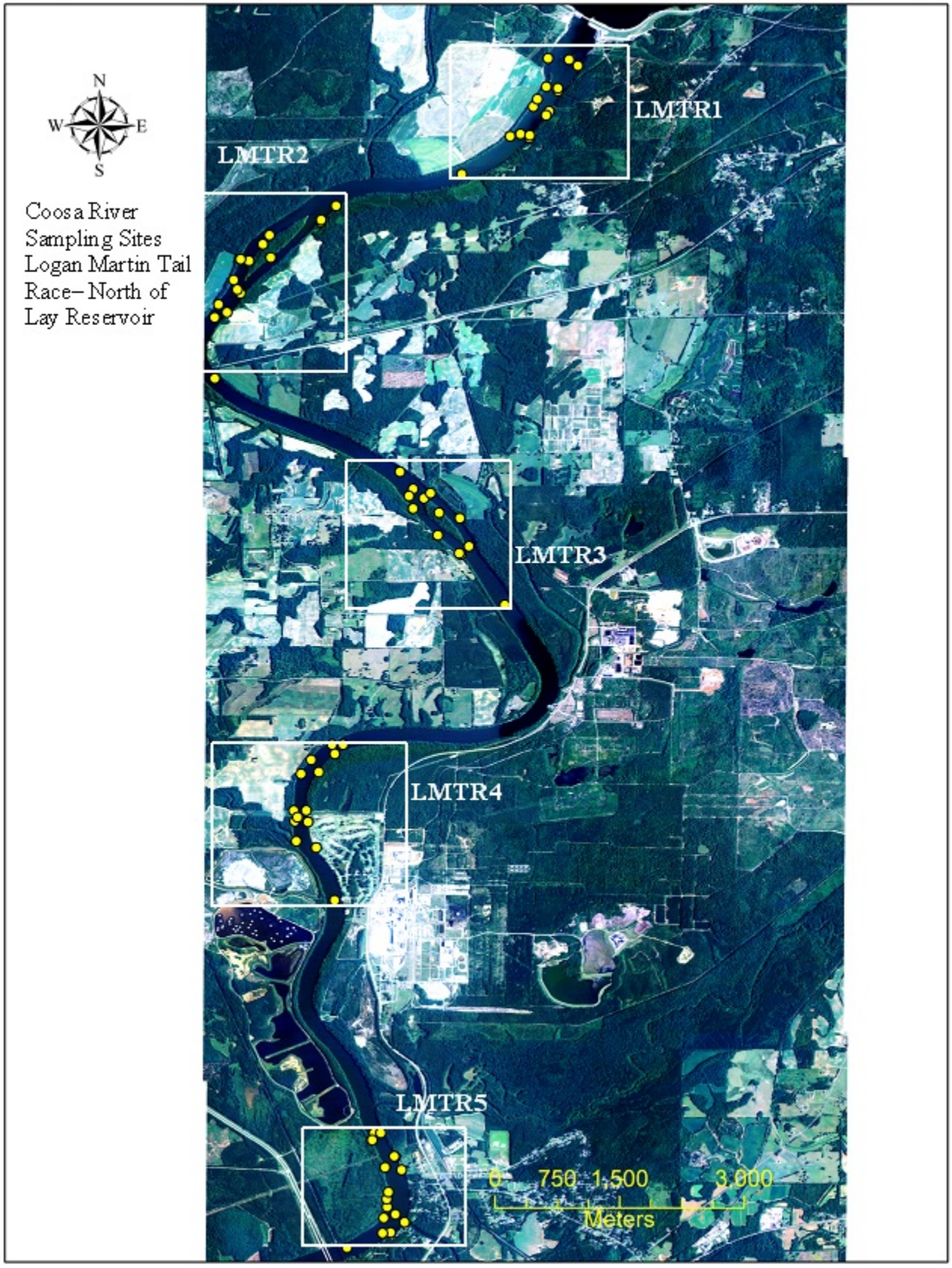
Morone saxatilis x M. chrysops - hybrid striped bass

Percidae

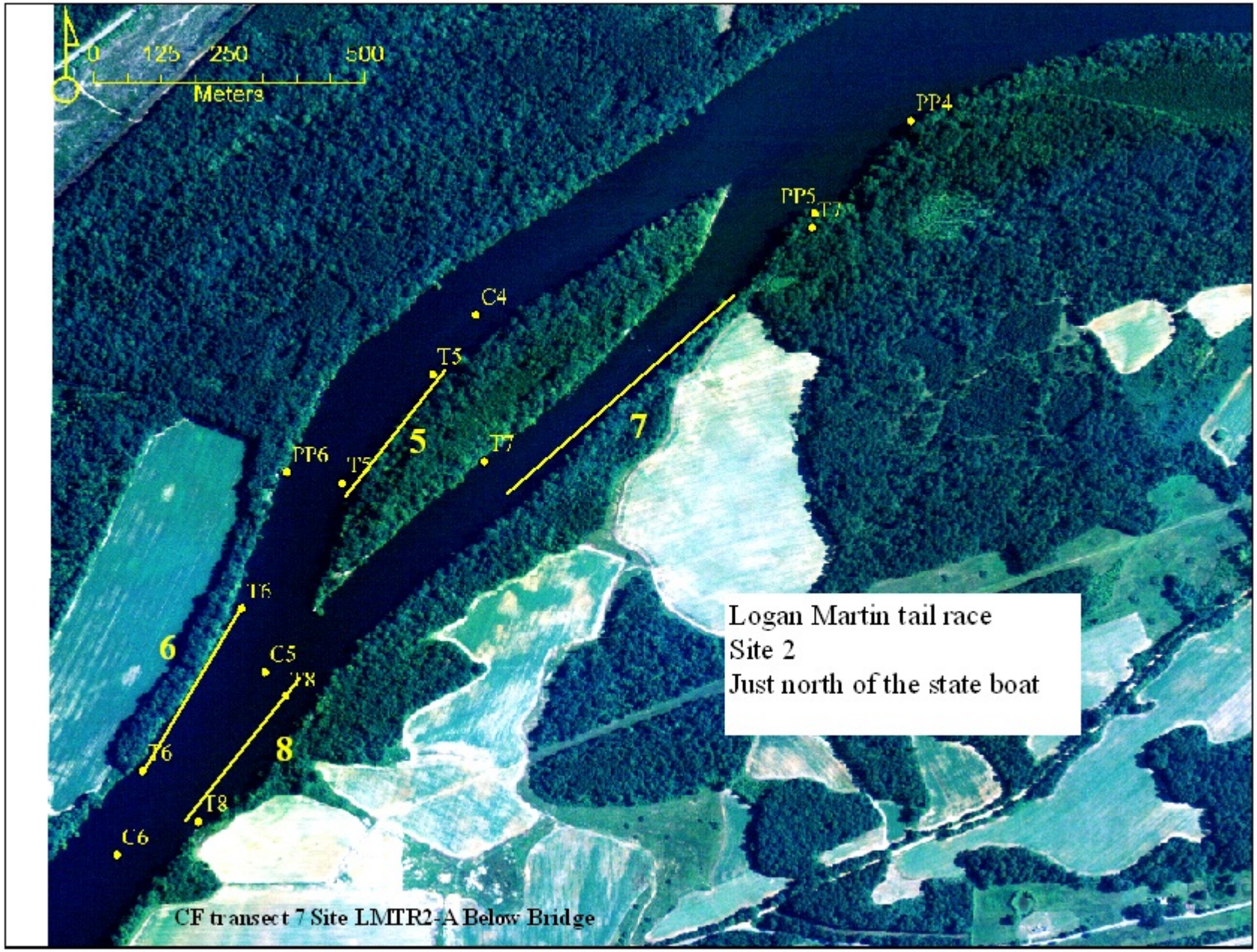
Sander vitreus- walleye

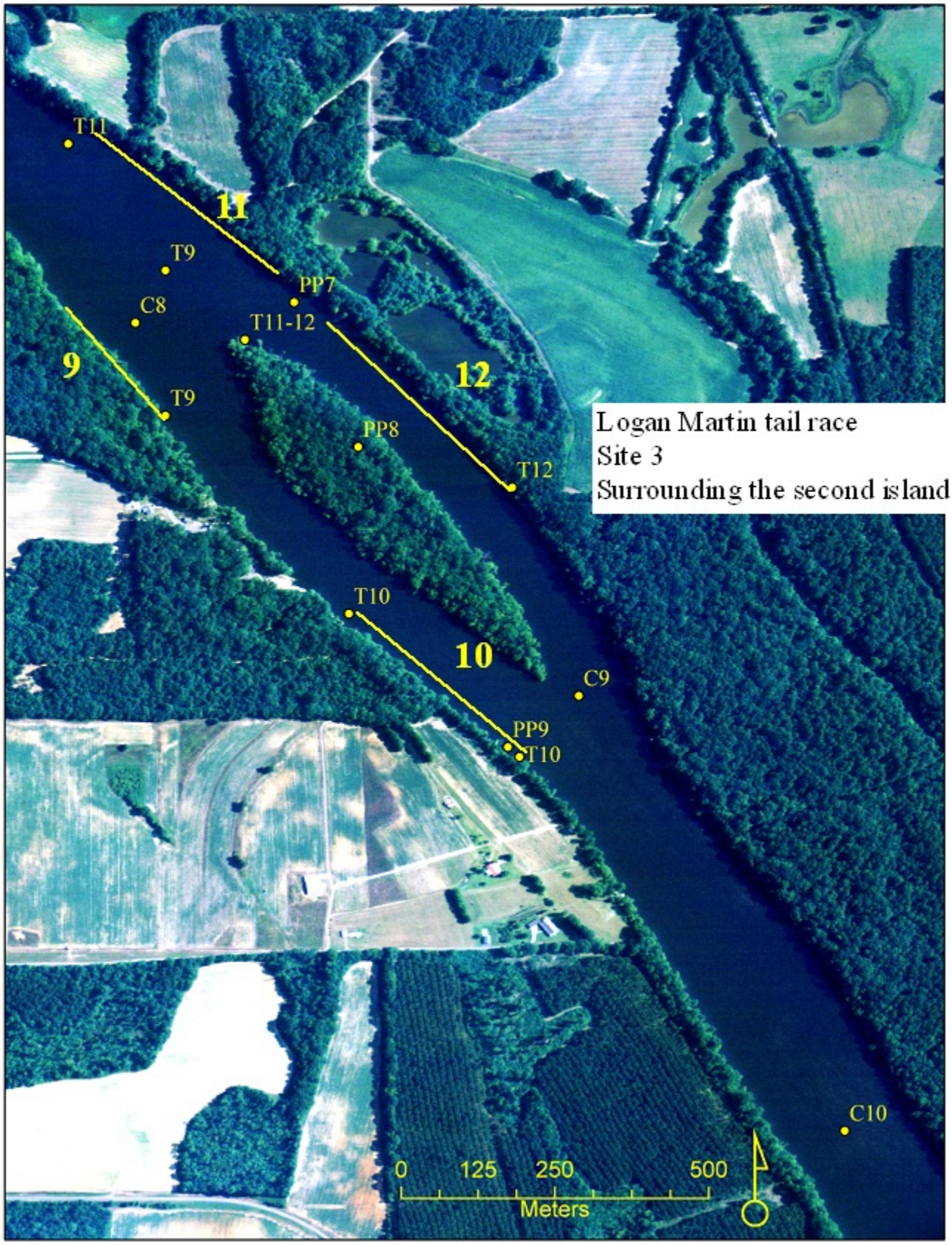
Sportfish Codes

Centrachidae	
Ambloplites ariommus- shadow bass	**SDB**
Lepomis auritus- redbreast sunfish	**RB**
Lepomis cyanellus- green sunfish	**GSF**
Lepomis gulosus- warmouth	**WAR**
Lepomis humilis- orangespotted sunfish	**OSF**
Lepomis macrochirus- bluegill	**BG**
Lepomis megalotis- longear sunfish	**LE**
Lepomis microlophus- redear sunfish	**RE**
Micropterus coosae- redeye bass	**REB**
Micropterus punctulatus- spotted bass	**SPB**
Micropterus salmoides- largemouth bass	**LMB**
Pomoxis annularis- white crappie	**WCP**
Pomoxis nigromaculatus- black crappie	**BCP**
Esocidae	
Esox americanus- redfin pickerel	**RPK**
Esox niger- chain pickerel	**CPK**
Ictaluridae	
Ameiurus melas- black bullhead	**BKB**
Ameiurus natalis- yellow bullhead	**YBH**
Ameiurus nebulosus- brown bullhead	**BBH**
Ictalurus furcatus- blue catfish	**BCF**
Ictalurus punctatus- channel catfish	**CCF**
Noturus funebris- black madtom	**BMT**
Noturus leptacanthus- speckled madtom	**SMT**
Pylodictis olivaris- flathead catfish	**FHC**
Moronidae	
Morone chrysops- white bass	**WHB**
Morone mississippiensis- yellow bass	**YWB**
Morone saxatilis- striped bass	**STB**
Morone saxatilis x M. chrysops - hybrid striped bass	**HSB**
Percidae	
Sander vitreus- walleye	**WAL**
Polyodontidae	
Polyodon spathula- paddlefish	**PAD**

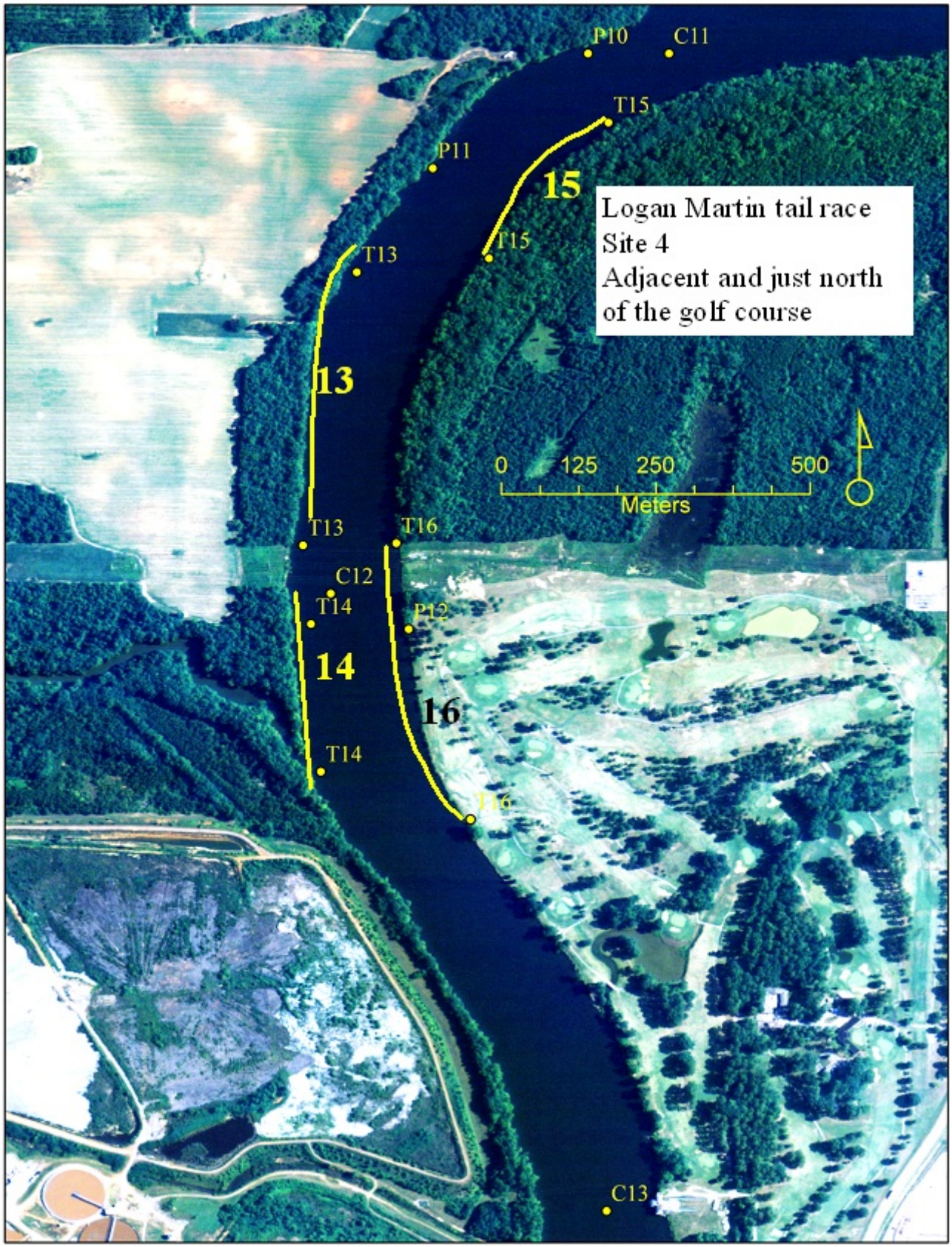

N
W
E
S
Coosa River
Sampling Sites
Logan Martin Tail
Race– North of
Lay Reservoir
LMTR1
LMTR2
LMTR3
LMTR4
LMTR5
0 750 1,500 3,000
Meters

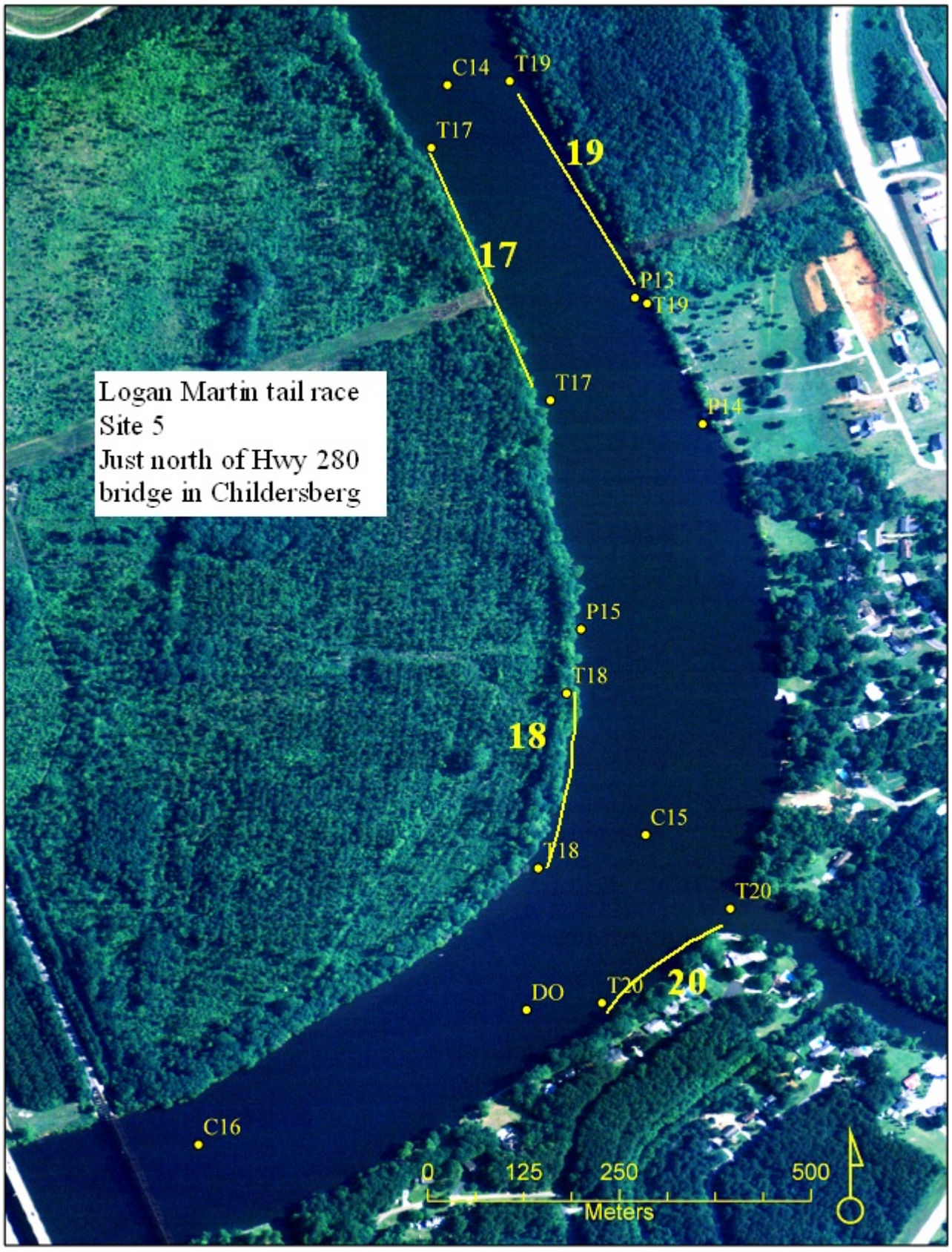

Logan Martin tail race
Site 1
Just below Logan Martin Dam
WATCH OUT FOR ROCKS
AND STUMPS!!!!!!
T1
BP
T3
1
3
T1
C1
T3
PP1
T2
T4
PP2
2
4
T2
C2
PP3
T4
C3
0
125
250
500
Meters

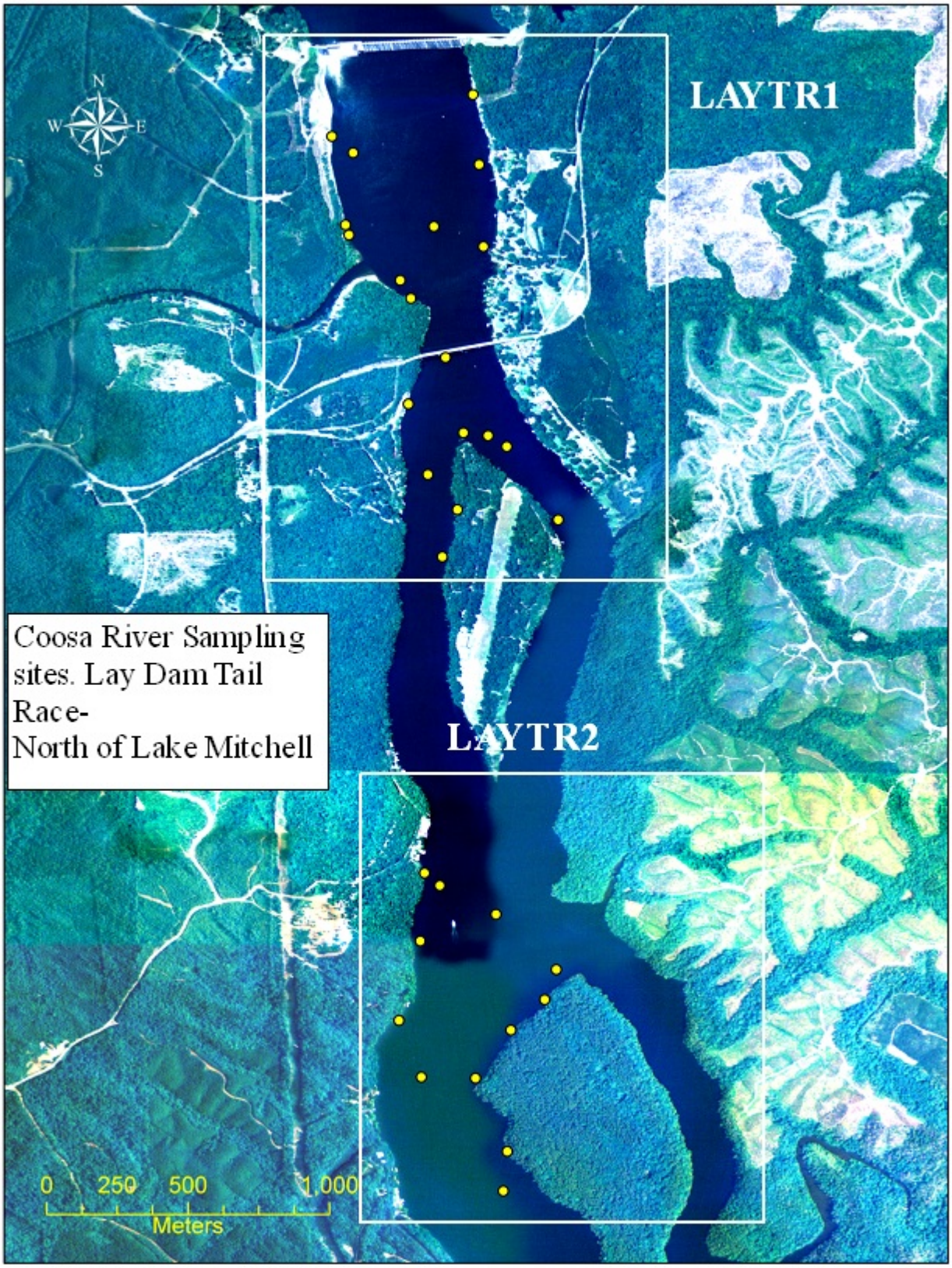

0 125 250 500
Meters
PP4
PP5
T7
C4
T5
5
7
PP6
T5
T7
T6
6
C5
T8
8
T6
T8
C6
Logan Martin tail race
Site 2
Just north of the state boat
CF transect 7 Site LMTR2-A Below Bridge



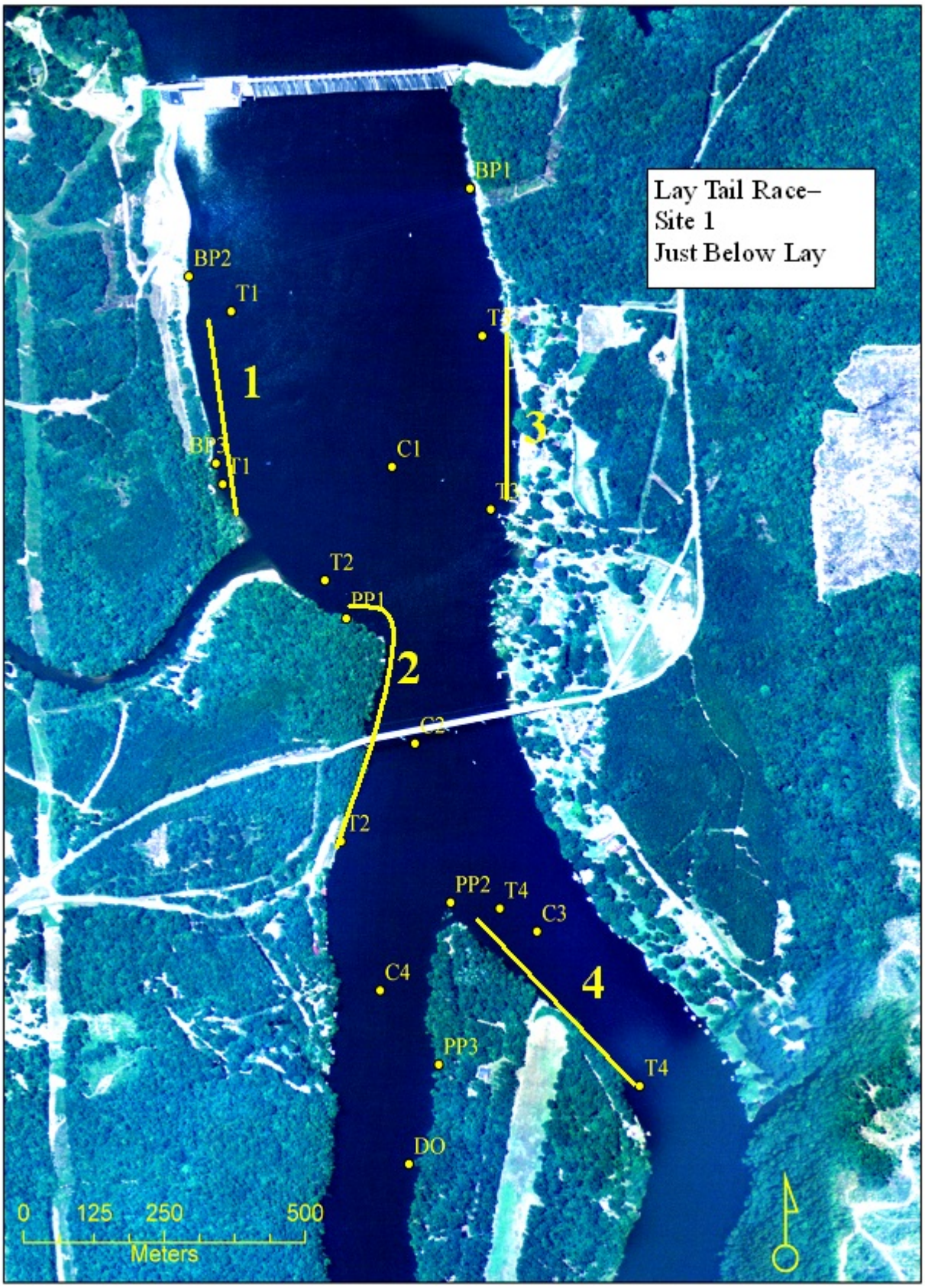
Logan Martin tail race
Site 3
Surrounding the second island

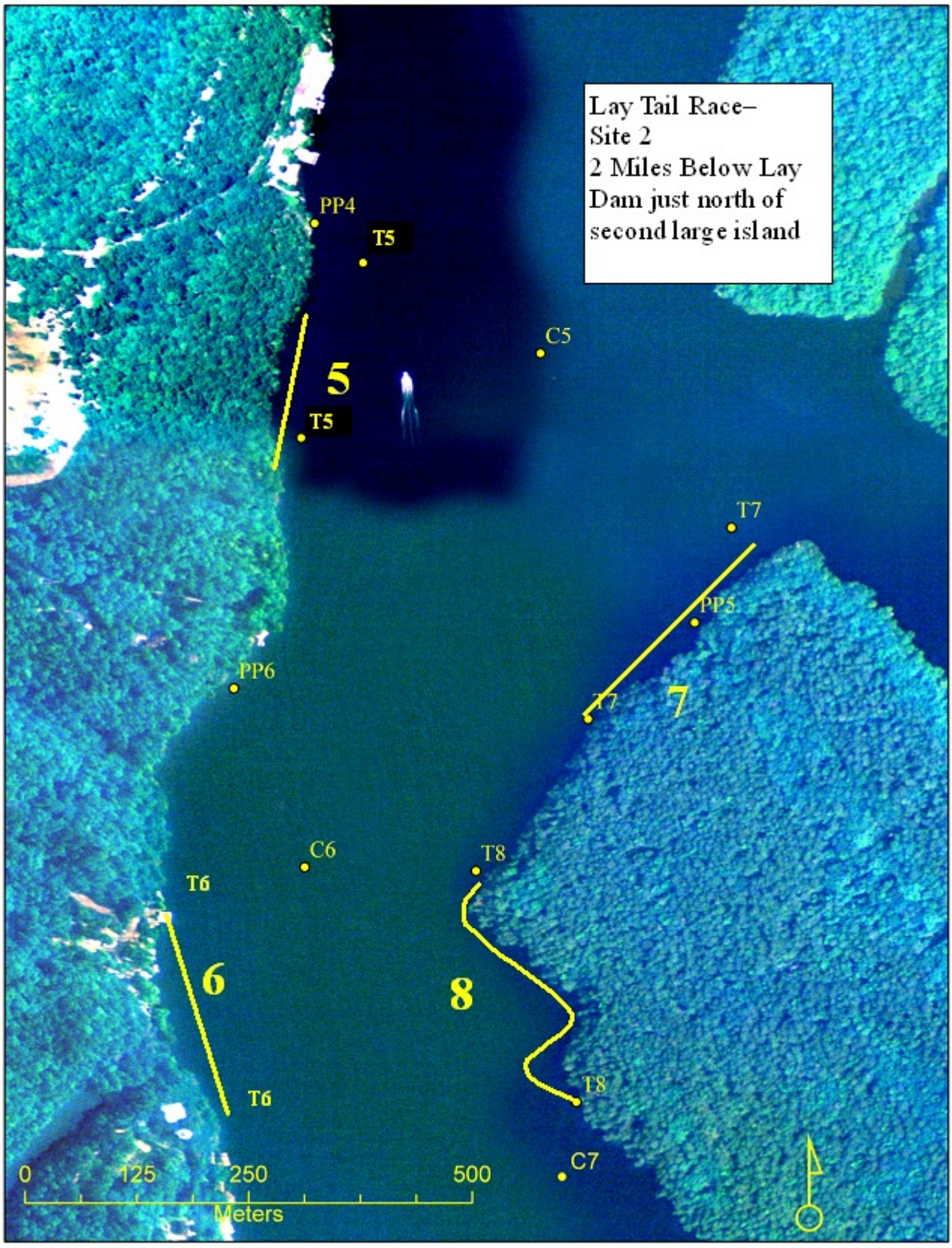

P10
C11
T15
P11
15
T15
T13
13
Logan Martin tail race
Site 4
Adjacent and just north
of the golf course
0
125
250
500
Meters
T13
T16
C12
T14
P12
14
16
T14
T16
C13


C14
T19
T17
19
17
P13
T19
T17
Logan Martin tail race
Site 5
Just north of Hwy 280
bridge in Childersberg
P14
P15
T18
18
C15
T18
T20
DO
T20
20
C16
0
125
250
500
Meters



Coosa River Sampling sites. Lay Dam Tail Race-
North of Lake Mitchell


Lay Tail Race–
Site 1
Just Below Lay
BP1
BP2
T1
T2
1
3
BP3
T1
C1
T2
T2
PP1
2
C2
T2
PP2
T4
C3
C4
4
PP3
T4
DO
0
125
250
500
Meters


Lay Tail Race–
Site 2
2 Miles Below Lay
Dam just north of
second large island
PP4
T5
C5
5
T5
T7
PP5
PP6
7
T7
C6
T8
T6
6
8
T6
T8
C7
0
125
250
500
Meters

Lat	Long	Tran	Site
33.41799999	-86.3414638	T1	LMTR1
33.42109951	-86.3412655	T1	LMTR1
33.41261319	-86.34538461	T2	LMTR1
33.41583327	-86.34286988	T2	LMTR1
33.42028703	-86.33803871	T3	LMTR1
33.41755612	-86.3401839	T3	LMTR1
33.4153292	-86.34114833	T4	LMTR1
33.41244767	-86.34327548	T4	LMTR1
33.39906947	-86.37369562	T5	LMTR2
33.40086789	-86.3721994	T5	LMTR2
33.39431361	-86.37700353	T6	LMTR2
33.39698505	-86.37536309	T6	LMTR2
33.39942313	-86.37134313	T7	LMTR2
33.40329082	-86.36590806	T7	LMTR2
33.39554775	-86.37463301	T8	LMTR2
33.39346325	-86.37608416	T8	LMTR2
33.37211871	-86.35590322	T9	LMTR3
33.37424888	-86.35590322	T9	LMTR3
33.36711297	-86.35072053	T10	LMTR3
33.36921316	-86.35321724	T10	LMTR3
33.37610804	-86.35732733	T11	LMTR3
33.37323273	-86.3547405	T11-12	LMTR3
33.37106489	-86.35082869	T12	LMTR3
33.33924871	-86.36884642	T13	LMTR4
33.34324707	-86.36806226	T13	LMTR4
33.33593542	-86.36858504	T14	LMTR4
33.3380966	-86.36872925	T14	LMTR4
33.34543819	-86.36439382	T15	LMTR4
33.34345037	-86.3661334	T15	LMTR4
33.33927883	-86.36748541	T16	LMTR4
33.3352351	-86.3664038	T16	LMTR4
33.30341335	-86.3603378	T17	LMTR5
33.30044524	-86.35894073	T17	LMTR5
33.29494568	-86.35908494	T18	LMTR5
33.2970024	-86.35875145	T18	LMTR5
33.30419679	-86.35941844	T19	LMTR5
33.30158277	-86.35780504	T19	LMTR5
33.29447104	-86.3568316	T20	LMTR5
33.29336355	-86.35833683	T20	LMTR5

Lat	Long	Tran	Site
33.417842	-86.34020192	C1	LMTR1
33.41286147	-86.34425794	C2	LMTR1
33.40850515	-86.3506304	C3	LMTR1
33.40185363	-86.37147833	C4	LMTR2
33.39593906	-86.37497552	C5	LMTR2
33.3929139	-86.37742716	C6	LMTR2
33.38626871	-86.37740913	C7	LMTR2A
33.37348112	-86.35634488	C8	LMTR3
33.36800875	-86.34985525	C9	LMTR3
33.36162515	-86.34596147	C10	LMTR3
33.34644714	-86.36351051	C11	LMTR4
33.33854088	-86.36844082	C12	LMTR4
33.32950427	-86.36442086	C13	LMTR4
33.30415159	-86.36014852	C14	LMTR5
33.29533744	-86.35782307	C15	LMTR5
33.29169852	-86.36306885	C16	LMTR5
33.4209641	-86.33898512	BP	LMTR1
33.41666085	-86.34241921	PP1	LMTR1
33.41490036	-86.34148182	PP2	LMTR1
33.41272604	-86.34323943	PP3	LMTR1
33.40505906	-86.36426763	PP4	LMTR2
33.40352408	-86.36587201	PP5	LMTR2
33.39924254	-86.37460597	PP6	LMTR2
33.3737822	-86.35401943	PP7	LMTR3
33.37165955	-86.35308203	PP8	LMTR3
33.36725599	-86.35089179	PP9	LMTR3
33.34644714	-86.36469126	P10	LMTR4
33.34476806	-86.36695362	P11	LMTR4
33.3380213	-86.36730514	P12	LMTR4
33.30165057	-86.35794926	P13	LMTR5
33.3001665	-86.35715608	P14	LMTR5
33.29775577	-86.35858019	P15	LMTR5

Lat	Long	Name	Site	Lat	Long	Name	Site
32.96002051	-86.51862165	T1	LAYTR1	32.95766849	-86.51605284	C1	LAYTR1
32.95740379	-86.51875685	T1	LAYTR1	32.95348612	-86.51568329	C2	LAYTR1
32.9559517	-86.51712543	T2	LAYTR1	32.9506423	-86.5137364	C3	LAYTR1
32.95200372	-86.51686404	T2	LAYTR1	32.94974981	-86.51624212	C4	LAYTR1
32.95964994	-86.5146107	T3	LAYTR1	32.93571074	-86.51407891	C5	LAYTR2
32.95702565	-86.5144755	T3	LAYTR1	32.9305136	-86.51644942	C6	LAYTR2
32.95099022	-86.51433128	T4	LAYTR1	32.9272400	-86.5135600	C7	LAYTR2
32.94830516	-86.51209597	T4	LAYTR1	32.96188091	-86.51480899	BP1	LAYTR1
32.93662607	-86.51586356	T5	LAYTR2	32.9605499	-86.51929765	BP2	LAYTR1
32.93485592	-86.51648548	T5	LAYTR2	32.95772143	-86.51886501	BP3	LAYTR1
32.9304200	-86.5179600	T6	LAYTR2	32.95537691	-86.51678292	PP1	LAYTR1
32.9281200	-86.5170700	T6	LAYTR2	32.95108098	-86.51511545	PP2	LAYTR1
32.93394813	-86.51215906	T7	LAYTR2	32.94863039	-86.51530473	PP3	LAYTR1
32.93201149	-86.5136012	T7	LAYTR2	32.93702699	-86.51635028	PP4	LAYTR2
32.93047577	-86.51472787	T8	LAYTR2	32.93298738	-86.51252861	PP5	LAYTR2
32.92813809	-86.51371837	T8	LAYTR2	32.93232166	-86.51716148	PP6	LAYTR2