Food Habits of Catfishes in Tailwater and Reservoir Habitats in a Section of the Coosa River, Alabama

Jeffrey C. Jolley, *Alabama Cooperative Fish and Wildlife Research Unit, 108 M. White Smith Hall, Auburn University, AL 36849*

Elise R. Irwin, *United States, Alabama Cooperative Fish and Wildlife Research Unit, 108 M. White Smith Hall, Auburn University, AL 36849*

Abstract: The food habits of blue catfish *(Ictalurus furcatus)*, channel catfish *(I. punctatus)*, and flathead catfish *(Pylodictis olivaris)* in a section of the Coosa River, Alabama, were determined by examining the contents of 800 catfish stomachs from tailwater and reservoir habitats on the Coosa River from 2001–2002. Stomachs were described using the Relative Importance Index. Small blue catfish consumed mainly molluscs in tailwaters and insects in reservoir habitats. Insects were most important to larger blue catfish in both habitats. Channel catfish consumed mostly insects in both habitats but a wider diversity was present in the diets from tailwater catfish. Flathead catfish had similar feeding patterns in both habitats. Small flathead catfish consumed mostly crayfish and zooplankton in tailwaters, whereas insects and fish were most important in reservoir areas. Mid-size flathead catfish consumed mainly fish and crayfish in both habitats and fish was overwhelmingly the most important diet item for large flathead catfish. Increased quantity and quality of prey items may have contributed to increased abundance, growth, and condition of catfishes in tailwater areas.

Key words: food habits, catfishes, Relative Importance Index, tailwater, reservoir

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 57:124–140

Catfishes (Ictaluridae) represent an important group of fishes, both recreationally and commercially, throughout many regions of the United States (Michaletz and Dillard 1999, USDI and USDC 2001); however, we lack information for many aspects of the biology of these fishes. Although food habits have been well documented for channel catfish (Bailey and Harrison 1948, Mathur 1970, Hill et al. 1995) and flathead catfish (Brown and Dendy 1961, Swingle 1967, Turner and Summerfelt 1971, Layher and Boles 1980), information on food habits of blue catfish remains scarce (Brown and Dendy 1961, Minckley 1962, Perry 1969, Cannamela et al. 1978). Jolley (2003) included a detailed survey of food habits of the three species of catfish from tailwater and reservoir sites in the Coosa River system. Because blue catfish, channel catfish, and flathead catfish occur naturally in many North American basins throughout the Southeast (Mettee et al. 1996), the potential for increasing our understanding of their basic biology exists.

Catfishes may be more abundant in tailwater areas of dams (Jacobs and Swink 1982, Jackson 1985, Jackson and Dillard 1993, Graham and DeiSanti 1999) than other areas of rivers and reservoirs. Tailwater areas are often popular for catfishing (Graham and DeiSanti 1999) and may produce larger fish (Chambers 1993); some anecdotal observations suggest that tailwater catfishes are larger (Jackson 1995) and in better condition with increasing flow (Jackson 1985). This perceived phenomenon might be related to quality and quantity of prey items.

Food habits of catfishes may differ among tailwater and reservoir habitats if differences in prey density exist. Catfish abundance may be higher in tailwater areas because catfishes may be attracted to abundant prey. Prey may either be discharged through the turbines (Walburg 1971, Sorenson et al. 1998), be attracted to increased velocity in tailwaters (Jackson 1995, Graham and DeiSanti 1999), or upstream movements may be blocked by dams (Hoyt and Kruskamp 1982). Blue catfish have been observed feeding on schools of gizzard shad *(Dorosoma cepedianum)* as well as dead and dying individuals in a Missouri tailwater (Graham and DeiSanti 1999). The specific objectives of this study were to quantify and compare diets of individuals in each habitat (tailwater versus reservoir) and season.

Methods

Study Area

Blue catfish, channel catfish, and flathead catfish were collected from two basic habitat types (three tailwater and three reservoir sites) on the Coosa River in central Alabama, part of the Mobile River drainage. Tailwater sites were located below Bouldin Dam, Jordan Dam, and Mitchell Dam and sampling occurred no more than 3.2 km downstream. All of the tailwater sites are highly regulated and discharge ranges from 0 to 1100 m^3/second. The Mitchell Dam tailwater is upstream of Jordan Reservoir and impounds Mitchell Reservoir. Jordan Dam and Bouldin Dam both impound Jordan Reservoir.

Jordan Reservoir is 29.6 km long (from Mitchell Dam to Jordan Dam) and is 2754 ha at full pool, draining 26,326 km^2. The reservoir sites were in the Bouldin Canal, the Shoals Creek Arm, and the mainlake of Jordan Reservoir near the town of Titus. Bouldin Canal is 1.4 km long and connects Jordan Reservoir to the Bouldin Dam forebay (forebay = 4.8 km long). The Shoals Creek arm is a shallow water embayment of Jordan Reservoir, 8 km upstream of Jordan Dam. Titus is located 17.7 km downstream of Mitchell Dam.

Field Methods

Blue catfish, channel catfish, and flathead catfish were collected seasonally (spring, summer, fall, and winter) from spring 2001 to summer 2002. Boat electrofishing with a Smith Root GPP voltage regulator was primarily used for collecting catfishes (15 pps, 2–5 amps). Experimental monofilament gill nets (45.7 x 1.6, 30.5 x 3.0, and 45.7 x 2.0 m nets with 4–6 7.6 m panels of 12.7, 25.4, 38.1, 50.8, 76.2, 101.6, 127, 152.4, 177.8, and 203.2-mm bar mesh) were also used. Catfishes were

Table 1. Number of catfish stomachs examined by habitat (tailwater and reservoir) and size group (mm) from the Coosa River, 2001–2002.

		Tailwater			Reservoir			
Species		Bouldin Dam	Jordan Dam	Mitchell Dam	Bouldin Canal	Shoals Creek Arm	Titus	Total
	Total examined	17	1	120	8	40	55	241
Blue	< 300 mm	4	0	91	6	36	48	185
catfish	≥300 mm	13	1	29	2	4	7	56
	Total examined	16	22	122	7	4	12	183
Channel	<250 mm	7	2	104	4	3	11	131
catfish	≥250 mm	9	20	18	3	1	1	52
	Total examined	50	6	263	26	0	31	376
Flathead	<250 mm	7	4	115	3	0	18	147
catfish	250–500 mm	14	1	73	15	0	1	104
	> 500 mm	29	1	75	8	0	12	125

not effectively captured in winter when water temperatures precluded effective electrofishing (Grussing et al. 1999).

Catfishes were measured (nearest mm TL) and weighed (nearest g). Large catfish (i.e., >6 kg) were weighed to the nearest 0.25 kg. Fish were euthanized, placed on ice, and returned to the laboratory.

Laboratory Methods

Stomachs from catfish collected by electrofishing or short gillnet sets (<2 hours; to minimize digestion of diet materials) were removed and placed in 10% formalin within six hours of capture. After one week, stomachs were placed in water for three to five days and then placed in 95% isopropyl alcohol and stored until diet items were identified. Food items were identified using a magnifying lamp and dissecting microscope, when necessary. Invertebrates were identified to family and fishes were identified to species when possible. Wet weight of each prey taxon was recorded to the nearest 0.01 g after blotting to remove excess water (Hyslop 1980). Prey digested beyond identification were placed into an "unidentified" category. Percent frequency of occurrence, percent composition by number, and percent composition by weight were calculated for diet items. The Relative Importance (RI) Index was then calculated (George and Hadley 1979). The equation is derived from the absolute importance index (AI_a). For food item a,

$$AI_a = \% \text{ frequency of occurrence} + \% \text{ total number} + \% \text{ total weight};$$

$$RI = 100 \times AI_a / \Sigma AI_a, \quad (1)$$

in which AI_a is summed over all food types. The RI Index ranges from 0 (not important) to 100 (very important), and the sum of all the RI values for the different prey taxa equals 100 (George and Hadley 1979) and ultimately takes into account both the amount (number) and bulk (weight) of food material present (Hyslop 1980).

Table 2. Number of catfish stomachs examined by season and size group (mm) from the Coosa River, 2001–2002.

		Season				
Species		Spring	Summer	Fall	Winter	Total
	Total examined	184	37	6	14	241
Blue	<300 mm	141	32	3	9	185
catfish	≥300 mm	43	5	3	5	56
	Total examined	84	82	17	0	183
Channel	<250 mm	54	66	11	0	131
catfish	≥250 mm	30	16	6	0	52
	Total examined	154	148	74	0	376
Flathead	<250 mm	74	48	25	0	147
catfish	250–500 mm	32	50	22	0	104
	>500 mm	48	50	27	0	125

Data Analysis

Diets were quantified for each species and described by habitat and season for each species. Prey items in the mollusc, zooplankton, and insect category that had RI Index values <3.0 for all size groups and habitats were pooled into an "other" category. Blue catfish were separated into small (TL <300 mm) and large (TL ≥300 mm) length groups for diet analysis. Channel catfish were separated into small (TL <250 mm) and large (TL ≥250 mm) length groups for diet analysis. Flathead catfish were separated into three different length groups for diet analysis (<250 mm, 250–500 mm, and >500 mm).

Results

A total of 800 stomachs were examined from collections between 12 April 2001 and 24 July 2002 across both habitats including 241 blue catfish, 183 channel catfish, and 376 flathead catfish (Table 1). Blue catfish from the Jordan Dam tailwater were omitted from the analysis due to low sample size ($N = 1$).

Blue catfish had a wide diet breadth, with 19 prey types identified (Table 2). Of blue catfish, 152 stomachs (63%) contained food items. For small blue catfish, 185 stomachs were examined and 110 (60%) contained food items. Fifteen prey types were identified. Molluscs had the highest RI Index value (55) for tailwater fish, whereas insects were the most important in reservoir areas (RI Index = 50; Fig. 1). The remaining prey categories had similar RI Index values between habitats (Fig. 1). Insects were most important in the spring (RI Index value = 47), molluscs most important in the summer (RI Index value = 79), and fish most important in the winter (RI Index value = 53; Fig. 2). The fall sample was omitted due to small sample size.

For large blue catfish, 56 stomachs were examined of which 42 (75%) contained food items. Sixteen prey types were identified. Insects as a group were the most im-

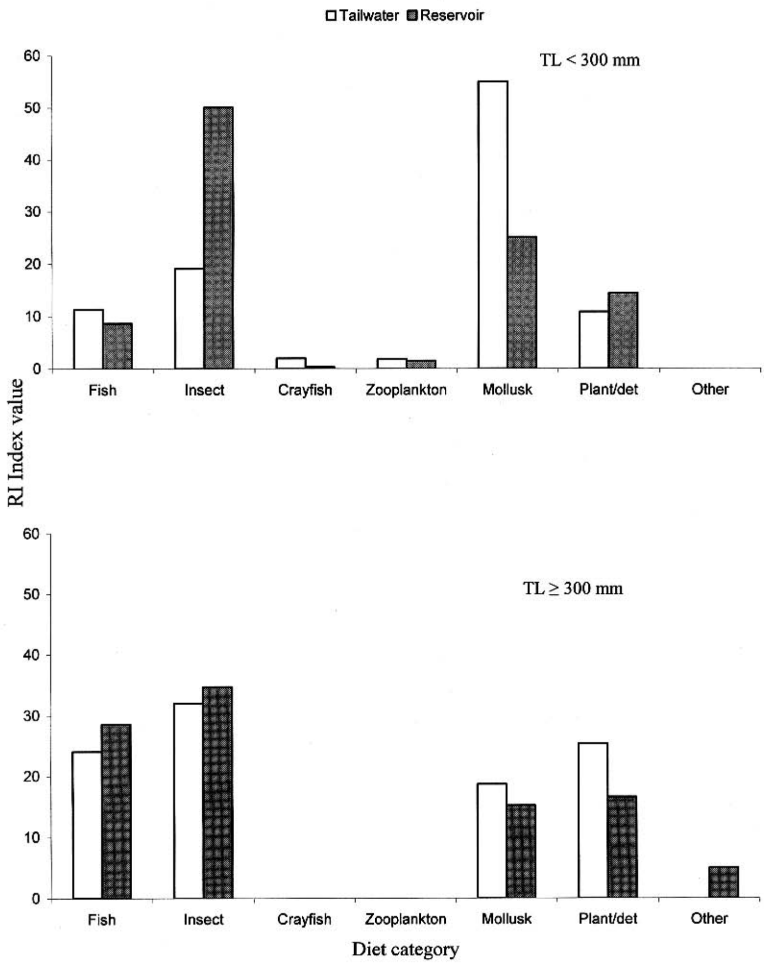

Figure 1. RI Index values for two length-groups (TL <300 mm; TL ≥300 mm) of blue catfish from tailwater and reservoir habitats in the Coosa River, 2001–2002.

portant prey items for tailwater (RI Index = 32) and reservoir (RI Index = 35; Fig. 2) habitats. Generally, all prey categories were similar in importance between habitats (Fig. 1). Insects were most important in the spring (RI Index value = 40); whereas, fish were solely consumed in summer (RI Index value = 100) and fish and plant/detritus were equally important in winter (Fig. 2).

Channel catfish also had a wide diet range; 16 prey types were identified (Table 3). Of channel catfish, 131 stomachs (72%) contained food items. For small channel catfish, 131 stomachs were examined of which 90 (69%) contained food items. Fourteen prey types were identified. Insects were the most important prey category for tailwater (RI Index = 44) and reservoir (RI Index = 59; Fig. 3) habitats. Plant/detritus was an important category for both habitats while zooplankton was important to tail-

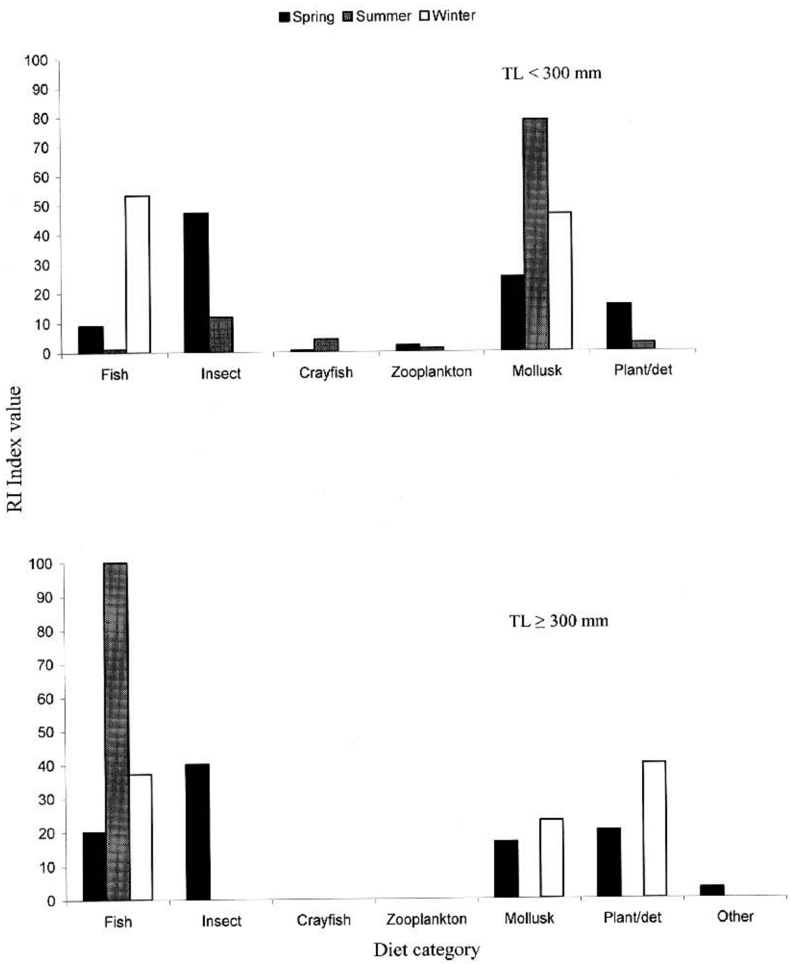

Figure 2. RI Index values for two length-groups (TL <300 mm; TL ≥300 mm) of blue catfish from three seasons (spring, summer, and winter) in the Coosa River, 2001–2002.

water habitats (RI Index = 15), but not reservoir habitats (RI Index = 2; Fig. 2). Insects were the most important prey category in spring, summer, and fall (Fig. 4). The winter sample was omitted due to low sample size.

Fifty-two large channel catfish stomachs were examined of which 41 (79%) contained food items. Fourteen prey types were identified (Table 3). Insects and plant/detritus were again important prey categories for both habitats, whereas fish prey items were consumed in tailwater areas (RI Index = 10) but were absent from diets in reservoir areas (Fig. 3). Insects were again the most important prey category in spring, summer, and fall while fish were unimportant in the spring (RI Index = 6) but became more important in the summer (RI Index = 28; Fig. 5).

Flathead catfish had a wide diet range; 17 prey types were identified (Table 4).

Table 3. Stomach contents of two size classes (small: TL <300 mm; large: TL ≥300 mm) of blue catfish from the Coosa River, 2001–2002. Hab = habitat R = reservoir T = tailwater.

			% occurrence		% weight		% number		Relative importance	
Prey type	Prey item	Hab	small	large	small	large	small	large	small	large
Plant/det	Plant/det	R	14.4	38.5	31.1	18.7	2.4	4.1	14.3	16.6
		T	7.4	34.9	21.4	40.9	1.3	7.9	10.8	25.3
Mollusk	Corbicula	R	17.8	23.1	24.1	3.1	29.0	5.7	21.2	8.6
		T	25.3	4.7	38.8	4.3	83.3	49.7	52.8	17.8
	Other mollusc[a]	R	6.7	7.7	1.2	0.2	5.0	16.3	3.9	6.5
		T	2.1	2.3	3.5	0.2	0.4	0.5	2.2	0.9
Zooplankton	Zooplankton[b]	R	3.3	0.0	0.1	0.0	1.5	0.0	1.5	
		T	2.1	0.0	0.0	0.0	2.9	0.0	1.8	
Crayfish	Crayfish	R	1.1	0.0	0.0	0.0	0.2	0.0	0.4	
		T	3.2	0.0	1.8	0.0	0.6	0.0	2.0	
Insect	Brachycentridae	R	2.2	7.7	0.2	0.2	0.6	4.9	0.9	3.5
		T	0.0	0.0	0.0	0.0	0.0	0.0		
	Chironomidae	R	17.8	15.4	0.7	0.0	18.1	3.3	10.9	5.1
		T	7.4	4.7	0.1	0.0	5.3	1.6	4.6	1.9
	Corduliidae	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	1.1	18.6	0.8	6.3	0.2	12.0	0.7	11.2
	Diptera pupae	R	17.8	7.7	1.0	0.0	8.2	1.6	8.1	2.5
		T	1.1	2.3	0.0	0.0	0.4	0.5	0.5	0.9
	Ephemeridae	R	24.4	7.7	2.3	3.5	30.1	57.7	17.0	18.7
		T	1.1	0.0	0.7	0.0	0.2	0.0	0.7	
	Unid insect	R	17.8	15.4	19.4	1.5	3.0	1.6	12.0	5.0
		T	12.6	9.3	6.2	0.5	2.2	2.1	7.6	3.6
	Terrestrial insect[c]	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	5.3	13.9	4.9	5.2	1.5	5.2	4.2	7.3
	Other Insect[d]	R	3.3	0.0	0.0	0.0	0.6	0.0	1.2	
		T	2.1	16.2	0.0	0.1	0.4	6.7	0.9	7.1
Fish	Black bass	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	0.0	2.3	0.0	1.3	0.0	0.5		1.3
	Drum	R	0.0	7.7	0.0	13.9	0.0	0.8		6.1
		T	0.0	0.0	0.0	0.0	0.0	0.0		
	Shad	R	1.1	0.0	1.7	0.0	0.2	0.0	0.9	
		T	1.1	0.0	0.0	0.0	0.2	0.0	0.5	
	Sunfish	R	0.0	7.7	0.0	1.7	0.0	0.8		2.8
		T	0.0	4.7	0.0	11.8	0.0	5.2		6.6
	Unid fish	R	6.7	23.1	18.2	47.3	1.1	2.4	7.8	19.7
		T	7.4	16.3	21.7	29.4	1.3	7.9	10.9	16.2
Other	Plastic worm	R	0.0	7.7	0.0	10.0	0.0	0.8		5.0
		T	0.0	0.0	0.0	0.0	0.0	0.0		

a. *Lampsilus*, Lymnaidae, and unidentified molluscs

b. Amphipoda, Chaoboridae, Cladocera, and Ostracoda

c. Arachnid, Coleoptera, and Hymenoptera

d. Aeshnidae, Ceratopogonidae, Elmidae, Gerridae, Hemiptera, Heptaganeidae, Tipulidae, and Trichoptera

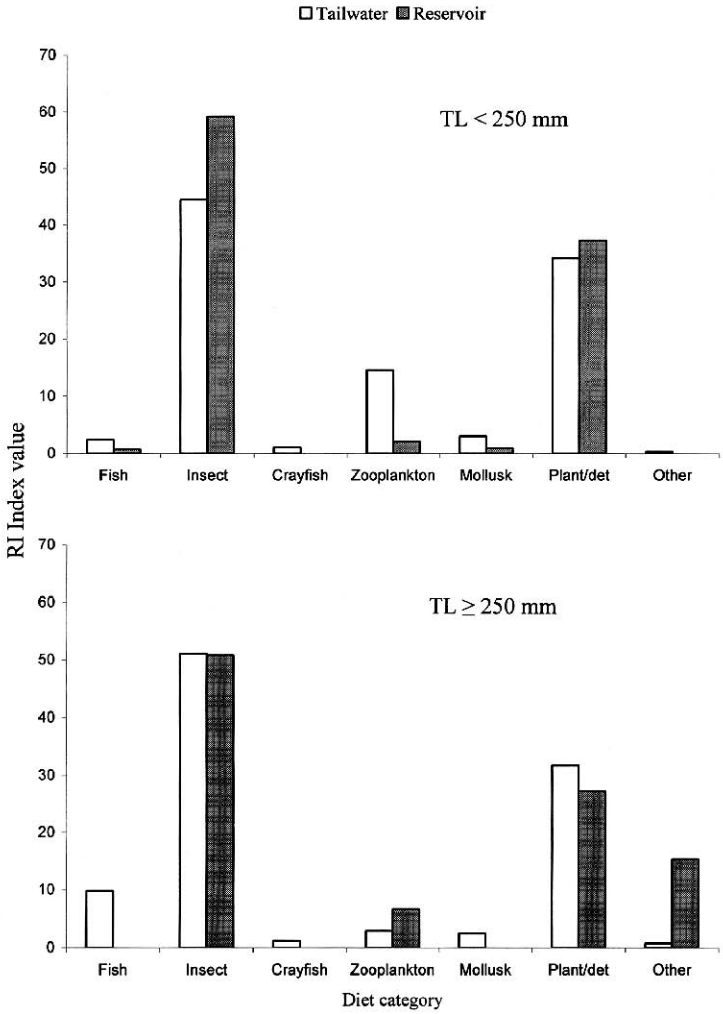

Figure 3. RI Index values for two length-groups (TL <250 mm; TL ≥250 mm) of channel catfish from tailwater and reservoir habitats in the Coosa River, 2001–2002.

Of flathead catfish, 194 stomachs (52%) contained food items. For small flathead catfish (TL <250 mm), 147 stomachs were examined; 91 (62%) contained food items and 12 prey types were identified. Crayfish and zooplankton were the most important categories in tailwater areas (RI Index = 44 and 33, respectively); whereas, fish and insects were the most important categories in reservoir areas (RI Index = 36 and 28, respectively; Fig. 5). For flathead catfish 250–500 mm, 104 stomachs were examined of which 60 (58%) contained food items. Thirteen prey types were identified. Fish prey items were slightly more important in tailwater areas (Fig. 3). For

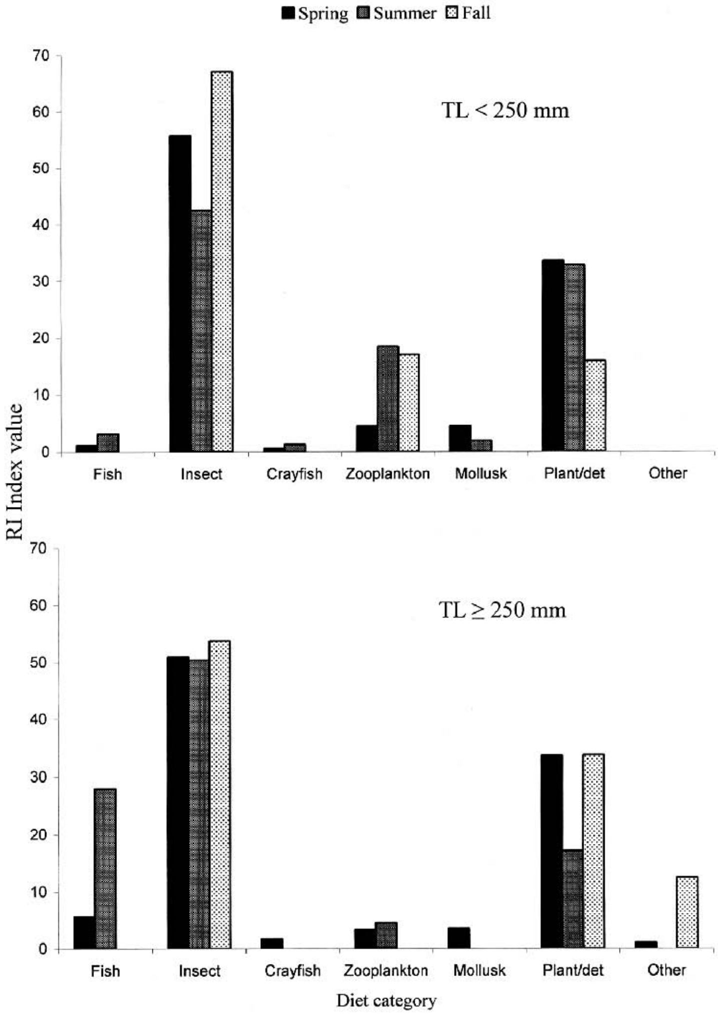

Figure 4. RI Index values for two length-groups (TL <250 mm; TL ≥250 mm) of channel catfish from three seasons (spring, summer, and fall) in the Coosa River, 2001–2002.

large flathead catfish (TL >500mm), 125 stomachs were examined of which 43 (34%) contained food items and 10 prey types were identified. Fish were overwhelmingly the most important diet category for both habitats (Fig. 5). Seasonally, insects and crayfish decreased in importance while fish and zooplankton increased in importance from spring to fall for small and mid-size fish (Fig. 6). Fish were important in all seasons for large flathead catfish.

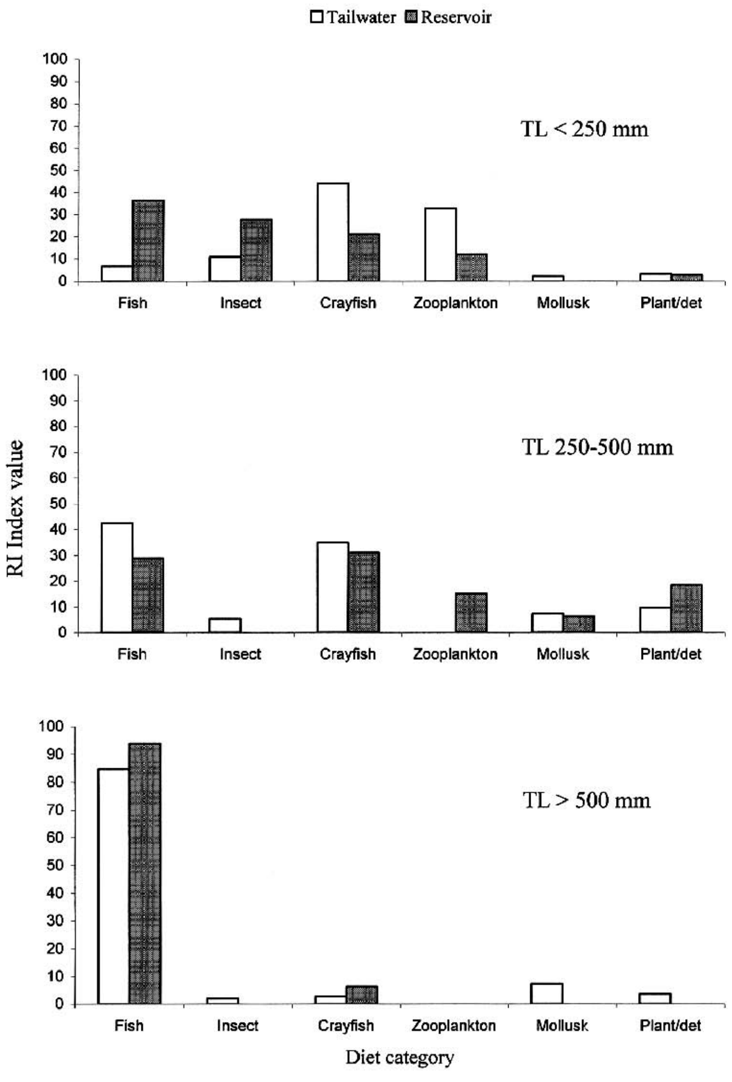

Figure 5. RI Index values for three length-groups (TL <250 mm; TL 250–500 mm; TL >500 mm) of flathead catfish from tailwater and reservoir habitats habitats in the Coosa River, 2001–2002.

Discussion

Although smaller blue catfish were collected, they were larger in tailwaters, indicating potential enhanced growth in those areas (Jolley 2003). In particular, molluscs were more important in tailwater areas for small fish. Mussels could be seen and felt protruding from the stomach wall of blue catfish sampled from tailwater ar-

Table 4. Stomach contents of two size classes (small: TL <250 mm; large: TL ≥250 mm) of channel catfish from the Coosa River, 2001–2002. Hab = habitat R = reservoir and T = tailwater.

			% occurrence		% weight		% number		Relative importance	
Prey type	Prey item	Hab	small	large	small	large	small	large	small	large
Plant/det	Plant/det	R	38.9	20.0	71.8	53.9	6.4	1.3	28.9	27.2
		T	38.9	48.9	76.7	77.5	6.7	8.0	34.2	31.8
Mollusk	Mollusc[a]	R	5.6	0.0	0.6	0.0	6.4	0.0	1.7	
		T	8.0	8.5	1.3	0.4	1.6	1.3	3.1	2.4
Zooplankton	Zooplankton[b]	R	16.7	20.0	0.1	0.0	2.8	1.3	4.8	6.6
		T	15.1	10.6	0.3	0.0	36.8	1.6	14.5	2.9
Crayfish	Crayfish	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	2.7	4.3	0.6	0.1	0.5	0.7	1.0	1.2
Insect	Chironomidae	R	55.6	80.0	3.8	0.3	51.4	46.8	27.3	50.8
		T	36.3	44.7	1.4	0.1	37.4	46.7	21.0	21.6
	Diptera pupae	R	16.7	0.0	2.5	0.0	20.2	0.0	9.7	
		T	8.0	19.1	0.2	0.0	5.2	4.9	3.7	5.7
	Ephemeridae	R	27.8	0.0	4.6	0.0	10.1	0.0	10.5	
		T	0.9	2.1	0.0	0.0	0.8	0.3	0.5	0.6
	Heptaganeidae	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	3.5	0.0	0.2	0.0	0.6	0.0	1.2	
	Hydropsychida	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	0.9	12.8	0.0	0.0	0.5	4.2	0.4	4.0
	Simuliidae	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	0.0	19.1	0.0	0.0	0.0	15.7		8.2
	Unid insect	R	33.3	0.0	16.7	0.0	5.5	0.0	13.7	
		T	20.4	21.3	9.3	3.1	3.5	3.5	9.3	6.6
	Other insect[c]	R	5.6	0.0	0.0	0.0	1.8	0.0	1.8	
		T	18.7	14.9	5.5	0.1	6.1	3.3	8.3	4.4
Fish	Shad	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	0.0	2.1	0.0	15.7	0.0	7.0		5.9
	Sunfish	R	0.0	0.0	0.0	0.0	0.0	0.0		
		T	0.9	0.0	3.3	0.0	0.2	0.0	1.2	
	Unid fish	R	5.6	0.0	0.0	0.0	0.9	0.0	1.6	
		T	2.7	12.8	1.2	2.0	0.5	2.1	1.2	4.0
Other	Other[d]	R	0.0	20.0	0.0	22.8	0.0	1.3		15.3
		T	0.9	2.1	0.0	0.8	0.2	0.3	0.3	0.8

a. Corbicula and unidentified molluscs

b. Amphipoda, Chaoboriidae, Cladocera, and Copepoda

c. Branchycentridae, Ceratopogonidae, Cordullidae, Gomphidae, Hydroptilidae, Tipulidae, and Trichoptera

d. Diplopoda and Oligochaeta

eas. This observation is corroborated by other findings that blue catfish gorge themselves on mussels (Graham 1999). This intense feeding behavior may have contributed to the larger size of individuals from tailwater areas.

Generally, large blue catfish (TL >500 mm) were not effectively captured in this study although anglers consistently reported catching larger blue catfish. The affinity of blue catfish for swift water and deep channels (Jenkins and Burkhead 1994) may explain our inability to effectively capture large individuals, as these conditions often preclude effective electrofishing. Although this study constitutes some

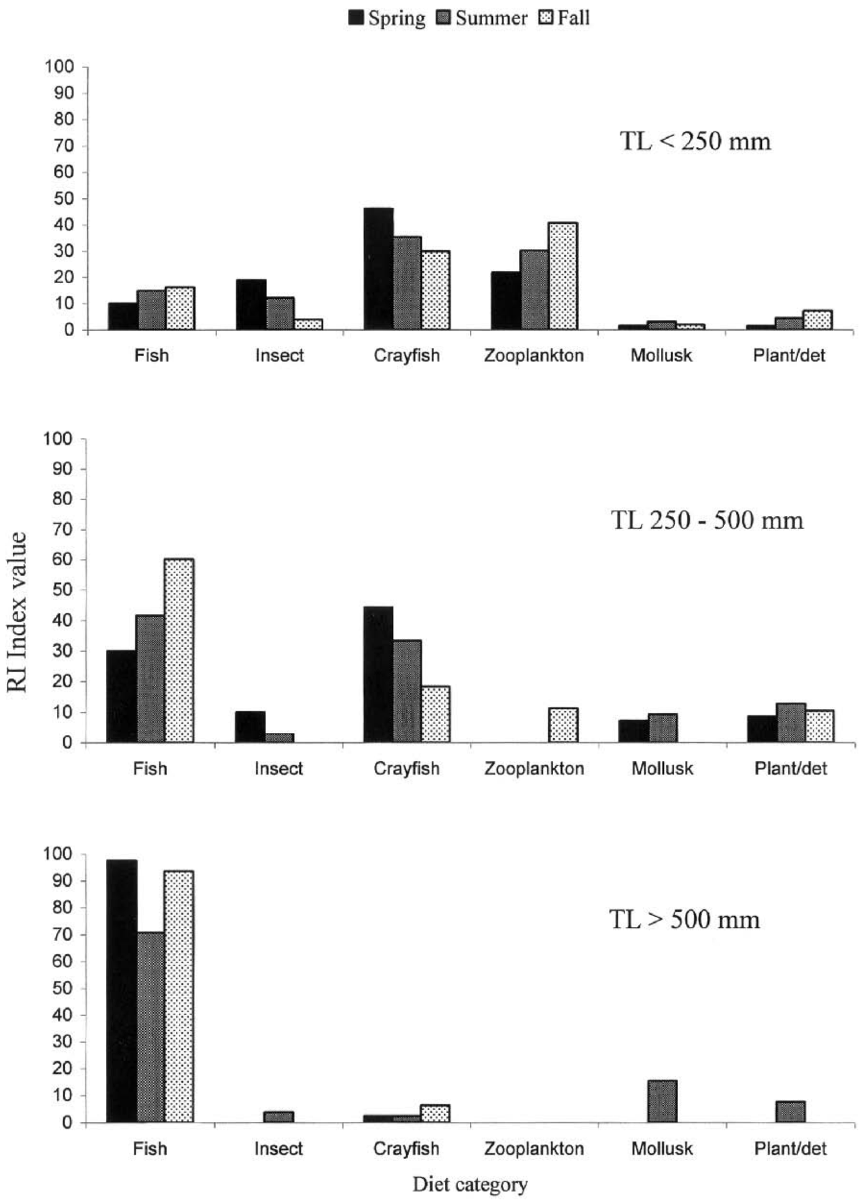

Figure 6. RI Index values for three length-groups (TL <250 mm; TL 250–500 mm; TL >500 mm) of flathead catfish from three seasons (spring, summer, and fall) in the Coosa River, 2001–2002.

Table 5. Stomach contents of three size classes (small: TL <250 mm; mid: TL 250–500 mm; large: T L >500 mm) of flathead catfish from the Coosa River, 2001–2002. Hab = habitat R = reservoir T = tailwater.

			% occurrence			% weight			% number			Relative importance		
Prey type	Prey item	Hab	small	mid	large	small	mid	large	small	mid	large	small	mid	large
Plant/det	Plant/det	R	4.8	12.5	0.0	0.0	17.7	0.0	3.3	18.2	0.0	2.9	18.4	
		T	6.2	11.8	2.9	1.4	1.5	0.3	1.6	14.5	5.8	3.1	10.1	3.7
Mollusk	Corbicula	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
		T	0.0	5.9	3.8	0.0	6.8	0.5	0.0	8.7	7.7		7.8	5.0
	Unid mollusk	R	0.0	6.3	0.0	0.0	1.3	0.0	0.0	9.1	0.0		6.3	
		T	3.9	0.0	1.9	1.4	0.0	0.2	1.0	0.0	3.8	2.1		2.5
Zooplankton	Zooplankton[a]	R	14.3	12.6	0.0	0.0	0.0	0.0	20.0	27.3	0.0	12.0	15.1	
		T	17.8	0.0	0.0	0.6	0.0	0.0	76.2	0.0	0.0	32.2		
Crayfish	Crayfish	R	23.8	12.5	5.0	19.5	50.9	0.1	16.7	18.2	10.0	21.0	31.1	6.2
		T	34.1	27.1	1.9	86.7	28.8	0.9	10.6	34.8	3.8	44.9	33.1	2.8
Insect	Heptaganeidae	R	9.5	0.0	0.0	0.5	0.0	0.0	36.7	0.0	0.0	16.4		
		T	11.6	2.4	0.0	0.4	0.0	0.0	4.1	2.9	0.0	5.5	1.9	
	Unid insect	R	9.5	0.0	0.0	0.3	0.0	0.0	6.7	0.0	0.0	5.8		
		T	4.7	1.2	0.0	0.1	0.0	0.0	1.2	1.4	0.0	2.0	1.0	
	Other insect[b]	R	9.5	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	5.7		
		T	7.0	2.4	0.0	0.0	0.0	0.0	3.2	2.8	0.0	3.4	2.0	
Fish	Channel catfish	R	4.8	6.3	5.0	33.7	12.9	1.5	3.3	9.1	10.0	14.6	10.7	6.7
		T	0.8	3.5	3.8	0.9	14.7	3.9	0.2	4.3	7.7	0.6	8.3	6.4
	Crappie	R	4.8	0.0	0.0	41.3	0.0	0.0	3.3	0.0	0.0	17.3		
		T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Drum	R	0.0	0.0	5.0	0.0	0.0	28.0	0.0	0.0	10.0			17.6
		T	0.0	0.0	1.9	0.0	0.0	28.6	0.0	0.0	3.8			14.2
	Flathead catfish	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
		T	0.0	2.4	1.0	0.0	22.5	8.0	0.0	2.9	1.9		10.1	4.5
	Logperch	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
		T	0.8	1.2	0.0	2.7	4.8	0.0	0.4	1.4	0.0	1.3	2.7	
	Unid catfish	R	4.8	0.0	0.0	4.5	0.0	0.0	3.3	0.0	0.0	4.4		
		T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Shad	R	0.0	0.0	15.0	0.0	0.0	56.6	0.0	0.0	30.0			41.5
		T	0.0	2.4	14.3	0.0	7.2	52.8	0.0	8.7	44.2		6.7	46.2
	Sunfish	R	0.0	0.0	5.0	0.0	0.0	3.3	0.0	0.0	10.0			7.5
		T	0.0	0.0	1.0	0.0	0.0	2.2	0.0	0.0	1.9			2.1
	Unid fish	R	0.0	12.5	10.0	0.0	17.2	10.5	0.0	18.2	30.0		18.2	20.6
		T	6.2	14.1	8.6	5.9	13.7	2.7	1.6	17.4	19.2	4.7	16.5	12.7

a. Amphipoda, Cladocera, Copepoda, and Isopoda

b. Brachycentridae, Chironomidae, Ephemeridae, Tricorythidae, and Trichoptera

of the first comprehensive data on blue catfish food habits, data are still lacking on diets of large blue catfish. Other studies found that Clupeids are important prey for this species (Graham 1999), particularly large individuals.

Fish as prey were important to flathead catfish in tailwater areas. Diet protein content is an important factor for fish growth (Bowen et al. 1995) and piscivory has been found to enhance fish growth (Phillips 1993, Jonsson et al. 1999). Fish as prey, particularly shad, have high caloric density (Miranda and Muncy 1989). The high incidence of piscivory in this study may help explain the occurrence of abundant flathead catfish and larger blue catfish at tailwater sites (Jolley 2003). Miranda and Muncy (1989) found that a diet of gizzard shad contributed to increased growth of largemouth bass *(Micropterus salmoides)*. Large flathead catfish are known to be obligate piscivores (Jackson 1999). Diet quality (i.e., consuming fish) may contribute to enhanced channel catfish growth in tailwaters, as well.

Jolley (2003) reported that channel catfish were heavier, on average, for a given length and in better condition (relative weight) in tailwater areas for both length groups collected. Increased quantity and quality of prey may contribute to enhanced growth and condition (Bowen et al. 1995) and relative weight may be a good predictor of prey availability (Liao et al. 1995). Fish were important (RI Index = 9.9) for large channel catfish (TL ≥250 mm) and were consumed only by tailwater fish. Fish were also the major diet item of channel catfish in a South Dakota tailwater (Walburg 1971). Zooplankton were more important to small channel catfish (TL <250 mm) in tailwaters. Catfishes may prey on items in direct relation to their abundance (Turner and Summerfelt 1971). Walburg et al. (1981) indicated that the occurrence of mayflies *Hexagenia* spp. in diets of channel catfish was the highest when mayflies were most abundant in a South Dakota tailwater. Novotny and Faler (1982) reported zooplankton were most dense in a Kentucky tailwater and was reduced downstream. The diversity of insects in the diets of channel catfish in this study was reduced in reservoir areas. In particular, large channel catfish only ate chironimids (in the insect category) in reservoir areas. Dipterans have approximately half the caloric value (600 cal/g wet weight) than other insects such as mayflies (1125 cal/g wet weight; Cummins and Wuycheck 1971). Alternative explanations for enhanced growth and condition of channel catfish in tailwater areas exist, including variation in physical habitat, competition, or predation; however, inference regarding these factors is limited by the data presented in this study. Finally, the Coosa River is a very productive system (Bayne et al. 1989). Prey is readily available in most areas and may explain why dramatic differences in diet items were not observed between habitat types in some instances.

Acknowledgments

Funding for this work was provided by the Alabama Department of Conservation and Natural Resources (ADCNR), Division of Wildlife and Freshwater Fisheries; Federal Aid in Sport Fish Restoration Project F-40-29. The authors thank K. Kleiner, A. Nichols, G. Katechis, C. Hayer, M. Ross, N. Trippel, B. Daniels, and W. Benson for field and laboratory assistance. In addition, we thank J. McHugh and S. Rider of ADCNR for their assistance in fish collection. Earlier drafts of this manuscript were greatly improved from the comments of Y. Brady, D. DeVries, K. Mickett, L. Roy, and P. Sakaris. Cooperators are the U.S. Geological Survey; Alabama Agricultural Experiment Station, Auburn University; Alabama Department of Natural Resources, Division of Wildlife and Freshwater Fisheries; the Wildlife Management Institute; and the U.S. Fish and Wildlife Service.

Literature Cited

Bailey, R.M. and H.M. Harrison, Jr. 1948. Food habits of the southern channel catfish *(Ictalurus lacustris punctatus)* in the Des Moines River, Iowa. Transactions of the American Fisheries Society 75:110–138.

Bayne, D.B., W.C. Seesock, and L.D. Benefield. 1989. Water quality assessment Alabama public lakes. Alabama Department of Environmental Management, Montgomery.

Bowen, S.H., E.V. Lutz, and M.O. Ahlgren. 1995. Dietary protein and energy as determinants of food quality: trophic strategies compared. Ecology 76:899–907.

Brown, B.E. and J.S. Dendy. 1961. Observations of the food habits of the flathead and blue catfish in Alabama. Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners 15:219–222.

Cannamela, D.A., J.D. Brader, and D.W. Johnson. 1978. Feeding habits of catfishes in Barkley and Kentucky Lakes. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 32:686–691.

Chambers, M.J. 1993. Angler diary survey of flathead catfish in the Yadkin-Pee Dee River system, North Carolina. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 47:547–551.

Cummins, K.W. and J.C. Wuycheck. 1971. Caloric equivalents for investigations in ecological energetics. International Vereinigung für theoretische und angewandte Limnologie, Mittelungen 18:1–151.

George, E.L. and W.F. Hadley. 1979. Food and habitat partitioning between rock bass *(Ambloplites rupestris)* and smallmouth bass *(Micropterus dolomieui)* young of the year. Transactions of the American Fisheries Society 108:253–261.

Graham, K. 1999. A review of the biology and management of blue catfish. Pages 37–49 *in* E.R. Irwin, W.A. Hubert, C.F. Rabeni, H.L. Schramm, Jr., and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

______ and K. DeiSanti. 1999. The population and fishery of blue catfish and channel catfish in the Harry S Truman tailwater, Missouri. Pages 361–376 *in* E.R. Irwin, W.A. Hubert, C.F. Rabeni, H.L. Schramm, Jr., and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Grussing, M.D., D.R. DeVries, and R.A. Wright. 1999. Stock characteristics and habitat use of catfishes in regulated sections of 4 Alabama rivers. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 53:15–34.

Hill, T.D., W.G. Duffy, and M.R. Thompson. 1995. Food habits of channel catfish in Lake Oahe, South Dakota. Journal of Freshwater Ecology 10:319–323.

Hoyt, R.D. and W.H. Kruskamp. 1982. Seasonal occurrences and movement patterns of fish in the Barren River, Kentucky. Transactions of the Kentucky Academy of Science 43:168–175.

Hyslop, E.J. 1980. Stomach contents analysis—a review of methods and their application. Journal of Fish Biology 17:411–429.

Jackson, D.C. 1985. The influence of differing flow regimes on the Coosa River tailwater fishery below Jordan Dam. Doctoral dissertation. Auburn University, Auburn, Alabama.

______. 1995. Distribution and stock structure of blue catfish and channel catfish in macrohabitats along riverine sections of the Tennessee-Tombigbee Waterway. North American Journal of Fisheries Management 15:845–853.

______. 1999. Flathead catfish: biology, fisheries and management. Pages 23–35 *in* E. R Irwin, W.A. Hubert, C.F. Rabeni, H.L. Schramm, Jr., and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

______ and J.R. Dillard. 1993. Sport fisheries exploitation in riverine sections of the Tennessee-Tombigbee Waterway. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 45:333–341.

Jacobs, K.E. and W.D. Swink. 1982. Estimations of fish population size and sampling efficiency of electrofishing and rotenone in two Kentucky tailwaters. North American Journal of Fisheries Management 2:239–248.

Jenkins, R.E. and N.M. Burkhead. 1994. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, Maryland.

Jolley, J.C. 2003. A comparison of the tailwater and reservoir catfish populations in a section of the Coosa River, Alabama. Master's thesis. Auburn University, Auburn, Alabama.

Jonsson, N., T.F. Naesje, B. Jonsson, R. Saksgard, and O.T. Sandlund. 1999. The influence of piscivory on life history traits of brown trout. Journal of Fish Biology 55:1129–1141.

Layher, W.G. and R.J. Boles. 1980. Food habits of the flathead catfish, *Pylodictus olivarus*, in relation to length and season in a large Kansas Reservoir. Transactions of the Kansas Academy of Sciences 83:200–214.

Liao, H., C.L. Pierce, D.H. Wahl, J.B. Rasmussen, and W.C. Leggett. 1995. Relative weight (W_r) as a field assessment tool: relationships with growth, prey biomass, and environmental conditions. Transactions of the American Fisheries Society 124:387–400.

Mathur, D. 1970. Food habits and feeding chronology of channel catfish *Ictalurus punctatus* (Rafinesque), in Conowingo Reservoir. Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners 24:377–386.

Mettee, M.F., P.E. O'Neal, and J.M. Pierson. 1996. Fishes of Alabama and the Mobile Basin. Oxmoor House, Inc., Birmingham, Alabama.

Michaletz, P.H., and J.G. Dillard. 1999. A survey of catfish management in the United States and Canada. Fisheries 24:6–11.

Minckley, W.L. 1962. Spring foods of juvenile blue catfish from the Ohio River. Transactions of the American Fisheries Society 9:95.

Miranda, L.E., and R.J. Muncy. 1989. Bioenergetic values of shads and sunfishes as prey for largemouth bass. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 43:153–163.

Novotny, J.F. and M.P. Faler. 1982. Diurnal characteristics of zooplankton and macroinvertebrates in the tailwater below a Kentucky flood control reservoir. Journal of Freshwater Ecology 1:383–393.

Perry, W.G. 1969. Food habits of blue and channel catfish collected from a brackish-water habitat. Progressive Fish-Culturist 31:47–50.

Phillips, J.M. 1993. Spatial and temporal variation in year class strength of age-0 largemouth bass in a southeastern reservoir. Doctoral dissertation. North Carolina State University, Raleigh.

Sorenson, K.M., W.L. Fisher, and A.V. Zale. 1998. Turbine passage of juvenile and adult fish at a warmwater hydroelectric facility in Northeastern Oklahoma: monitoring associated with relicensing. North American Journal of Fisheries Management 18:124–136.

Swingle, H.S. 1967. Experiments with the flathead catfish *("Pylodictus olivarus")* in ponds. Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners 18:303–308.

Turner, P.R. and R.C. Summerfelt. 1971. Food habits of adult flathead catfish, *Pylodictus olivaris* (Rafinesque), in Oklahoma reservoirs. Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners 24:387–401.

U.S. Department of Interior (USDI), Fish and Wildlife Service, and U.S. Department of Commerce (USDC), U.S. Census Bureau. 2001. 2001 national survey of fishing, hunting, and wildlife-associated recreation. Washington, DC.

Walburg, C.H. 1971 Loss of young fish in reservoir discharge and year-class survival, Lewis and Clark Lake, Missouri River. Pages 441–448 *in* G. E. Hall, editor. Reservoir fisheries and limnology. American Fisheries Society, Special Publication No. 8, Bethesda, Maryland.

______ and six co-authors. 1981. Effects of reservoir releases on tailwater ecology: a literature review. U.S. Army Corps of Engineers Waterways Experiment Station Technical Report E-81-12, Vicksburg, Mississippi.