

FLOODPLAIN FISHERIES RESOURCES UNDER TRIBAL JURISDICTION OF THE MISSISSIPPI BAND OF CHOCTAW INDIANS

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INTRODUCTION

Floodplain river fisheries are sustained by the spawning and foraging activities of many fishes in oxbow lakes and other backwater areas during high-water periods (Risotto and Turner 1985). In floodplain river ecosystems, the duration and magnitude of flooding and associated river-floodplain exchanges of water, nutrients, and fishes can significantly influence fish production (Welcomme 1976, 1979, 1985, 1986; Goulding 1980) and, thus, angler harvests. Fish catches from floodplain river systems are positively correlated with water levels for the current and previous years (Welcomme 1976; Holck and Bastl 1977). Main channels of floodplain rivers are important in the downstream transport of materials, but data on the distribution and density of fish populations support the postulate that most biological activity and the physical storage or retention of nutrients and organic matter may occur in lateral backwater areas (*e.g.*, oxbow lakes) (Anderson and Day 1986; Grubaugh and Anderson 1989).

The Pearl River basin encompasses portions of midcentral and southeast Mississippi and southeast Louisiana. The main river channel and its oxbow lakes (old river channels seasonally inundated by the river) comprise two major parts of this natural floodplain river ecosystem. Flooding occurs primarily in the winter-spring, and during low flow periods (primarily summer and fall) fish resources can become concentrated in main river channels and in oxbow lakes. Once they are concentrated, fish can be harvested efficiently.

Choctaw Indian Reservation (CIR) lands near Philadelphia, Mississippi, encompass main channel and floodplain components of the upper Pearl River basin. This natural ecosystem establishes culturally important seasonal rhythms on the landscape, within which the Choctaw Indians orient their interactions with fish and wildlife resources. Preliminary consultation with management representatives (Joe Gairdinski, Mississippi Band of Choctaw Indians, personal communication) suggested that most fishing by Choctaw Indians on CIR lands occurs in the oxbow lakes for recreational and subsistence purposes. However, there is little published information on the fish assemblages in this section of the upper Pearl River basin.

Our objective was to characterize the fisheries resources of the Pearl River and its oxbow lakes (in particular) on CIR lands. This was identified by the CIR as an important first step in safeguarding and enhancing relationships between Choctaw Indians and the fisheries resources on their properties and, ultimately, integrating management orientations into overall natural resources programs on the reservation.

METHODS

Limnological conditions and fish populations were sampled in the main channel and oxbow lakes of the Pearl River system near Philadelphia, Mississippi, during spring-summer 1994. Two main channel reaches of the Pearl River were sampled during March-May 1994. Five of the principal oxbow lakes associated with the Pearl River were sampled during May-July 1994. Sampling effort was more intensive in the oxbow lakes, which were presumed to receive most of the fishing pressure.

In stream channels, surface water temperature (°C) and dissolved oxygen concentrations (DO, mg/l) were measured using a YSI Model 54 ARC oxygen meter, stream velocity (m/s) using a General Oceanics current meter, and water clarity (cm) using a Secchi disk. Secchi disk visibility, surface water temperature, and DO were measured at one location per reach and date; water velocity and depth were measured at 15 locations (one for each hoop net) per reach and date. In the oxbow lakes, water depth and vertical profiles (1-m intervals) of water temperature and DO were measured at 1 - 2 locations per lake and date.

River fish populations were sampled using a combination of gears. On each sampling trip, two 23-m trotlines (25 size 4/0 hooks per line) and 15 hoop nets (3 designs x 5 replications) were set ≥ 100 m apart (to reduce gear competition) and fished for approximately 24 hours. Three hoop-net designs were used: (1) small-mesh hoop nets, 1.3-m long, four 0.51-m diameter hoops, 2.5-cm mesh, baited with cheese; (2) small hoop nets, 1.3-m long, four 0.51-m diameter hoops, 3.81-cm mesh; and (3) large hoop nets, 4.3-m long, seven 1.07-m diameter hoops, 7.62-m mesh.

Lake fish populations were sampled using electrofishing, experimental gill nets, and trotlines on 2 - 3 sampling trips per lake (1 - 2 days each). Shoreline electrofishing was conducted using a boat-mounted backpack unit (set at 60 Hz, 600 V) and a two-person crew (one person operated the boat while the other dipped fish); sampling time was approximately 30 minutes per lake and date. Two trotlines (described above) and 2 - 3 experimental gill nets (1.8-m deep x 30-m long, five 6.1-m panels with mesh sizes of 2.5, 3.18, 3.81, 5.08, and 7.62 cm) were set ≥ 100 m apart and fished for approximately 24 hours per lake and date.

All fish collected in the river and lakes were identified to species, measured in total length (mm), weighed (g), and then released. Gear-specific catch rates were used as indices of relative abundance. (River- and lake-fish populations were sampled differently and therefore no statistical comparisons were made between these two habitat types.) The relative weight (Wr) index was used to assess the condition (or plumpness) of stock and quality sizes of fish (Anderson and Gutreuter 1983). Common and scientific names of all fish species (per Robins *et al.* 1991) collected in this study are given in Table 1 (common names only are used in the text).

RESULTS

A total of 30 fish species was identified in collections from the main channel (8 species) and oxbow lakes (27 species) of the Pearl River ecosystem on CIR lands, including 20 species of recreational or commercial importance (Table 1). Bowfin, channel catfish, bluegill, white crappie, and freshwater drum were present in both the main channel and oxbow lakes.

Main Channel

In the Pearl River proper, surface current velocity averaged 21 (range = 12 - 28) cm/s, surface water temperature was 17°C (15 - 24), surface DO concentration was 8.3 (6.7 - 9.5) mg/l, and Secchi disk visibility was 54 (39 - 65) cm.

Of the 8 fish species collected, all were of commercial or recreational importance. Centrarchids (sunfishes, crappies) and ictalurids (catfishes) comprised most of the hoop-net catch (75% of total) and trotline catch (95%), respectively (Table 2). Channel catfish were present in both hoop-net and trotline catches (Table 2).

On average, most of the fishes collected (all except bluegill) exhibited total lengths greater than the minimum quality sizes desired by anglers (Gabelhouse 1984) (Table 3). Catfish weights averaged > 0.40 kg (> 0.8 lb), which included one 4.2-kg (9.3-lb) flathead catfish (Table 3). Wr values averaged 85 for stock-size bluegill (SE = 3, N = 10),

94 for quality-size channel catfish (SE = 6, N = 6), and 96 for quality-size white crappie (SE = 6, N = 4).

Oxbow Lakes

Vertical physicochemical profiles provided evidence of monthly patterns (May - July) of thermal and chemical stratification from the water surface to the bottom (Table 4). Water temperatures, which increased over time and decreased with depth, averaged 27 (range = 24 - 29) °C at 0 m, 25 (21 - 27) °C at 1 m, and 22 (19 - 25) °C at 2 m. DO concentrations, which decreased over time and with depth, averaged 4.5 (range = 2.3 - 6.7) mg/l at 0 m, 2.6 (0.5 - 6.6) mg/l at 1 m, and 1.6 (0.2 - 2.9) mg/l at 2 m. Maximum water depth averaged 1.7 (range = 1.2 - 2.4) m and Secchi disk visibility was 70 (48 - 109) cm.

Average catch rates from gill-netting, electrofishing, and trotlining document the relative abundance of fishes (Table 5). Spotted gar accounted for most (38%) of the gill-net catch, followed by chain pickerel (10%), bowfin (8%), spotted sucker (8%), yellow bullhead (8%), and gizzard shad (6%); other individual taxa represented $< 5\%$ of the catch. Bluegill comprised most (55%) of the electrofishing catch, followed by minnows/shiners (15%), largemouth bass (9%), spotted gar (5%), redear sunfish (5%); other individual taxa represented $< 5\%$ of the catch. Channel catfish and yellow bullhead collectively comprised over 80% of the trotline catch.

On average, most of the fishes collected exhibited average total lengths greater than the minimum quality sizes desired by anglers (Table 6). Individual weights averaged > 0.91 kg (> 2 lb) for bowfin and chain pickerel; and weights averaged > 0.45 kg (> 1 lb) for spotted gar, brown bullhead, yellow bullhead, and channel catfish (Table 5). Wr values for stock sizes of fish averaged 98 for bluegill (SE = 2, N = 76), 88 for redear sunfish (SE = 3, N = 7), and 101 for largemouth bass (SE = 4, N = 3); Wr values for quality sizes were 91 for bluegill (SE = 2, N = 36), 88 for redear sunfish (SE = 1, N = 3), and 105 for largemouth bass (SE = 2, N = 4).

DISCUSSION

Limnological characteristics of the Pearl River and its oxbow lakes were representative of those reported for other low gradient warmwater stream ecosystems in the southeastern U.S. (Hynes 1970; Winger 1981). Generally, water temperatures and DO concentrations observed were suitable for the growth and/or reproduction of most warmwater fishes (Wheaton 1977; Stickney 1979). However, after the oxbow lakes lose their hydrological connection with the Pearl River, in the spring-summer, the remaining lake-fish populations may experience high natural mortality rates associated with the combination of high temperatures and

low DO concentrations; for example, July DO concentrations averaged 1 mg/l, lethal for most fishes (Wheaton 1977; Stickney 1979), in the oxbow lakes at depths ≥ 1 m. Flood pulses, which normally occur in the winter-spring in the Pearl River system, generate a moving littoral habitat in the aquatic-terrestrial zone which prevents stagnation and allows rapid recycling of organic matter and nutrients (Junk et al. 1989).

Fishes (30 species) collected in our study of the Pearl River and its oxbow lakes have been reported in other similar habitats of this river system south of CIR lands (Cook 1959; Holman 1990). Oxbow lakes and other backwater areas provide feeding and spawning habitat for several species of lake- and river-dwelling fishes, as well as nursery grounds for larval and juvenile fishes (Sheaffer and Nickum 1986; Scott and Nielsen 1989; Dewey and Jennings 1992). We observed sexually mature individuals (based on body size (Gabelhouse 1984), presence of eggs or milt, and coloration of males) in the vast majority of the fish populations sampled in the oxbow lakes.

Length and weight data indicate that CIR fisheries resources are interfacing with and are components of functionally efficient floodplain river ecosystem dynamics. Commercial and sport fishes (20 species) collected in our study exceeded the minimum total lengths used to define quality fishing experiences (Anderson and Gutreuter 1983). Most fish were in good condition. On average, species- and size-specific W_r values fell within or close to the optimal range of 95 - 100, suggesting that the fish populations were in balance with their food supply (Flickinger and Bulow 1993). Also, numerous collections of partially eaten fishes (usually in gill nets or on trotlines), large piscivorous fishes (e.g., spotted gar, bowfin, largemouth bass, chain pickerel), and other large vertebrate predators (e.g., alligators, Alligator mississippiensis; snapping turtles, Chelydra serpentina; water snakes, Nerodia spp.) reflect complex predator-prey relationships.

Pearl River channel and oxbow lake fish stocks identified in this study are exploited by the Choctaw Indians (though the nature and extent of fishing effort is unknown) on CIR lands and are renewable resources dependent upon the integrity of an intact floodplain river ecosystem. Flooding recharges shallow aquifers, distributes nutrient-rich materials throughout the floodplain, and stimulates fish production (via spawning and growth). Hence, the sustained abundance and diversity of fisheries resources on CIR lands are dependent on seasonal flooding from the Pearl River.

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Table 1. A list of fish species collected by sampling in the Pearl River floodplain (river proper and oxbow lakes) on CIR lands in Mississippi, March - July 1994.

Common name	Scientific name	River	Lakes
spotted gar ¹	<u>Lepisosteus oculatus</u>		X
bowfin ¹	<u>Amia calva</u>	X	X
gizzard shad	<u>Dorosoma cepedianum</u>		X
chain pickerel ¹	<u>Esox niger</u>		X
blacktail shiner	<u>Cyprinella venusta</u>		X
golden shiner ¹	<u>Notemigonus crysoleucas</u>		X
bluntnose minnow	<u>Pimephales notatus</u>		X
bullhead minnow	<u>Pimephales vigilax</u>		X
lake chubsucker ¹	<u>Erimyzon sucetta</u>		X
spotted sucker ¹	<u>Minytrema melanops</u>		X
yellow bullhead ¹	<u>Ameiurus natalis</u>		X
brown bullhead ¹	<u>Ameiurus nebulosus</u>		X
blue catfish ¹	<u>Ictalurus furcatus</u>	X	
channel catfish ¹	<u>Ictalurus punctatus</u>	X	X
flathead catfish ¹	<u>Pylodictis olivaris</u>	X	
pirate perch	<u>Aphrododerus sayanus</u>		X
blackstripe topminnow	<u>Fundulus notatus</u>		X
blackspotted topminnow	<u>Fundulus olivaceus</u>		X
brook silverside	<u>Labidesthes sicculus</u>		X
shadow bass ¹	<u>Ambloplites ariommus</u>	X	
warmouth ¹	<u>Lepomis gulosus</u>		X
bluegill ¹	<u>Lepomis macrochirus</u>	X	X
longear sunfish ¹	<u>Lepomis megalotis</u>		X
redecor sunfish ¹	<u>Lepomis microlophus</u>		X
white crappie ¹	<u>Pomoxis annularis</u>	X	X
black crappie ¹	<u>Pomoxis nigromaculatus</u>		X
largemouth bass ¹	<u>Micropterus salmoides</u>		X
darters	<u>Etheostoma</u> spp.		X
logperch	<u>Percina caprodes</u>		X
freshwater drum ¹	<u>Aplodinotus grunniens</u>	X	X

¹ Fish species of commercial and/or recreational value in Mississippi.

Table 2. Mean catch rates and standard errors (SE) of fish collected by hoop-netting and trotlining (number per 24 hours) in the main channel of the Pearl River on Choctaw Indian Reservation lands in Mississippi, May-July 1994.

Species	Hoop-Netting (number/day) ¹			Trotlining (number/day)
	SHN-25	SHN-38	LHN-76	
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
bowfin				0.1 (0.1)
blue catfish				1.0 (0.3)
channel catfish		0.1 (0.1)	0.1 (0.1)	0.8 (0.8)
flathead catfish				0.1 (0.1)
bluegill	0.5 (0.5)			
shadow bass			0.1 (0.1)	
white crappie			0.3 (0.3)	
freshwater drum			0.1 (0.1)	
Total	0.5 (0.5)	0.1 (0.1)	0.6 (0.1)	2.0 (0.1)

¹ Three hoop-net designs were used: SHN-25 = small hoop net, 25-mm mesh; SHN-38 = small hoop net, 38-mm mesh; LHN = large hoop net, 76-mm mesh.

Table 3. Mean total length and weight (and standard errors, SE) of stock-size fish collected by hoop-netting and trotlining in the main channel of the Pearl River on Choctaw Indian Reservation lands in Mississippi, May-July 1994.

Species	N	Length (mm)	Weight (g)
		Mean (SE)	Mean (SE)
blue catfish	5	365 (24)	403 (98)
channel catfish	8	353 (19)	411 (72)
flathead catfish	1	690 (-)	4200 (-)
bluegill	10	123 (4)	31 (4)
shadow bass	1	171 (-)	110 (-)
white crappie	5	254 (4)	230 (23)
freshwater drum	1	384 (-)	854 (-)

Table 4. Water temperatures (TEMP) and dissolved oxygen (DO) concentrations estimated in five oxbow lakes in the Pearl River floodplain on Choctaw Indian Reservation lands in Mississippi, May-July 1994.

Parameter: depth (m)	May	June	July
	Mean (range)	Mean (range)	Mean (range)
TEMP (° C):			
0	25 (24-26)	27 (26-28)	28 (26-29)
1	23 (21-27)	26 (23-27)	26 (25-27)
2	21 (19-21)	22 (19-25)	24 (23-24)
DO (mg/l):			
0	4.9 (3.8-6.7)	4.7 (3.1-6.0)	4.0 (2.3-5.9)
1	3.9 (2.2-6.6)	2.9 (1.2-4.4)	1.0 (0.5-2.0)
2	2.1 (1.5-2.6)	2.0 (0.6-2.9)	0.6 (0.2-1.2)

Table 5. Mean catch rates and standard errors (SE) of fish collected by gill-netting, electrofishing, and trotlining in five oxbow lakes in the Pearl River floodplain on Choctaw Indian Reservation lands in Mississippi, May-July 1994.

	Gill-netting (number/day)	Electrofishing (number/hour)	Trotlining (number/day)
Species	Mean (SE)	Mean (SE)	Mean (SE)
spotted gar	1.9 (0.7)	2.0 (2.5)	
bowfin	0.4 (0.2)	0.4 (0.2)	0.1 (0.1)
chain pickerel	0.5 (0.1)		
gizzard shad	0.3 (0.2)		
spotted sucker	0.4 (0.1)	0.1 (0.1)	
lake chubsucker	0.2 (0.2)	1.1 (0.8)	
minnows, shiners		5.7 (2.1)	
channel catfish	0.2 (0.1)		0.2 (0.1)
brown bullhead	0.1 (0.1)		
yellow bullhead	0.4 (0.1)		0.3 (0.1)
topminnows		0.9 (0.6)	
silversides		0.6 (0.4)	
bluegill	0.1 (0.1)	23.7 (7.1)	
redeer sunfish	<0.1 (0.1)	2.0 (0.5)	
longear sunfish		0.2 (0.2)	
warmouth	0.1 (0.1)	0.8 (0.5)	
white crappie	<0.1 (0.1)	0.2 (0.2)	
black crappie	0.1 (0.1)	0.3 (0.3)	
largemouth bass	0.2 (0.1)	3.9 (1.2)	
darters, logperch		0.5 (0.3)	
freshwater drum	<0.1 (0.8)		
Total	5.1 (0.8)	43.0 (10.5)	0.6 (0.1)

Table 6. Mean total length and weight values (standard errors (SE) in parentheses) of stock-size fish collected by electrofishing, gill-netting, and trotlining in five oxbow lakes in the Pearl River floodplain on Choctaw Indian Reservation lands in Mississippi, May-July 1994.

Species	N	Length (mm)		Weight (g)	
		Mean	(SE)	Mean	(SE)
spotted gar	37	533	(22)	624	(91)
bowfin	7	557	(11)	1600	(120)
chain pickerel	2	523	(59)	932	(269)
brown bullhead	2	320	(25)	464	(221)
channel catfish	2	424	(43)	767	(234)
yellow bullhead	7	276	(4)	281	(21)
bluegill	114	135	(3)	55	(3)
redeer sunfish	11	146	(10)	69	(13)
warmouth	7	133	(18)	72	(24)
black crappie	4	239	(25)	262	(64)
white crappie	2	197	(24)	87	(32)
largemouth bass	7	302	(15)	435	(70)