Literature Survey, Status in States of Historic Occurrence, and Field Investigations into the Life History of Alligator Gar in the Ouachita River, Arkansas

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Top left: Felsenthal Lake above dam; Top right: Ouachita River below Felsenthal Lock and Dam; Middle left: Old river channel (note railroad piers and snags); Middle right: Green's Lake; Lower left: Deep Slough; Lower right: placing alligator gar in support bag for weighing.

Left: Weighing alligator gar; Right: large alligator gar prior to release; Bottom: releasing alligator gar.

List of Conclusions

1. A total of 14 alligator gar were captured in the lower Ouachita River in 64 gill net/trammel net nights; 36 jug line nights, 12 hoop net nights, 60 mini-fyke net nights, 110 seine hauls, and 28 days and nights of observation assisted with spot beam lights. No young or juvenile gars were captured during this effort.
2. Alligator gars were not captured above Felsenthal Lock and Dam, although sampling was performed at four general sites. Effort included 28 gill net/trammel net nights, 14 hoop net nights, 10 mini-fyke net nights, 15 trawl hauls, and 28 days and nights of observation with a spot beam light.
3. Alligator gar below Felsenthal Lock and Dam appear to overwinter in the old river channel. Nine alligator gar were captured in the old river channel during winter.
4. Alligator gar may stage prior to spawning in the old river channel, however, alligator gar do not spawn when necessary high water temperature and high water conditions do not coincide.
5. During summer alligator gar utilize the area immediately below Felsenthal Lock and Dam. Seven alligator gar were captured immediately below the dam during summer, two of which had been tagged during winter sampling.
6. Population estimates suggest the alligator gar population below Felsenthal Lock and Dam in the Ouachita River is extremely low, perhaps as few as 31 individuals. Alligator gar ranged in size from 1,059 mm to 2,055 mm in size. Four alligator gar caught by the authors prior to this study but within the study area ranged in size from 562 mm to 2,210 mm.

Abstract

This study includes a survey of know literature on the subject of alligator gar as well as a survey of states known to historically contain populations of alligator gar. A field study was also conducted of a population of alligator gar in the Ouachita River of Arkansas. It appears that the species only occurs in that portion of the Ouachita River below Felsenthal Lock and Dam and above the Louisiana border. Recapture data suggest that the population is extremely small and hence quite vulnerable to over exploitation. The alligator gar in this population appear to restrict their movements within about a 6 km distance: from the channel block in the old river channel during late fall and winter, which area they also may use for spawning during years when favorable conditions exist during March to May, back to the main river channel and upstream to Felsenthal Lock and Dam during summer. Spawning was not documented to occur during 2008, presumably because water levels needed to inundate herbaceous vegetation did not coincide with necessary spawning temperatures. Recommendations concerning management of this alligator gar population are provided.

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Alligator gar, Atractosteus spatula, is considered as a species in need of conservation in the State of Arkansas. It is generally felt that major declines in populations have occurred in the past half century. Notable sport fisheries once existed into the late 1950's and early 1960's in Arkansas' rivers (Layher and Phillips 2000). No spawning has been recorded until 2007 in Arkansas until Adams (2008) found fish spawning in the Fourche La Fave River, a tributary to the Arkansas River.

Layher and Phillips (2000) documented the continued occurrence of alligator gar in the Ouachita River. This study was funded by the Arkansas Game and Fish Commission through State Wildlife Grant funds and by Layher BioLogics RTEC, Inc. The study was divided into three parts: 1) a review of literature on the species; 2) a survey of the status of alligator gar in states of historical occurrence; and 3) a field study of the alligator gar population in the Ouachita River, AR.

A Survey of Known Literature on Alligator Gar

Taxonomy

The alligator gar, Atractosteus spatula (Lacepede 1803), was formerly considered in the genus Lepisosteus. Suttkus (1963) provided a key, synonymy, and descriptive comments and placed the species in the genus Lepisosteus. Wiley (1976) placed the species in the genus Atractosteus. Jollie (1984) offers a review of some bone formations in the species and taxonomic ramifications. A checklist of North American fish species created in 1991 referred to the species by choosing to include the genus category as Lepisosteus (Robins et al. 1991). Some guides to fishes published after 1991 have chosen to follow Wiley's generic suggestion (Page and Burr 1991; Etnier and Starnes

1993; Nelson 1994). Alligator gar has been described from Pleistocene fossils in Kansas, Oklahoma, Nebraska, and Texas (Smith 1958, 1962; Swift 1968).

Description

Miller and Robison (2004) describe the fish as follows: A large, heavy-bodied gar which differs from all other species in having enlarged teeth on the palatine bones of adults. Teeth in the upper jaw are in two rows. The snout is relatively short and broad, the body is covered with heavy ganoid scales, and the tail is abbreviate-heterocercal. Both dorsal and anal fins are situated far back on the body. Lateral-line scales are 58-62. The body is greenish above and paler below, with no spots evident in adults. Young alligator gar may be distinguished from other species by the presence of a narrow, white middorsal stripe bordered by thin, dark lines that run from the snout tip to the dorsal origin. Echelle and Riggs (1972) described characteristics of juvenile alligator gar.

Size

The species is reported to reach adult size between 1,650 mm and up to 2,960 mm. Miller and Robison (2004) report the record alligator gar as nine feet eight and one-half inches long and weighing 302 pounds. The Oklahoma state record was 153 pounds and was taken from the Red River. Weed (1923) offered anecdotal reports of lengths of twenty feet being attained by the species. He does also provide reports of others and their observations. Gars of over nine feet in length were noted in Moon Lake, Mississippi and were being utilized for food by humans.

Range

The alligator gar is known from the Mississippi River basin in the United States. It either occurs or has occurred historically in the states of Alabama, Arkansas, Florida, Illinois, Indiana, Kentucky, Louisiana, Missouri, Mississippi, Ohio, Oklahoma, Tennessee, and Texas. Historically it occurred northward into southwestern Ohio and southward to the Gulf of Mexico. It occurred from the Florida panhandle (Gilbert 1992) in the east to Veracruz, Mexico in the west (Lee et al. 1980). A disjunct population occurs in Nicaragua and northwestern Costa Rica (Lee et al. 1980). The fish is an inhabitant of large rivers, bays, and coastal marine waters. Goodyear (1966) indicates that the fish prefers more pelagic conditions of larger, deeper bodies of water than some other gar species. Warren et al. (2000) list the alligator gar as vulnerable throughout its occurrence in the southeastern United States. They define vulnerable as a species that may become endangered or threatened by a relatively minor disturbance to its habitat or that one that deserves careful monitoring of its distribution and abundance in continental waters of the U. S. to determine its status. Jelks et al. (2008) in a review of North American fishes concluded that alligator gar are vulnerable. Their definition of vulnerable is defined as a taxon that is in imminent danger of becoming threatened throughout all or a significant portion of its range. Reasons listed include habitat destruction and over exploitation of the fisheries.

The alligator gar was common in the rivers and oxbows of Arkansas during the first half of the 20th century (Black 1940; Robison and Buchanan 1988). The fish is known to have occurred in the White River, Cache River, Mississippi River, Arkansas River, Red River, and Ouachita River within Arkansas. Recent captures of alligator gar

have been reported to be primarily large adults. Layher and Phillips (2000) reported capturing three alligator gar in the Ouachita River below Felsenthal Lock and Dam and one specimen in the White River. They concluded that reproduction must be minimal and of concern due to their inability to capture smaller specimens in a survey of Arkansas large rivers (Layher 1998).

The alligator gar occurs in Oklahoma from Green Leaf Creek, to the Poteau, Mountain Fork, and Deep Fork rivers and the Red River westward to Lake Texoma (Miller and Robison 2004). Pigg (1982) noted that the species had been collected in Millwood Reservoir in Arkansas and he sampled the Little River in Oklahoma and did not find alligator gar. Millwood Reservoir is a mainstream reservoir on the Little River near the Oklahoma border in Arkansas.

Etnier and Starnes (1993) report historic photos of specimens from Reelfoot Lake and from the Hatchie River system, as well as a note of two specimens from Kentucky Reservoir, however they note that fisheries biologists have not seen nor taken the species in recent years from any of those locations. They conclude that the alligator gar may be extirpated in the state due to the clearing and draining of swamps, channelization, and other habitat destruction. They do indicate that commercial fishermen profess to catch occasional specimens in the Mississippi River.

Clay (1975) indicates that the alligator gar is rare in Kentucky. Recent collections at the time of Clay's report include a specimen from the Bayou de Chien near Hickman and as far upstream in the Ohio River as Bracken County. Burr and Warren (1986) offer only four records of the species in Kentucky waters.

Boschung and Mayden (2004) report that in Alabama, the alligator gar occurs in the Mississippi Sound and brackish water of the Gulf Coast and Mobile-Tensaw Delta. They noted that the species rarely moves far inland. Alabama represents the periphery of the species' range. The species is classified as a sport fish in Alabama and a creel limit of two per day was established. Commercial exploitation is not allowed (Boschung and Mayden 2004).

Trautman (1981) included the alligator gar in the fish faunal list of Ohio thought he had never seen a specimen form the state. Kirtland's drawing and description from 1844 indicate that the fish occurred in the Ohio River at that time. Trautman's records in The Fishes of Ohio (1981) are based primarily on anecdotal reports and are limited to a few locals.

Smith (1979) reports the species as rare in Illinois waters with few records available. The fish had been reported from the Big Muddy River near Carbondale and the Mississippi River above St. Louis as well as from the lower Illinois River. Several other locals have specimen records from files. A juvenile was reported as collected in the Illinois River in 1935.

Pflieger (1975) reports alligator gar only occurring in Missouri in the Mississippi River. He indicates that recent collections are rare. The fish rarely occurs above the confluence of the Missouri river.

Robinson (1959) reports the alligator gar from the lower portion of the Rio Grande River in Texas.

Fuller et al. (1999) does not list introductions of alligator gar into waters outside of its historical range in the United States. Raquel (1992) reported the collection of one

large alligator gar, (1.5 m in length) in the Sacramento-San Joaquin Delta of California 130 km upstream of the Golden Gate Bridge. Raquel (1992) hypothesized that the occurrence was the result of an aquarium enthusiast who released the specimen, which is sometimes sold by the pet trade near that local.

Spawning:

Etnier and Starnes (1993) suggest that little is known of the life history of alligator gar but note that the April to June spawning season coincides with seasonal flooding of bottomland swamps and due to the building of levees and channelization, both the gar and its spawning habitat have declined sharply. Suttkus (1963) indicates spawning as occurring in Louisiana from April to June. Moore et al. (1973) described a postlarval alligator gar collected in May from the Red River. May and Echelle (1968) found young alligator gar in Oklahoma in Lake Texhoma and concluded that spawning must have occurred in the first half of May. McCarley and Hill (1979) found two young alligator gar in a pond next to Lake Texoma in July. They indicated that the pond was connected to the lake during June of that year. Pigg (1982) found two alligator gar of lengths 10 and 11.9 centimeters on July 1, 1981, in a backwater channel along the Red River in Oklahoma. Twenty-one young-of-the-year were collected in the Arkansas River on June 16, 1993 in a large floodwater area. Specimens ranged from 15 to 21 mm and represented the first evidence of reproduction in Oklahoma waters since the early 1980's (Pigg and Gibbs 1996). Mexican researchers found alligator gar to spawn in a reservoir from July through August (Garcia De Leon et al. 2001). Ferrara (2001) collected 250 alligator gar from three populations; one in Alabama and two in Louisiana. Sex ratios were essentially 1:1 in all three populations however there was a difference in both length

and weights in the populations. Fecundity averaged 157,291 eggs per female with larger females producing more eggs. Based on otoliths the maximum age was 50 years with the average female at 13.9 years and males averaged 11.0 years in age. Otolith bands form in late spring and early summer. Gar from Alabama differed in age structure, mean age was 17 years compared to 12 at other locations. Ferrara (2008) reports a generation time of 36.1 years for Alabama populations and 22.4 years for Louisiana populations. Modeling life history indicates a reproductive output of 22 to 94 female offspring per female during a lifetime. Because of low productivity, the alligator gar is most vulnerable to anthropogenic factors.

Food Habits

Sutttkus (1963) found alligator gar to feed on fishes and crabs. Raney (1942) noted that alligator gar sometimes feed on birds. He described predation by gar on water turkeys (anhingas), ducks, and the use of grackles as bait for alligator gar. Goodyear (1967) reported feeding by the species on refuse. He examined 36 individuals and found 47 food items. The most common item was the sea catfish, Galeichthys felis. Small specimens of this catfish are often released from fishing boats around docks making them easy prey for larger fish. All of the alligator gar in Goodyear's study were collected around such docks. Seidensticker (1987) collected 209 alligator gar in Sam Rayburn Reservoir for stomach analysis, and 126 of these specimens contained no food items. Twelve fish species occurred in the stomachs: gizzard shad, channel catfish, freshwater drum, sunfish, suckers, white bas, buffalo, largemouth bass, spotted gar, lake chubsucker, crappie, and carp. A coot was also found in one specimen. Gar food items varied

significantly from fish captures in gill nets using an electivity index. Most common food items were gizzard shad, freshwater drum and channel catfish. Garcia De Leon et al. (2001) found that largemouth bass were the primary food item of alligator gar in a Mexican Reservoir. Fishes collected were those taken by commercial fishermen who collected alligator gar during spawning season in shallow waters. It appeared that primarily males were taken and that males remained in such shallow areas longer than females which were rarely caught. Alligator gars were not caught in October through February when they were thought to move offshore into deeper waters. Juvenile gar were found to feed on insects and gambusia (Echelle and Riggs 1972). Hussakof (1914) noted a six inch long crappie removed from the stomach of a large alligator gar being prepared for food by local citizens at Moon Lake, Mississippi. Another gar he described was reported as containing a shortnose gar of slightly over two feet in length.

Age

Irwin et al. (2001) reported that females in a population studied in the Mobile-Tensaw Delta were older and larger than male counterparts. Females reached sexual maturity at age 11 and were reported as reaching 50 years of age. Males matured at age 6 and reached an age of 26 years. Gonadosomatic indices and reproductive hormone analyses indicated spawning occurred in late spring. Fecundity is related to length with an average of nearly 140,000 eggs produced per female.

Home Range

Sakaris (2003) fitted alligator gar with external transmitters in an attempt to document movements of fishes. Fifteen fish were tracked with twelve being located after tagging. Fish home ranges were thought to vary from 2.73 to 12.25 km. Small fish exhibited site fidelity while larger fish were highly mobile.

Capture Techniques

Most researchers appear to catch specimens in gill nets of varying dimensions. Seidensticker and Ott (1988) compared the use of gill nets with jug lines in capturing alligator gar in a reservoir environment. Catch per Unit Effort data were significantly greater for jug lines than gill nets and jug lines appeared to be more selective for gar.

Management Considerations

Wilde et al. (2007) suggest that sexual dimorphism in alligator gar should be considered in establishing fishing regulations based on fish length. Not doing so may result in overfishing and population declines. However it is difficult to distinguish males from females. Ferrara and Irwin (2001) suggest that even examination of internal reproductive organs is not reliable during all seasons as ovaries may resemble testes. They suggest examining gamete release pathways as a method of distinguishing males from females by identifying either oviducts or vasa efferentia. Obviously this has ramifications especially for research on the species and the determination of management options including population structure information.

Many authors suggest that fishermen often view gars as causing declines in sportfishing (Scarnecchia 1992). Even fish managers often view gars as detrimental to sportfish populations (Gowanloch 1940). Bonham (1940) found eel, freshwater drum, and bigmouth buffalo in stomach analyses of 21 large alligator gars. Weed (1923) indicated the dislike of gar by the public but offered that perhaps we should consider other things related to the species. Scarnecchia (1992) suggests that gar may actually increase the size of sportfishes caught by anglers. Knapp (1953) suggests that gars do not detrimentally affect sportfish populations.

Simon and Wallus (1989) offer a few notes on gar larval development. Mendoza et al. (2002) studied the culture of alligator gar and document physiological and anatomical changes during development. They also developed a diet of artificial food reducing cannibalism in young gar increasing survival to a stocking age. They offer that growth rates equaled those of natural diets and that gar juveniles reached 30 cm in four months.

Ferrara (2008) summarizes a number of possible management strategies. If alligator gar are considered threatened then all life stages should be protected. Of interest, Alabama exhibited the lowest exploitation rate and had the oldest and largest individuals of three populations sampled. For exploited populations options may include maximum size limits, slot limits, creel or effort restrictions, catch quotas, refuges, and complete closure of fisheries. She suggests maximum size limits to protect all adults such as less than 1000 mm TL or to allow harvest of young adults but protect older individuals who are more important to reproductive output, fish less than 1650 mm. Slot

limits could also protect adult fishes. Closure during spawning would assist reproductive efforts and trophy tags including a lottery to fix harvest potential are additional options.

Survey Regarding the Status of Alligator Gar

A survey (Figure 1) was sent to a list of persons who were known to have interest in gar species. The list of individuals to whom the survey was sent included those contained in a list of individuals maintained by the International Network for Lepisosteid Fish Research and Management. The survey contained questions regarding the existence of populations within a state, whether or not alligator gar were considered game fish, whether harvest occurs, what restrictions if any are placed on harvest, and whether numbers are available for harvest and methods used for the harvest. Additionally respondents were asked to provide any reports and or data that might be available and to describe any current surveys or research investigations which might be occurring within their respective states. Responses were received from two individuals in Louisiana, Mississippi, and Oklahoma; one each from Texas, Arkansas, Indiana, and Ohio. Three responses were received from Florida.

Florida:

The harvest of alligator gar has been prohibited in Florida based on anecdotal reports about low numbers of fish and based on sampling for other species such as striped bass with low catch rates of alligator gar. Distribution is northwest Florida east to Bay County. They are known to occur in the Choctawhatchee River and likely occur in all coastal rivers westward from that point.

Louisiana:

Louisiana respondents indicated that alligator gar occur statewide. They are not considered game fish in Louisiana and there are no restrictions on harvest. Data apparently is collected by the Louisiana Department of Wildlife and Fisheries; however it is only released upon written request with an explanation of why the data is requested. We did request the information but have not received any information to date. The agency has conducted an ageing methodology study. Researchers at Nicholls State University are currently engaged in studies regarding specific life history parameters, population genetics, age and growth, gonad histology, aquaculture, and tolerance to salt, nitrite, and ammonia.

Texas:

Texas indicated that populations occur in the Trinity River, Lake Livingston, and Sam Rayburn Lake. Kirkland (2008) has tagged over 350 specimens this calendar year with five individuals weighing over 200 pounds. Kirkland (2008) reported that alligator gar are considered rough fish in Texas with virtually no regulations on take. Most gar harvest is from commercial fishermen and bow fishing. Gar spawn in flooded grasses in the Trinity River from May through to as late as July. Kirkland (2008) noted juvenile gar with dorsal stripes from May through August in 2007. Kirkland 92008) believes alligator gar may gain 10 to 20 pounds in one year during early years and has documented 18.5 inch growth in one tagged individual in six months.

Oklahoma:

In Oklahoma, effective January 2009, the following regulation will be enforced: One (1) alligator gar (Atractosteus spatula) per day, statewide, except during the period of May 1 through May 31 when angling for alligator gar by all angling methods is prohibited on Lake Texoma between the Highway 99 bridge upstream to the I-35 bridge. The catch and release of alligator gar is permitted year round, except during the closure referenced above, by use of rod and reel, trotline and throw lines. Alligator gar must be released immediately unless kept for the daily limit. Alligator gar taken by bow and arrow, gigs, spears or spear guns shall not be released. Alligator gar caught and placed on a stringer or otherwise held in possession cannot be released (no culling). Persons fishing trotlines or throw lines must release all alligator gar on their lines, except the one (1) alligator gar held in possession for their daily limit, before leaving the trotline or throw line. Anglers must cease snagging when they have taken their daily limit of alligator gar into possession. Popular recreational harvest methods include rod and reel and bow fishing. Miller R. J. and H. W. Robinson. (2004) in Fishes of Oklahoma. University of Oklahoma Press, Norman, OK. indicate that alligator gar are primarily found in the lower Red River and select tributaries west to Lake Texoma which contains a breeding population. Although absent or rare today, alligator gar were historically found in lower reaches of the Arkansas River within Oklahoma including Robert S. Kerr Reservoir. The Oklahoma Cooperative Fish and Wildlife Research Unit (Oklahoma State University) is finalizing a study focusing on alligator gar distribution, abundance, movements, habitats and population characteristics in the Red and Arkansas River drainages of Oklahoma (Brinkman and Fisher 2007.), Distribution and Ecology of

Alligator Gar in Oklahoma, Performance Report, Federal Aid Project F-62-R-2, Stillwater, OK. A 2008 Performance Report and/or Final Report is pending.

Arkansas:

Arkansas contains alligator gar populations in the White River, lower Cache River, the Arkansas River, Fourche River, Ouachita River, and perhaps the Red River. The alligator gar is considered a sport fish, harvest does occur by angling, commercial fishing, and bow fishing. There is a sportfish creel of two fish per day. Current investigations include a study of the life history of alligator gar in the Ouachita River, a literature survey on alligator gar, and a state survey of the status of the species. These efforts are contained within this report. Researchers at the University of Central Arkansas are currently investigating a population of alligator gar in the Fourche La Fave River near the confluence with the Arkansas River. Researchers have documented spawning for two years, delineated some growth information for juveniles, and tagged specimens to track movements (Adams 2008). Life history and habitat information are being collected by the Arkansas Game and Fish Commission on the Cache, Mississippi, and White Rivers. Recently in September of 2008 a 197 pound alligator gar was captured by a commercial fisherman in the White River at the confluence of Roc Roe Bayou.

Mississippi:

Alligator gar are distributed in Mississippi in coastal rivers and bays. Campbell (2008) noted a capture of alligator gar in the Coldwater River Basin in Bobo Bayou. Based on sizes of fish land at an annual fishing rodeo, the Mississippi Deep Sea Fishing

Rodeo in Gulfport, populations appear stable (Riecke 2008). Length and weight data has been collected for the past ten years at the event. Tissue samples are sent to Auburn University and Southern Illinois University for genetic analysis. The species formerly occurred in the Yazoo River system but few reports of captures or sightings have been made the past few years. Alligator gar are not considered game fish but there are restrictions on harvest since March 2001 which set a daily limit of two per day for both sport and commercial fishing. Alligator gar are currently spawned at a hatchery in Tupelo, MS for transfer to Tennessee and Alabama. Some gar used for spawning have been captured near Natchez, MS in the Mississippi River floodplain as the river rises prior to spawning. This usually occurs at a water temperature of 72-74 degrees F (Campbell 2008).

Alabama:

The State of Alabama restricted a two fish per day limit in 1992. This also ended commercial harvest and current harvest is restricted to bow-anglers and hook-and-line anglers (Ferrara 2001).

Ohio:

Alligator gar are considered extirpated in Ohio. Only four confirmed records exist: one from between 1838 and 1840; one from around 1840; one from 1928; and the most recent was collected in 1946. All records came from the Ohio River.

Indiana:

Historical records of alligator gar are available from Indiana. Records of occurrence are available from the lower Wabash River in southwestern Indiana and from the Ohio River (Falls of the Ohio). The fish is considered extirpated from Indiana (Fisher 2008).

Life History Study of the Alligator Gar in the Ouachita River, Arkansas

A field study of alligator gar was conducted in the Ouachita River, Arkansas during 2008. Objectives of the study were: 1) develop a length-frequency histogram of alligator gar captures in the Ouachita River; 2) determine if reproduction is occurring in alligator gar in the Ouachita River; and 3) document seasonal distribution of alligator gar in the Ouachita River.

Study area

The study area included two regions of the Ouachita River and associated backwaters and sloughs connecting areas to the river. The Moro Bay State Park area and adjacent backwater areas to the Ouachita River downstream including Green Lake, Deep Slough, and Pine Prairie Flat (Figure 1-5) comprised the study area above Felsenthal Reservoir.

Moro Bay is a relatively deep open water habitat for some distance upstream on Moro Creek. At the upper end of the bay a large wetland area exists with cypress trees in the open water and during high water, many areas of inundated terrestrial herbaceous plants as well as inundated buttonbush and other shrub-like vegetation. Moro Creek is the tributary which enters Moro Bay.

Downstream of Moro Bay, a backwater channel exists bordering the State Park on the south. This channel is relatively deep and well incised with no vegetation present in littoral areas.

Some distance downstream, Deep Slough forms a confluence with the river. At times when water is high enough to connect Green Lake with the Ouachita River via Deep Slough, the lower part of the Deep Slough Channel is relatively open water and

varies in depth from two to six feet. Farther upstream Deep Slough bends sharply to the right facing upstream. On the left at this bend, a large open water area exists with standing cypress trees. Before reaching that area a shallow wetland area exists on the right with large amounts of inundated terrestrial vegetation such as ragweed and cocklebur as well as shrubby vegetation. Deep Slough from this juncture up to Green Lake is a not well defined channel with much woody vegetation and inundated buttonbush. Green Lake consists of an old oxbow lake that is relatively deep, open water habitat ringed with cypress.

Some distance downstream on the Ouachita River from Deep Slough is a backwater area that at one time was connected to the Ouachita River as an embayment above a bend in the river. The connection of the area, Pine Prairie Flat, is now cutoff from the river by large deposits forming a sandbar. Upstream a manmade channel has been constructed some twenty feet wide which allows boat access to the backwater. The riverward side of the backwater consists of willows, and herbaceous vegetation which is inundated at high water levels. Some grassy areas also become inundated. The easterly side of the embayment consists of well groomed yards where dwellings exist, mostly seasonal cabins.

The study area also included the area from Felsenthal National Wildlife Refuge including the Felsenthal Lock and Dam down to the Louisiana border (Figure 1). This area consisted of that portion of Felsenthal in proximity to the dam on the upstream side, the downstream river to the Louisiana border, the boat access channel below Felsenthal to the river, the old river channel, and several small backwater areas between Felsenthal Lock and Dam and the Louisiana border. The only tributary of significance entering the

river in this segment is Coffey Creek which discharges wastewater from Georgia Pacific. The stream exhibits high water temperatures often over 100 degrees and virtually is devoid of dissolved oxygen. The stream is deeply entrenched with bare banks and no vegetation in the water. Discharge is about one million gallons per day of effluent.

Methods

Funding for the project was received in mid-December for the project. We decided that it might be wise to wait sometime before beginning sampling due to high water and cold temperatures.

Because of the uncertainty of the distribution of alligator gar in the lower Ouachita River, our first objective was to locate areas that the species utilized. Layher and Phillips (2000) failed to find alligator gar below Callion Lock and Dam upstream of Moro Bay. Because the river had not been sampled between Felsenthal and Callion, the reach from Moro Bay to Felsenthal was considered a possible area of inhabitation by the fish. Alligator gar were known to exist below Felsenthal Lock and Dam from prior collections (Layher and Phillips 2000). Upon locating alligator gar adults in winter, we made an attempt to follow their movements both with netting and visually. Upon monitoring adult individuals throughout the potential spawning period based on literature, April through June, we hoped to observe spawning activity by adults and follow this effort with seining, spot lighting and the utilization of mini-fyke nets in an attempt to document the occurrence of juvenile fish. All adult fish captured were marked with an ear tag, normally used for pigs, by placing the tag next to the caudal penduncle in the center of the caudal fin. This identification would allow the recognition of adults if captured in other areas in later seasons. Areas where alligator gar adults were captured

were monitored until no other captures occurred or no visual observations were made. Visual observations were used to locate gar during summer. These areas were then sampled with additional netting activity. All gill nets and trammel nets were ran at least every three hours in an effort to prevent mortality of captured fish.

Sampling was initiated in the Moro Bay area on February 9, 2008. Five experimental gill nets consisting of monofilament mesh and 91 m (300 ft) in length and 1.8 m (6 ft) in depth were placed in the upper end of Moro Bay. This area was relatively deep (12 ft) and was interspersed with islands of inundated shrubs, willows, and with occasional cypress trees in open water. Two trammel nets were also deployed. Each trammel net consisted of a mesh size of 7.6 cm (3 in) in the inner panel, with two outer panels having a mesh size of 61 cm (24 in). Nets were 3m (10 ft) in depth.

Seven hoop nets were placed in the main river channel above Moro Bay along shorelines with relatively steep drop offs. Five mini-fyke nets were also deployed along an open sand bar and in vegetated areas along the river with leads extending out into the river channel but in areas with little velocity to keep them from rolling. All nets were run for a two day period. Several trawl hauls were conducted on February 9, 2008 upstream of Moro Bay in the main river channel. Trawls were again made above Moro Bay (three hauls), in Moro Bay (two hauls), and in the main river channel near Pine prairie Flat (three hauls) on June 12, 2008. Four seine hauls were made above Moro Bay in the main river channel and six hauls were made in the vicinity of Pine Prairie Flat on the same date.

Three experimental gill nets and one trammel net were deployed in Green Lake on May 19, 2008 and run for two nights. Simultaneously, a single gill net and a single trammel net were placed in the small backwater area known as Pine Prairie Flat.

The Moro Bay backwater area, Green Lake, and Deep Slough were all traversed at least two days and nights per week beginning in mid-April through mid-July. This effort consisted of traveling shallow backwater areas, shorelines, and stream edges in an attempt to view either staging or spawning adults or juvenile alligator gar. Spot beam lights were used at night to examine water edges especially in or near vegetation. Two boats were utilized, each with an operator and a person operating the light in the bow of the boat.

On February 22, 2008 we set experimental gill nets and trammel nets in the main river channel below Felsenthal Lock and Dam and in the old river channel. One gill net was placed in the main river channel immediately below the buoy line on the right side of the river facing upstream. Another was placed perhaps 400 m below the dam channel block in the old river channel. Two trammel nets were placed in the old river channel, one in the bend of the channel and another just above the confluence of the old channel with the river. A gill net was deployed above the confluence of the boat access channel with the river. Nets were run for three days and two nights.

We returned to the old river channel on February 29, 2008 and deployed two trammel nets in the old river channel. One net was placed below submerged trees at the upper end of the channel and another trammel net was set near the confluence with the river. Three gill nets were placed in between the trammel net sets.

A total of nine gill and trammel nets were deployed on March 08, 2008. A gill net was placed between the channel block at the upper end of the old river channel and the railroad piers downstream (channel). A gill net was placed some short distance below the piers and above submerged trees. Another was placed between submerged trees. A trammel net was placed below the third gill net. Another gill net was placed in the old channel just above the bend. Two gill nets were placed longitudinally in the channel near either end of the last placed gill net. A final trammel net was placed at the mouth of the old river channel near the main river channel. We placed a ninth net (gill net) across the mouth of Coffey Creek and tied it to trees on either side.

Beginning in mid-April, shoreline observations were begun similar to those employed in the Moro Bay area utilizing spot beam lights at night. Shorelines of the old river channel, boat access channel, backwaters and river shorelines were traversed at least four nights per week and three days. Some backwater areas were seined and min-fyke nets were used to sample vegetated areas and other shoreline habitats. These efforts continued through July 12, 2008.

Two trammel nets were placed in the old river channel on June 02, 2008. One net was placed between the railroad piers and the channel block. The remaining net was placed longitudinally in the old channel in front of the confluence of a small slough on the right side facing upstream just below the area of submerged trees in the old channel. A series of jug lines were placed in the main river channel from the buoy line below the lock and dam downstream to the river's confluence with the old river channel. All jugs were placed in low velocity areas along the right bank facing upstream.

On June 28, 2008 four trammel nets and two gill nets were placed above the buoy line just below the lock and dam. Nets were placed at intervals between the dam and the buoy line prohibiting recreational craft up to the dam. With the assistance of the Arkansas Game and Fish Commission we were able to obtain permission from the U. S. Army Corps of Engineers to access the area. Six jug lines were also placed above the buoy line and four hoop nets were placed just above and below the boat access channel within the Ouachita River. Two mini-fyke nets were placed downstream in the Ouachita River in a backwater area that was the confluence of a slough with the river.

Alligator gar captured were measured in mm and weighed in pounds, later converted to grams. Other fishes captured were also measured and many were weighed. This bycatch will be reported in a summary of large river fish distributional studies currently being conducted. Water temperature and dissolved oxygen were measured with EPA approved water quality testing equipment. Depths were also recorded using a Hummingbird depth finder.

Results and Discussion

All efforts in the Moro Bay vicinity including Green Lake, the main river channel, Deep Slough, and Pine Prairie Flat were negative with regards to alligator gar. No adults were seen or captured and no juvenile were observed. Conversations with local fishermen both recreational and commercial indicated that no alligator gar had been seen in those areas for years.

Green Lake was interesting in that no fish captures of any species occurred in that water body utilizing gill and trammel nets. Depths of net sets varied from 14 to 22 ft. Secchi disk readings exceeded 764 mm.

Pine Prairie Flat water temperature was 80 degrees F on May 19, 2008. Water depths ranged from nine to eleven feet. Fishes caught in this backwater included black buffalo, channel catfish, common carp, and skipjack herring.

On February 09 and 10 of 2008, we set nets at Moro Bay on the Ouachita River. Five gill nets and two trammel nets were set for two nights each for a total of 14 net nights and resulted in the capture of no fish of any species. We also set 7 hoop nets in the main river channel for two nights which also did not result in a single fish capture. Water temperature was 52 to 53 degrees F. We did visit with several fishermen who were pulling nets and indicated verbally to us that they also were not catching fish. We pulled our nets as well. We were able to capture small fishes with trawls and mini-fyke nets including a variety of chubs, cyprinids, and percids.

On February 22-24, we utilized gill nets and trammel nets in the Ouachita River at Felsenthal below the lock and dam. We set nets in the backwater near where the boat access is located, in the main river channel near the buoy line below the dam, and up the old river channel. Air temperature was around 35 degrees F however water temperature was 53 degrees. Our efforts resulted in the capture of a 53 lb. alligator gar in the old river channel on February 24.

On February 29, 2008 we set five gill nets and trammel nets in the old river channel at Felsenthal as this was our only capture location to date. Nets were tied so that the lead line was on the substrate of the channel. We captured six alligator gar in the nets on 03/01/08. Two additional specimens were captured on the following day on 03/02/08 for a total of eight specimens for this sampling trip.

We returned to the old river channel area on 03/09/08. Recently cold temperatures with snow made us think that gar may still be in the old channel. However air temperatures warmed up quickly the day after the snow fall. We placed a total of eight gill nets and trammel nets in the old river channel as well as a gill net across Coffey Creek which had water flowing into it from the rising Ouachita River. In total nine gill nets and trammel nets resulted in no alligator gar captures. Water temperature had risen to 59 degrees F and secchi disk readings were 263 mm, while on the previous week the secchi disk reading was 549 mm.

At this time we felt that alligator gar perhaps had started moving to potential spawning areas as fish were no longer found on the channel bottom. We chose not to continue netting as we did not want to disrupt potential spawning behavior and fish movement. We began our visual reconnaissance of the river and backwaters at this time.

The only area which we observed alligator gar was in the upper one-half of the old river channel below Felsenthal Lock and Dam. Juvenile shortnose gars were abundant in flooded vegetation along the right side of the old river channel facing upstream toward the channel block on May 21, 2008. A small slough enters the channel approximately 400 meters below the channel block. High water had inundated willows and shrubs in this area adjacent to the confluence of the slough and extended back into larger riparian growth. A large alligator gar estimated at nearly seven feet in length was noted in the open water near the inundated vegetation line at 10:20 p.m.

On May 26, 2008 a large number of alligator gar were noted rolling on the surface at the upper end of the old river channel in the area between old railroad bridge piers. It seemed that the most activity was noted between 2 and 5 p.m. On May 31, 2008 water

temperatures in the old river channel had risen to 29.7 degrees C. Dissolved oxygen was relatively high at 8.80 mg/l. Large gars were noted in the open channel near several submerged snags, though not nearly as abundant as on May 26. During this time between May 21 and May 26 water temperatures rose significantly however water levels also dropped significantly leaving previously inundated vegetation dry. The last alligator gar noted in the old river channel was at 7:55 a.m. on June 01, 2008. Adams (2008) indicated similar staging behavior in a population of alligator gar in the Fourche River, AR during this same time period.

We placed two trammel nets in the upper end of the old river channel on June 02, 2008 in areas where gar had been noted for the prior month. Water temperature was 30.6 degrees C and dissolved oxygen was 6.34 mg/l. One net was placed between the railroad piers and the other was placed longitudinally with the channel in front of the confluence of the small slough where juvenile shortnose gar had been seen. Jug lines were also placed in the Ouachita River. No alligator gars were captured. Other fishes captured included bigmouth buffalo, smallmouth buffalo, blue catfish, flathead catfish, freshwater drum, common carp, and longnose gar. With no captures made at this time in the old river channel, observations of other areas continued with some seining of small backwater inclusions on the river and the use of mini-fyke nets in the small slough areas downstream. No juvenile alligator gars were ever captured and no adults were observed at any location except for immediately below the lock and dam.

With no evidence that spawning had occurred based on adult observations and shoreline sampling and reconnaissance for juvenile occurrence, we decided to sample the area below the lock and dam as described in the methods section. A total of five

untagged alligator gar were caught, three on 06/27/08 and two on 06/28/08. They ranged in total length from 1104 mm to 2055 mm. Two alligator gar previously tagged in February in the old river channel were also captured. Tag numbers of the recaptured fish were tag number 2 and tag number 10. The two alligator gars captured on 06/28/08 were dead upon net retrieval. Water temperature was 30.6 degrees C and dissolved oxygen was 6.30 mg/l. Because of mortality and the small number of gar thought to make up the population in the area it was decided to cease netting activities.

A length weight plot was made (figure 8) which included four fishes caught in previous studies but in the area of the population studied. Table 1 denotes individual lengths, weights, dates of capture, and tag numbers if applicable.

From data on recaptures, it is apparent that the population of alligator gar below Felsenthal Lock and Dam in the Ouachita River is in peril. Multiplying tagged fish in February (9 total) and upon summer sampling only seven fish were captured (two tagged), results in a population estimate of 31 individuals. Fish were caught in the summer some 6 kilometers distant from capture at tagging.

It is apparent that alligator gars spend the winter in the old river channel. Local commercial fishermen indicate that every late fall to early winter the alligator gar move out of the river channel into the old river channel through winter. Our observations confirm this. We also feel that even though spawning was not recorded that the fish utilize low lying areas adjacent to the old channel when conditions are correct. In our sampling (2008) the river was high during late winter but by the time water temperatures reached nearly 30 C, the river level had dropped and removed potential spawning habitat. Because of the lack of all sizes of alligator gar captured which doesn't reflect a

continuum; we hypothesize that alligator gar spawn infrequently in the Ouachita River. Most years probably do not afford suitable habitat and temperature. The gar moved into the river and were located near the dam on the edges of current in slower waters where they undoubtedly were feeding.

Several options are available to restore the alligator gar populations in the Ouachita River. Firstly affording protection to the existing numbers should be a high priority. Either limiting harvest extremely by a trophy tag scenario (perhaps 1 per year) or completing closing the season on alligator gar harvest is recommended. We also believe that alligator gar should be protected during winter from net exploitation by closing the season in the old river channel permanently. This would also protect spawning individuals.

The construction of a one to two acre spawning wetland is another possibility. Such an area could be constructed along the old river channel and planted to herbaceous wetland vegetation. This would insure spawning habitat even if the river dropped prior to adequate temperatures being reached to entice spawning in the fish.

It is quite probable that the fish has lost its reproductive habitat through the construction of upstream reservoirs that control spring flood events by lengthening the time it takes for such waters to exit the system, thereby keeping the river somewhat higher than average for a longer period but not high enough to flood spawning areas. Because such releases are also made from hypolimnions, temperatures are artificially cooled which prevents the combination of high water and warm temperatures needed for spawning in alligator gar. Length-frequency distribution of captured alligator gar in this

study indicate that few year classes are present and that recruitment to the population is infrequent (Figure 9).

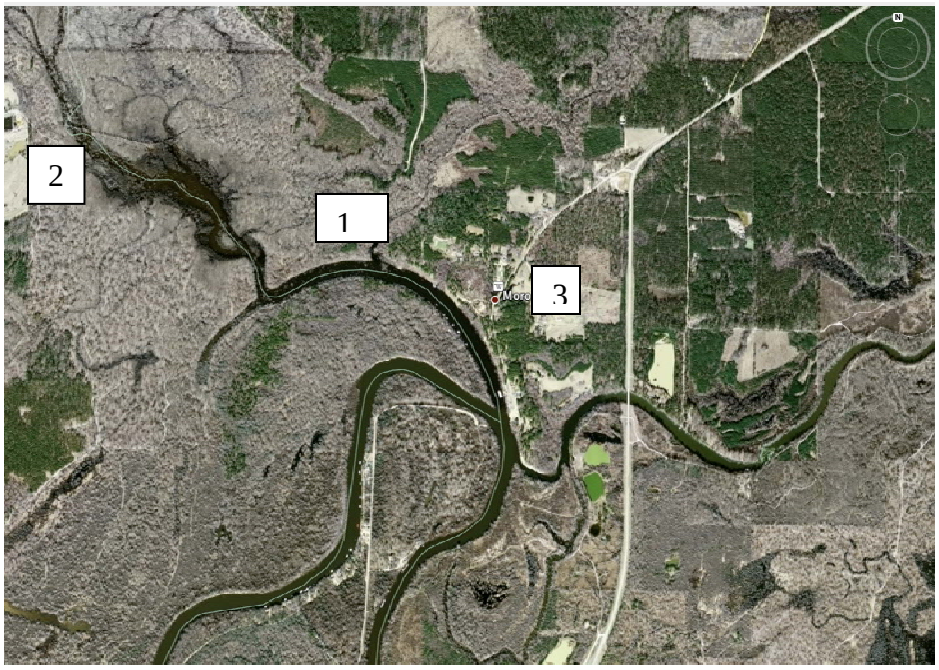

Figure 1. Moro Bay (1) and loop of the Ouachita River. Moro Creek (2) enters the bay area through a wetland located in the top left of photo. The arched area below the wetland in center is Moro Bay. Moro Bay State Park (3) is located in the top right quadrant of photo.

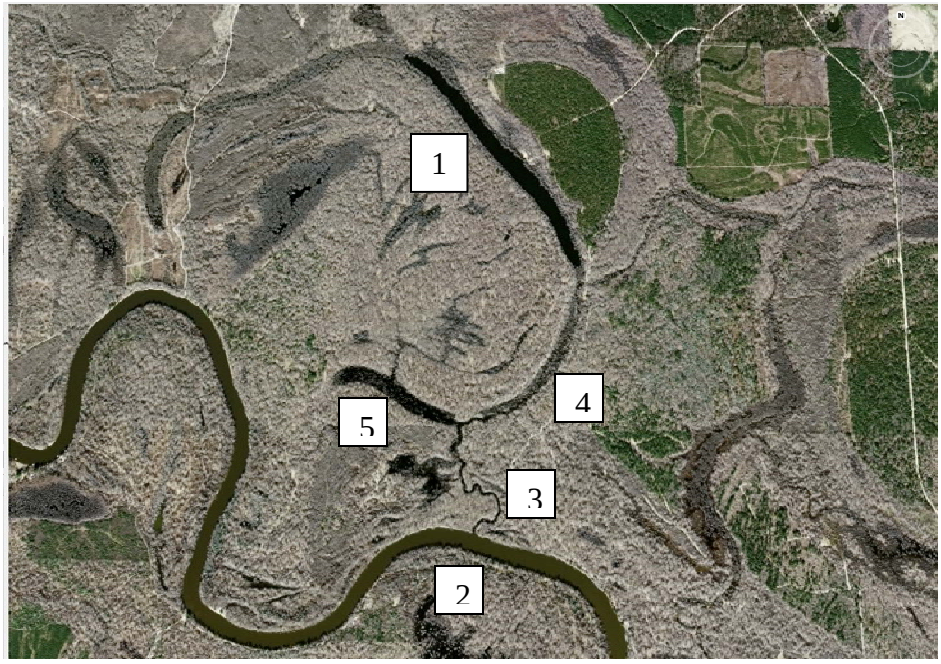

Figure 2. Green Lake (1) is located in the top center of the photo. We entered the lake from the Ouachita River (2) at bottom center of photo, traversed upstream through Deep Slough (3) and entered a wetland area at upper end of slough (4) which turns right from an unnamed water body (5) and continues through a not well defined channel into Green Lake.

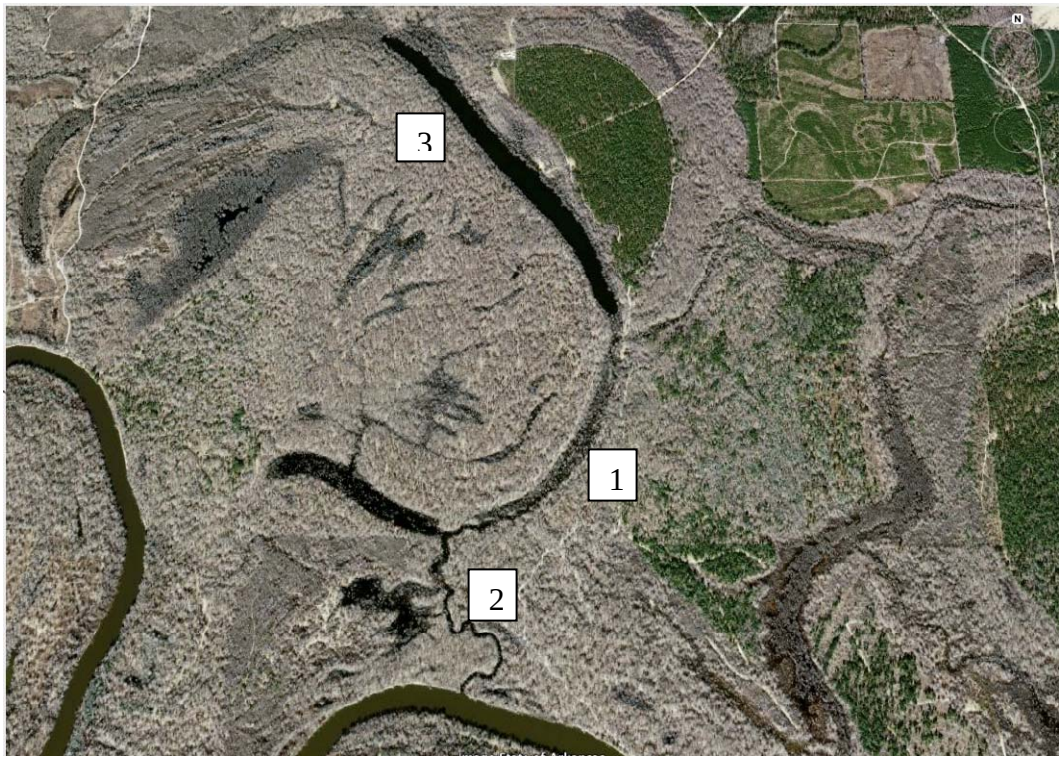

Figure 3. Note vegetation in channel (1) between upper end of open channel of Deep Slough (2) and Green Lake (3).

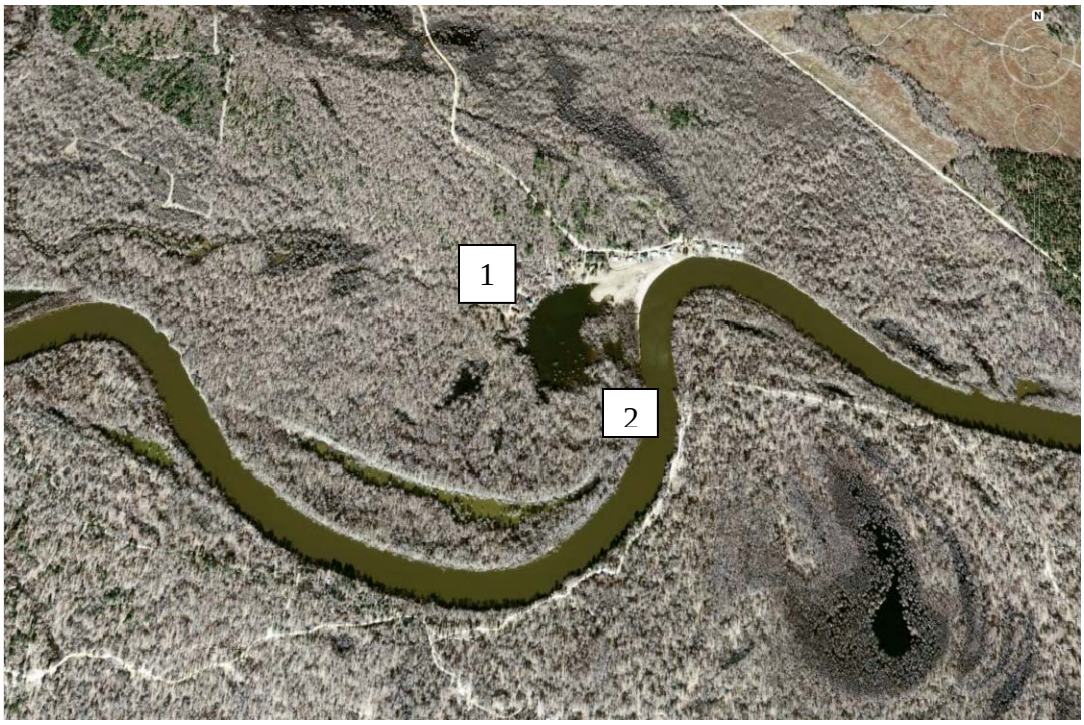

Figure 4. Pine Prairie Flat backwater (1) is located near the center of the photo just upstream of a large sandbar which blocks the backwater from the river. A seemingly man-made connection (2) has been constructed from the river to the backwater.

Figure 5. A view of Moro Creek and Moro Bay upper left down past Pine Prairie Flat toward lower right. Green Lake lies in the upper center of the aerial photo.

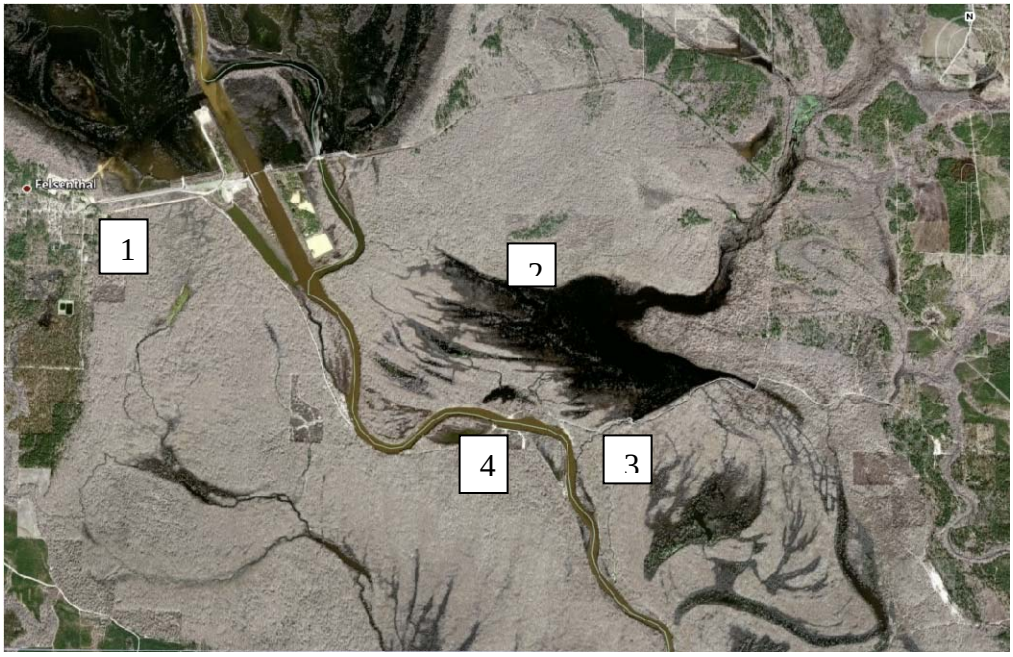

Figure 6. Felsenthal Lock and Dam (1) is in the upper left of photo. Large water body is Georgia Pacific's wastewater holding area (2) which was a wetland. Coffey Creek (3) drains this water body near center of photo. A small slough lies upstream on the opposite side of the river from Coffey Creek (4). Bottom of photo is Stateline.

Figure 7. Felsenthal Lock and dam is in the upper center of photo. Brown colored water is the Ouachita River. Channel on left is the boat ramp access channel with confluence at a right angle to the river. The old river channel is directly across the Ouachita River from the boat access channel and is on the right of the photo. If one looks closely the old railroad bridge piers are visible in the old river channel at top next to the channel block which is an extension of the dam.

Figure 8. Length-weight relation of alligator gar from the Ouachita River below Felsenthal Lock and Dam, Arkansas.

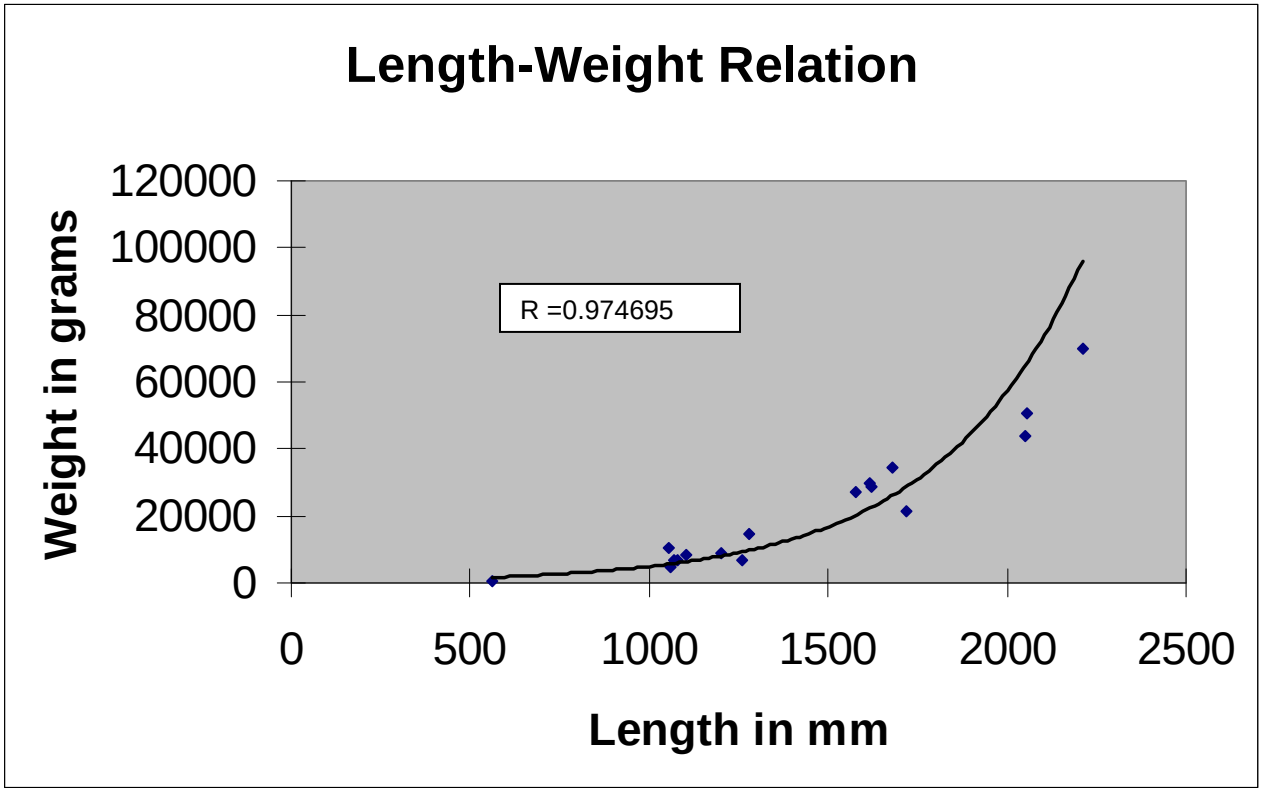

Table 1. Lengths, weights, dates of capture, and tag numbers if applicable for alligator gars captured below Felsenthal Lock and Dam in the Ouachita River.

Length (mm)	Weight (gm)	Date of capture	Tag Number	Location of capture*
1633	24062	2/24/2008	1	ORCl
1059	4653	3/1/2008	Recaptured laterduring summer 2	ORCl l
1068	6583	3/1/2008	3	ORCl
1080	6810	3/1/2008	5	ORCl
1614	29510	3/1/2008	6	ORC
1054	10669	3/1/2008	7	ORCl
1260	6810	3/1/2008	8	ORCl
1280	14755	3/2/2008	9	ORCl
1620	28602	3/2/2008	Recaptured later during summer 10	ORCl
2210	69,860		None previous study	FLD
1720	21,600		None previous study	FLD
1578	27,216		None previous study	FLD
562	582	6/22/2005	None previous study	Mouth of Coffey Creek
1682	34,504	6/28/2008	None, dead	FLD
1104	8,399	6/28/2008	None, dead	FLD
2055	50,848	6/27/2008	14	FLD
2053	44,038	6/27/2008	11	FLD
1202	9,080	6/27/2008	12	FLD

* ORC = Old River Channel; FLD = Below Felsenthal Lock and Dam

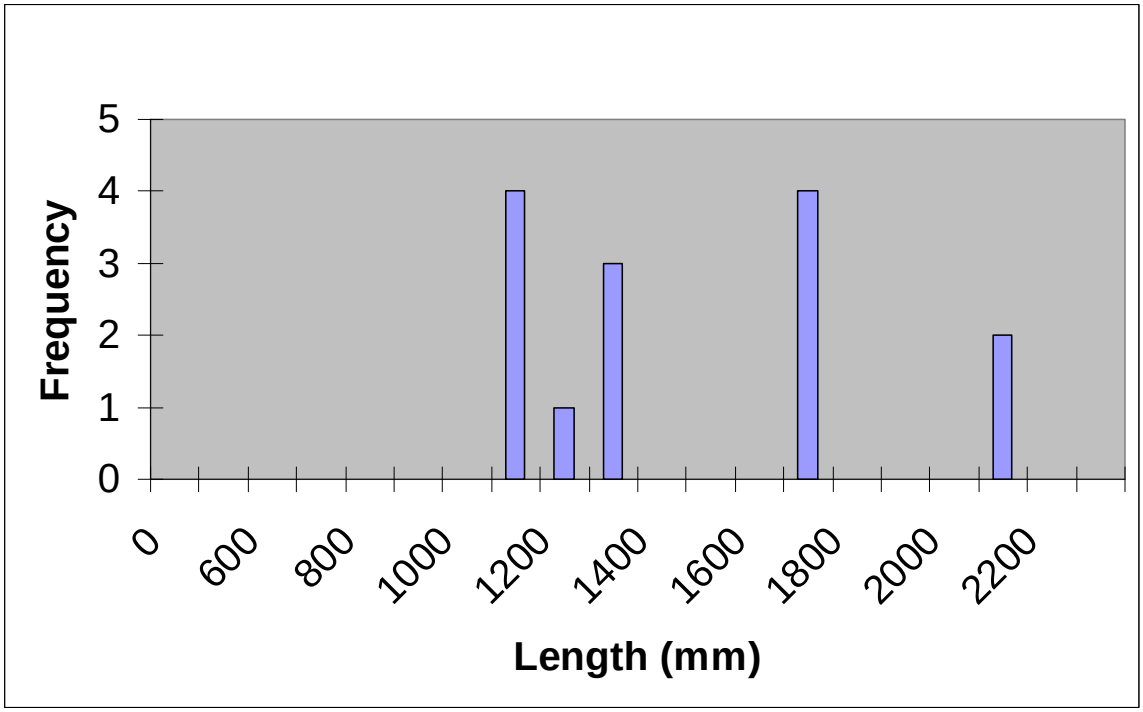

Figure 9. Length frequency distribution of alligator gar captured during 2008.

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Statement of Cost share by Layher BioLogics RTEC, Inc. to date (03/13/08) for the alligator gar project on the Ouachita River.

An estimate of cost share is provided by category below:

Per diem	$720.00
Lodging	$1,440.00
Boat oil/gas	$ 216.00
Data analysi/data entry	$ 240.00
Literature Review/travel, etc. associated with it	$15,000.00
Equipment	$11,200.00
Overhead for project	$ 5,396.00
Total	$34,212.00