

ABSTRACTS

The Fish Community of Indian Bayou, a Coastal Plain Stream of Remarkable Species Richness in the Lower White River Drainage of Arkansas

Thomas M. Buchanan

Department of Biology
Westark community College
Fort Smith Arkansas 72913

The loss of aquatic habitat in Arkansas due to human activity is especially severe in the Coastal Plain Lowlands. Aquatic environments associated with the lower White River now face new potential threats to their fisheries resources, making it increasingly important to identify areas of unique biodiversity in that region. Indian Bayou a chute-fed drainage off the White River in Monroe County, has a community of fishes unique to the Delta ecoregion of the state. This is particularly evident in the species-rich assemblage of darters (family: Percidae). Fish sampling over an 18-year period has provided documentation of this diversity and its temporal stability.

Identifying Factors Leading to Variable Trout Reproductive Success in Arkansas Tailwater Rivers

Danielle R. Painter and Thomas J. Kwak
Arkansas Cooperative Fish and Wildlife Research Unit
Department of Biological Sciences
University of Arkansas
Fayetteville, AR 72701

Brown trout (*Salmo trutta*) reproductive success in White River tailwaters is highly variable, resulting in the need for supplemental stocking in most systems. A better understanding of the physical and biotic factors contributing to reduced survival and variation among tailwaters will facilitate fisheries composed of greater proportions of wild populations to increase the quality of the fish and fishery. Gonadosomatic Index (GSI) was estimated from a sample of 12 female brown trout (35-43 cm) collected prior to spawning from each of four sample sites: Beaver Tailwater, Bull Shoals Tailwater near the dam, Bull Shoals Tailwater at Rim Shoals, and Norfolk Tailwater. Brown trout from Beaver Tailwater had significantly lower GSI values than those of the other three sites, while there was no difference among the other sites. Brown trout spawning behavior was observed from October 11 to November 23, and microhabitat measurements were collected from redds. Brown trout redds at Beaver Tailwater had significantly lower water temperatures, lower pit and tail mean velocities, lower tail bottom velocities, shallower pit and tail depths, and smaller pit gravel sizes than redds at Rim Shoals, while there was no difference between sites in dissolved oxygen concentrations, pit bottom velocities, tail gravel sizes, and proximity to bank. Brown trout redds had significantly lower pit and tail bottom velocities and deeper pit and tail depths than those of rainbow trout (*Oncorhynchus mykiss*), whereas there was

no difference between species in redd dissolved oxygen concentrations, water temperatures, pit and tail mean velocities, pit and tail gravel sizes, and proximity to bank. Brown trout spawning microhabitat in both tailwaters fell within or near optimal ranges reported in the literature for all variables, except temperature, which was above the optimal range at both sites. Ongoing investigations into trout early life history may reveal additional differences and influential factors to suggest strategies to improve trout reproductive success and increase the proportion of wild fish in these systems.

Selection of Spawning, Minimum, and Temperature Control Releases for Wild Brown Trout in Arkansas' White River Tailwaters.

John Stark
Arkansas Game and Fish Commission
457 Surrey, Lane
Lakeview, AR 72642
501-424-5924; FAX 501-424-7883

Although wild brown trout in Arkansas' White River already reach world-class proportions, historic challenges to trout management exist in these tailwater fisheries. Specifically, inadequate minimum flows, and episodes of warm water temperatures are detrimental to the further development of wild trout fisheries. Typically used methods of determining suitable flows are difficult if not impossible to apply to peaking power tailwaters of the magnitude found in the White River.

Therefore application of TVA's ADYN-RQUAL Dynamic Flow Model to Bull Shoals and Norfolk tailwaters of the White River during 1996 was explored. Objectives of the model included the development of flow regimes suitable for wild brown trout (*Salmo trutta*) spawning, (redd construction and fry emergence), increased permanent wetted area, and water temperature control during off-peak hydroelectric demand. A coordinated multi-agency and interest group approach was used to successfully plan and carry out field studies and evaluate model outputs.

Techniques unique to the ADYN-RQUAL Model such as high resolution aerial videography, rhodamine dye tracking, and continuous on-site meteorological and water temperature monitoring were applied along with more commonly used methods such as channel transects. Additional applications of the ADYN-RQUAL Model will include a dissolved oxygen reaeration subroutine and brown trout bioenergetics. Implementation of the recommended flow regime and other applications should further increase reproduction, growth, and carrying capacity of brown trout in these nationally known fisheries.

Evaluation of Fish Habitat Rehabilitation in Beaver Tailwater

Jeffrey W. Quinn and Thomas J. Kwak
Arkansas Cooperative Fish and Wildlife Research Unit
Department of Biological Sciences
University of Arkansas Fayetteville, AR 72701

We evaluated habitat rehabilitation in the White River below Beaver Lake Dam, that was completed in response to flooding that severely degraded stream habitat. We studied trout populations and microhabitat use of a modified and reference reach (700-800 m). The ratio of trout biomass (kg/ha) in the modified reach relative to that of the reference reach increased from 1.4 before modification to 2.4 after modification. Similarly, the ratio of trout density (fish/ha) in the modified to reference reach increased from 2.4 to 3.5. The increased ratios of relative abundance suggest that trout shifted their relative distribution into the modified reach in response to habitat rehabilitation. The range of water velocity available during base flow was greater after modification than that before ($P < 0.05$), but depth and substrate did not change ($P > 0.05$). Cover increased in the modified area, with the greatest addition being at the base-flow, land-water interface. Trout microhabitat use and snorkeling observations indicated that velocity refuges were important during high-flow water releases. Combined benefits of bank stabilization and additional velocity refuges for trout were gained by positioning rehabilitation structures at the low-flow, land-water interface.

Movement of Resident Brown Trout in the Bull Shoals Tailwater in Response to Differing Levels of Dissolved Oxygen and Spawning

John Stark
Arkansas Game and Fish Commission
457 Surrey Lane
Lakeview, AR 72642
501/424-5924. FAX 505-425-7883)

Behavioral responses of holdover or wild brown (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) were monitored to evaluate the effects of low dissolved oxygen on them. During portions of 1992-93, 44 TL 400-500 mm (16-20 in.) trout (32 brown, 12 rainbow) were successfully implanted with radio transmitters and followed until transmitter failure or trout mortality occurred.

Brown trout exhibited differential responses to various levels of dissolved oxygen. At lower oxygen levels (3-4 mg/l) positive selection occurred for areas of highest available oxygen. At higher oxygen levels (6-8 mg/l) areas of highest available oxygen were often not utilized; which corroborates that the laboratory derived "acceptable" value of 6 mg/l is accurate for "acclimatized" fish in uncontrolled environments

Many trout seeking higher dissolved oxygen levels were not found in areas that had adequate current shelters; indicating that trout seeking a higher dissolved oxygen levels were unable to locate areas that had both sufficient oxygen and adequate current shelters. Trout holding under these conditions faced greater energy costs. Additionally, feeding efficiency, angler catch rates and therefore trout growth were probably, detrimentally impacted below 6 mg/l because current shelters are often excellent feeding stations.

Important information on brown trout movement and spawning migration was also obtained. Large scale pre-spawning movements of nearly all the tagged trout occurred in the latter half of October during both study years. Although largely stationary for much of the year during the spawning run brown trout traveled upstream as much as 13-16 km (8- 10 mi.) per day. Post-spawn migration occurred in early January and the majority of individuals returned to within 55 m (50 yds.) of the area in which they were located prior to the spawning season: which strongly suggests that brown trout in this system have well established home ranges.

Management recommendations included an operational target of 6 mg/l dissolved oxygen particularly during the brown trout spawning season and instream habitat improvement including current shelter placements.

Biological Evaluation of Dam Modifications Designed to Improve Dissolved Oxygen, Temperature and Minimum Flow in Bull Shoals and Norfolk Tailwaters

OBJECTIVE 3

The Arkansas Game and Fish Commission has initiated a study in order to determine the impacts of future improvements to Norfolk and Bull Shoals dams. One portion of the study utilizes the Fish Health Condition Profile (Goede 1993). The profile gives an overview of the general condition of the fish. Brown trout *Salmo trutta* and brook trout *Salvelinus fontinalis* were chosen as the indicator species, as they best represent both ends of the spectrum in regards to tolerance of poor water quality. The program generates several important indices: 1) Ktl x 105 and Ctl x 104. 2) Normality percentage. 3) Severity Percentage. These indices were used to compare the relative condition of the two species of trout to each other within their respective sample areas, and to a normal range. Both species of trout were sampled at the dam and in the catch and release area, Both species had a Normality Index outside the acceptable range at both sites. The brook trout at the dam site had a significantly higher Severity Index than any other group sampled. The results were as expected for fish exposed to different degrees of low dissolved oxygen. I feel we can potentially use brook trout directly below the dam as one of the indicator species to monitor future changes in the dam.

Selected Community Characteristics of Freshwater Mussels (Unionacea) in the Lower Little Missouri and Saline Rivers, Arkansas.

Chris L Davidson, John L. Harris and George L. Harp
Arkansas State University
Department of Biological Sciences
State University, Arkansas

The Little Missouri River originates in the southwestern part of Montgomery County, Arkansas, and drains southward to its confluence with the Ouachita River in Clark County, Arkansas. Research was conducted on the lower 16 km of the Little Missouri River. Four minor beds (area < 500 m²) were defined on this river. Twenty 1 m² samples were taken, yielding 548 individuals. Thirty-four species were identified. *Pleurobema pyrimadatum* dominated numerically with 42.0% of the total. Two federally endangered species, *Lampsilis abrupta* and *Quadrula fragosa*, were represented in the study area. The Saline River originates in northern Saline County, Arkansas, and drains southward to its confluence with the Ouachita River near the Arkansas-Louisiana state line. Research was conducted on the lower 17.6 km of this river. Five major beds (area > 500 m²) and five minor beds were mapped. One hundred fifteen 1 m² samples were taken yielding 3,278 individuals. Thirty-one species were identified. *Amblema plicata* dominated numerically with 34.91% of the total.

MUSSEL HARVEST IN ARKANSAS (1993-1996)

TIM BURNLEY, STAN TODD, AND JEFF FARWICK
ARKANSAS GAME AND FISH COMMISSION, LITTLE ROCK, AR 72205

Historically, mussels were harvested for the production of buttons and supported a thriving industry in Arkansas. Today, mussel shell is used primarily for seed pearls in the production of cultured pearls in Japan, China, and Australia. Mussel harvest and value increased from 1993 (191 tons, \$1 450/ton) to 1995 (1096 tons, \$2360/ton) and decreased slightly in 1996. License sales showed the same pattern with 289 sold in 1993 and 518 sold in 1995. The discovery of a previously little harvested bed of mussels on Macon Bayou made 1995 an unusual year with three-ridges and washboards comprising 89.5% of the harvest by species and 45.3% of the total harvest coming from Macon Bayou. Mussel harvest and value are controlled by many factors which make it difficult to predict future harvest. However, industry experts expect depressed market conditions in 1997. Even though tremendous headway in collecting accurate harvest data has been made, research into mussel life histories and ecology is needed for better management of this valuable resource.

Population Dynamics and Some Preliminary Effects of Zebra Mussels in Lake Dardanelle

Jason W. Phillips, Charles J. Gagen, and Joseph N. Stoeckel

The first confirmed sighting of zebra mussels (*Dreissena polymorpha*) in the Arkansas River was in Lake Dardanelle in 1992. Exponential population growth has led to ecological alterations in more northern lakes. Our objective was to characterize biological, physical and chemical variables in Lake Dardanelle before dense populations became established and to compare them to post-infestation conditions. Larval mussel (veliger) and settling juvenile densities were determined from biweekly samples at four sites. Adult populations were sampled at 16 shoreline sites. Three additional shoreline sites were set aside for measuring macrophyte abundance. The maximum mean veliger density rose from 87/m³ in 1993 to 60,000/m³ in 1994. In 1995 and 1996, the peak mean densities were 51,000/m³ and 39,000/m³, respectively. No settling juveniles were collected in 1993, and few were found in 1994. However, in 1995 we observed a peak settling density of 30,000/m², followed by a peak settling density of 155,000/m² in 1996. Few adult zebra mussels were collected in 1993 (<45/man-hour), 1994 (<58/man-hour), and 1995 (<140/man-hour). Densities increased dramatically in 1996, when we documented a mean density of 4377/m². Adults were attached to boulders, cobbles, gravel, vegetation, and woody debris. They also colonized silty substrates by attaching to each other in clumps. Turbidity was lower, and Secchi disk visibility was higher in 1996 when compared with previous years. We conclude that zebra mussels can colonize and proliferate in shallow, turbid southern reservoirs, even where there is a lack of their preferred rock attachment sites. It seems likely that they will have a significant ecological impact, but continued monitoring is needed to account for natural variations in the zooplankton community, water chemistry, and macrophyte abundance.

RELOCATION OF ARKANSAS UNIONID MUSSELS TO ESTABLISH A VIABLE REFUGIA.

Cristin D. Milam, J.L. Farris and J.L. Harris

Arkansas State University and Arkansas Dept. of Highways and Transportation

Freshwater mussel declines in North America continue due to various direct and indirect causative factors. Efforts to maintain healthy populations in Arkansas have received support from both the Arkansas Game and Fish Commission and the U.S. Fish and Wildlife Service at Mammoth Springs. In response to the recent introduction of the zebra mussel (*Dreissena polymorpha*) to Arkansas' waters, greater attention has been given to the establishment of a viable and sustainable mussel refugia. This study summarizes the collection and transfer of approximately 750 individuals from the White River, Arkansas within the months of August and October 1996. Twenty-seven different species were collected, measured and tagged prior to transfer in quarantine tanks at Arkansas State University prior to introduction into the federal hatchery. Mortality estimates remain below 12% following the first six months of holding in two hatchery ponds. Procedures will be presented involving evaluation of growth and survival of relocated mussels as well as a review of the transfer protocol involving an exotic species.

OZARK-OUACHITA HIGHLANDS ASSESSMENT (1996-1998)
ALAN CLINGENPEEL, HYDROLOGIST
OUACHITA NATIONAL FOREST

The Ozark/Ouachita Highlands Assessment is designed to provide citizens and natural resource agencies with an information base that synthesizes existing data concerning regional social, economic and environmental conditions. This information base, compiled from existing sources representing the work of many agencies, research scientists and others will aid revision of National Forest and, if appropriate, other public land management plans. Initiation of this multi-agency assessment represents the very earliest stage of Forest Plan revision for the Ozark-St. Francis, Ouachita and Mark Twain National Forests, slated to be completed in each case by 2001.

The Aquatic Assessment Team is gathering regional data to be analyzed at the hydrological unit or watershed level. Information regarding associated land uses, lakes and streams, fishes, crayfishes, PETS (proposed, endangered, threatened and sensitive) species, freshwater mussels and aquatic macroinvertebrates in lentic and lotic environments is being compiled for an initial data base and a comprehensive analysis.

Ozark Stream Fish Assemblages Associated With Watersheds of Varying Land Use

Ronald D. Rambo and Thomas J. Kwak
Arkansas Cooperative Fish and Wildlife Research Unit
Department of Biological Sciences
University of Arkansas Fayetteville, AR 72701

The effect of watershed land-use patterns on stream fish assemblages is critical information required for effective ecosystem management. We estimated fish populations using mark-recapture and removal methods in streams of three watersheds representing extremes in agriculture, timber harvest, and undisturbed forest in the Boston Mountains of Arkansas. The fish assemblage of an agricultural watershed contained the highest fish density (13,624 fish/ha.) and biomass (78 kg/ha) with sediment-tolerant species common and included an intermediate black bass (*Micropterus* spp.) density (103 fish/ha) and lowest biomass (1.6 kg/ha). Fishes of a watershed of intensive timber harvest were lowest in density (6,748 fish/ha), high in biomass (72 kg/ha), and highest in black bass abundance (247 fish/ha, 11.1 kg/ha). The stream of a relatively undisturbed, forested watershed contained a dense fish assemblage (12,236 fish/ha) with low biomass (54 kg/ha) and the lowest black bass density (55 fish/ha) and intermediate biomass (3.0 kg/ha). Species richness was equivalent among assemblages (14-16 species). Our results suggest differences among fish assemblages associated with varying watershed land use, which may be further explored with manipulative research to establish cause-effect and mechanistic relationships.

AN INITIAL ASSESSMENT OF THE WATER CHARACTERISTICS AND AQUATIC BIOTA OF BLANCHARD SPRING

J. Scott Covington and John D. Rickett
University of Arkansas at Little Rock
Department of Biology 2801 South University
Little Rock, AR 72204

From October of 1995 through February of 1997 we sampled water flow, water quality, fish and macrobenthos at two sites above and two sites below Mirror Lake on the outfall of Blanchard Springs, Stone County, Arkansas to determine what effect the impoundment has had on the physical and biotic features of the stream. Temperature increased slightly, whereas dissolved oxygen declined slightly downstream. Often water chemistry measurements varied randomly among the sites and dates. Macrobenthos composition showed variation in seasonality as well as by site. Mayflies and amphipods were more abundant above the lake whereas caddisflies were more abundant below. The four most abundant macrobenthos collected included the orders Amphipoda, Ephemeroptera, Oligochaeta and Plecoptera. Fish species were distributed broadly among sites and dates. Southern redbelly dace, rainbow trout, and banded sculpins were more abundant above the lake. The four most abundant fish species included *Cottus carolinae*, *Etheostoma caeruleum*, *Notropis nubilus*, and *Phoxinus erythrogaster*. We also collected fingerling rainbow trout (*Onchorynchus mykiss*).

MORPHOMETRY AND BASIC HYDROLOGY OF STREAMS ON CAMP ROBINSON MILITARY BASE

John D. Rickett
Biology Department University of Arkansas at Little Rock Little Rock, AR 72204

From May 1993 through May 1995 basic hydrology, hydroperiods and morphometry were recorded at 15 sites on nine streams draining all but the extreme southeast corner of Camp Robinson Military Base in Faulkner and Pulaski Counties, Arkansas. All were small and had characteristics typical of transition-zone streams. At the measuring points, widths ranged from 0.4 to 11 meters, depths ranged from 0.03 to 0.20 meters, whereas velocities ranged from too-slow-to-measure (tstm) to 0.8 meters per second (m/s). When streams were flowing, discharges ranged from 0.00001 to 1.19 cubic meters per second (0.01 to 1,189 liters/sec). Stream integrity exhibited considerable variation as all streams became interrupted in the summer of 1993, and most streams became interrupted in the summer of 1994. Six streams became entirely dry during 1993, whereas only two dried up completely in 1994. The total amount of runoff for the two years was approximately equal (16.7- and 16.2-million cubic meters for 1993 and respectively), but the distributions during the 12 months of each year (May 93-April 94 and May 94-May 95) were quite different. Estimated total TDS carriage was 4,097ka for May 93-Apr 94 and 3,184kg for May 94-May 95. Rainfall was more concentrated in the Spring months during the first year and slightly more spread over the summer months during the second year.

BASIC WATER QUALITY IN STREAMS DRAINING CAMP ROBINSON MILITARY BASE

John D. Rickett

Biology Department University of Arkansas at Little Rock Little Rock, AR 72204

Basic water quality was measured for 12 variables at 25 sites on nine streams draining all but the extreme southeast corner of Camp Robinson Military Base, Faulkner and Pulaski Counties, Arkansas from May 1993 through May 1995. The variables were grouped as (1) basic life support components, (2) buffering capacity ions, (3) nutrients and (4) indicators of sediment transport. Temperature, pH and dissolved oxygen compared favorably with average measurements from other natural waters in the region. Total alkalinity and total hardness indicated the streams on Camp Robinson had very low buffering capacity, and spillage of material containing ionizable substances could be hazardous. Nitrate⁻ phosphate and sulfate tests indicated lower than normal concentrations of basic nutrients. Turbidity, total dissolved solids (TDS), specific conductance and iron data showed both spatial and temporal variations of localized soil disturbances. Airborne dust from roads and surface scouring caused by training maneuvers were the two primary sources of particulates. Flowage interruption during the summers of both years caused pooling and extreme concentration of iron, turbidity and TDS. Heavy rainfall caused moderately higher transport of materials for short periods.

Metabolic rates and behavior for organisms inhabiting Logan Cave and Logan Cave Stream in northwest Arkansas.

Ginny Boyd

Cave systems have often been described as relatively simple ecosystems in terms of energetics, biodiversity, and productivity. obligate cave organisms have acquired unique adaptations to deal with an environment that includes not only lower food availability but also lack of photoperiod and variable temperature cues that most epigeal (surface) animals rely on to complete their life cycle. Logan Cave provides the opportunity to examine aquatic epigeal organisms outside the cave that live in a constant temperature but variable photoperiod environment, and compare them to the same species that have taken up temporary residence inside the cave and experience constant temperature and photoperiod. In addition, it allows comparison of obligate cave organisms with epigeal organisms that live just outside the cave. Cave specialized organisms in this study were Ozark cavefish (*Amblyopsis rosae*) and cave crayfish (*Cambarus aculabrum*) and the epigeal organisms were banded sculpin (*Cottus carolinae*) and the common crayfish, *Orconectes neglectus*. organisms were collected and acclimated to an open test chamber for 24 hours before measurements were taken. Metabolism was measured by sealing the chamber and measuring the rate of oxygen depletion over a three hour period. Ozark cavefish did not show a significant difference in metabolic rate between the summer and autumn seasons. However, cave crayfish had a significantly lower metabolic rate in the fall than in the spring ($P < 0.05$). The epigeal organisms were each divided into two groups,, one group represented by individuals outside the cave and the second comprised of the same species but captured inside the cave. For the epigeal crayfish, the metabolic rate was significantly higher ($P < 0.05$) outside than inside for

both summer and fall. However,, there was not a significant difference in respiration rate by season for the outside or inside groups. Sculpin data has been analyzed only for sculpin outside the cave. There was not a significant difference in respiration rate between summer and fall. Behavioral data on organisms includes both habitat preference and activity at the time of collection.

COMPARISON OF GROWTH, RELATIVE WEIGHT AND HEALTH OF LARGEMOUTH BASS IN TWO ARKANSAS LAKES

Ronald L. Johnson
Department of Biology
Arkansas State University
State University, AR 72467

Lakes Ashbaugh and SWEPCO are both located in northern Arkansas, yet at opposite ends of the state. SWEPCO Lake is unique among Arkansas reservoirs in that it receives thermal effluent from an electrical power station. SWEPCO Lake was intentionally stocked with Florida Largemouth bass a single time in 1930; Lake Ashbaugh was initially stocked with 50,000 Florida largemouth bass followed by successive stockings of 76,000 northern largemouth bass over the next decade. Both reservoirs have previously been identified as possessing Florida bass alleles. Bass were collected from Lake Ashbaugh (n = 436) and SWEPCO Lake (n = 141) for the years 1995-1996. Growth, relative weight, phenotype and health were determined for both populations. Length-at-age and relative weight were significantly greater for SWEPCO Lake bass than for Lake Ashbaugh bass. Allele frequencies of three discriminant allozyme loci, AAT-B, IDH-B and MDH-B, between Florida and northern largemouth bass were determined. Over half (62%) of the largemouth bass of Lake Ashbaugh and 98% of SWEPCO bass possessed Florida largemouth bass alleles, with F₁ bass dominant. No significant differences were identified for back-calculated length-at-age between the phenotypes of the northern largemouth bass, F₁, and F₂, intergrades for Lake Ashbaugh, while both F₁ and Florida largemouth bass exhibited significantly greater lengths-at-age than did northern largemouth bass for age I and II bass. No phenotypic differences were observed for relative weight and condition for either reservoir. An autopsy-based fish health assessment revealed that SWEPCO bass also had greater health. No significant differences were identified for bass possessing or lacking Florida alleles for any of the health parameters measured-within each lake.

A Comparison of Trapnets to Rotenone for Crappie Sampling on a Small Impoundment

Ralph A. Fourn, Arkansas Game and Fish Commission, 2805 West Oak, Rogers, AR 72756

Ronald D. Moore, Arkansas Game and Fish Commission, 2805 West Oak, Rogers, AR 72756

Carolyn Fielder, Arkansas Game and Fish Commission, 2805 West Oak, Rogers, AR 72756

Abstract: Routine trapnet sampling from 1991 to 1995 and rotenone sampling from 1988 through 1993 on 80-hectare Bob Kidd Lake were evaluated. Trapnet estimates of recruitment ranged

from 0 to 0.8 age 0 fish per net-night. Trapnet estimates of density ranged from 1.8 to 7.2 (age 1 and over) per net-night. Rotenone sampling demonstrated massive spawns in 1989, 91, and 93 when numbers per hectare were 2,375, 1,920, and 4,797 respectively. These spawns were shown by rotenone sampling to have recruited to strong intermediate densities the following year, and to strong adult populations in subsequent years. Trapnet densities actually declined in the years following the "big spawns. We conclude that neither sampling technique gave a complete picture of the crappie population in Bob Kidd Lake. Trapnets severely underestimated recruitment and density, whereas rotenone showed both to be quite high. Conversely, rotenone underestimated the proportion of fish over 250mm in length while trapnets showed they comprised a relatively large proportion of the population.

Seasonal Migration and Annual Exploitation of Walleye in Greers Ferry Lake, Arkansas as Determined by a Tag Reward Study

Carl A. Penin, Arkansas Game and Fish Commission, Conway, AR 72032

Thomas R. Bly, Arkansas Game and Fish Commission, Heber Springs, AR 72543

Abstract: A tag reward study was initiated in February 1996, in an effort to obtain seasonal migration and annual exploitation information on walleye (*Stizostedion vitreum*) in Greers Ferry Lake, Arkansas. A total of 516 walleye were tagged with reward tags having values of \$5, \$20, or \$100. A minimum of 125 walleye from each main tributary (South Fork, Middle Fork, Devil's Fork) and the main lake were tagged. To date there have been 106 tag returns revealing an estimated exploitation rate of 27.7%. Tag returns revealed that walleye traveled an average of 12.2 miles with a minimum distance of 0.0 miles and a maximum distance of 27.0 miles before capture. Tag return data revealed wide dispersal of all sub-populations after tagging. An effort was made to validate creel data collected in 1988 - 1992 which revealed mean annual harvest to be 4,254.8 walleye. Population estimates collected through cove rotenone sampling revealed estimated mean population density to be approximately 37,818 individuals 300mm or greater in length during this time period. An exploitation rate of 27.7% would have resulted in a mean harvest of 10,475.6 walleye. It is our assumption that either (1) the creel survey underestimated harvest of walleye or (2) creel surveys and tagging studies should run concurrently for true comparison.

LAKE OUACHITA ANGLER CREEL SURVEY

Stuart Wooldridge
Arkansas Game & Fish Commission
350 Fish Hatchery Road Hot Springs, AR 71913

ABSTRACT. Angler creel census data for the first two years (October 1994-September 1996) of a three year survey on Lake Ouachita show a great deal of interest in catch and release black bass fishing. Lake Ouachita is a 40,000 acre Corps of Engineers impoundment in west central Arkansas. An access point creel survey was selected to interview Lake Ouachita fishermen due to the high use of specific access points by both boat and bank fishermen. An aerial count was done

to determine angler pressure. Spearfishermen were surveyed in addition to hook-and-line anglers. To this date total fishing pressure averaged 18.3 hours/acre/year with the total fish harvest averaging 8.5 pounds/acre/year. Average annual harvest of major game species is: largemouth bass, 1.5 lbs/acre; bluegill, 0.4 lbs./acre; spotted bass, 0.7 lbs./acre; striped bass, 2.9 lbs./acre; walleye, 0.3 lbs/acre; catfish combined, 1.5 lbs./acre; crappie combined, 0.8 lbs./acre. Angler species preference for black basses jumped from 56.2% the first year of the survey to 63.8% in the second year. Nearly 85% of largemouth bass caught during the two survey years were released by anglers. For the two years of the survey spearfishing harvest of largemouth bass totaled 926 bass weighing 1, 178 pounds. Primary game fish targeted and harvested by spearfisherrnen were walleye, catfish, and black basses. Spearfishermen harvested 1.8 percent of the total harvested by all anglers. The final creel survey year will be completed on August 31, 1997.

The Enforcement Aspect of Natural Resource Management

William Howell

Enforcement Division Arkansas Game and Fish Commission Little Rock, Arkansas 72205

Wildlife Officer enforcement of aquatic regulations is vital to the success of any management program in helping to reach its established goals and objectives. The economic value and the influence of commercial markets encourage illegal harvesting. These illegal harvesting activities have the potential to significantly impact natural resources.

During the past several years, the commercial value of paddlefish roe has increased dramatically. Arkansas Wildlife Officers have since encountered an increase in commercial fishing activity dealing with this particular species of fish. The most common violation has dealt with length limit restrictions. In Western Arkansas, Wildlife Officers recently checked four commercial fishermen. Three of those fishermen were cited for length limit violations. The number of short fish in possession ranged from three to ten fish. Several commercial fishermen have since been apprehended with just the roe in possession. This, perhaps, indicates sub-legal paddlefish are being sacrificed for the commercial value of the roe.

Arkansas and Oklahoma Wildlife Officers apprehended an individual in a pickup pulling a small stock trailer in January, 1996. An investigation revealed the trailer contained approximately 15,000 lbs. of mussel shells. After a lengthy investigation involving Arkansas, Oklahoma, Kansas and the U. S. Fish and Wildlife Service, the individual paid a \$1,500.00 fine in Arkansas and a \$1,000.00 fine and \$1,100.00 restitution in Oklahoma. The shells were sold at auction in Arkansas for \$16,010.00. The stock trailer was also sold at auction. The proceeds were divided equally between Arkansas and Oklahoma pursuant to an Arkansas court order. The individual involved also had his hunting and fishing privileges suspended in Arkansas.

Arkansas Wildlife Officers first encountered commercial mussel harvesters in Bayou Mason in June, 1995. Word of the high quality mussel shells spread rapidly and prices quickly rose from fifty cents per pound to over six dollars per pound for high quality shells. one commercial shelter reported harvesting 1,900 lbs. of shells in three hours and fifteen minutes. Based on information gained from shell buyers, fisheries biologists estimated buyers had bought 300 tons of shells during a four week period in Chicot County, Arkansas. Wildlife Officers made 54 arrests dealing with illegal mussel harvesting from June through November, 1995. Commercial shellers have

indicated this type activity will not occur in Bayou Mason anytime in the near future because the shell beds have been eliminated.

There is an apparent need to properly evaluate these type of illegal activities to assess their impact on the resource. There needs to be better communication among states, wildlife enforcement personnel and aquatic resource professionals concerning the economic values of various aquatic resources. Wildlife Officers should be properly trained in identification and measuring techniques associated with these various aquatic resources. There needs to be uniformity among regulation where appropriate.

FACTORS AFFECTING FISH MERCURY CONCENTRATION IN ARKANSAS LAKES AND STREAMS

K. W. Thomson, A. Price, M. Armstrong, J. Nix, J. Giese, and D. Turman

'FTN Associates, Little Rock, AR, 4R Dept. of Pollution Control and Ecology, Little Rock, AR, Game and Fish Commission, Little Rock, AR, 'Ross Foundation, Arkadelphia, AR

ABSTRACT. Mercury is the primary contributor to fish consumption advisories in AR. Over the past 2 years, 170 lakes and streams were sampled to determine the magnitude and extent of the mercury problem and factors that might be contributing to fish contamination. Water quality and habitat indicators were measured along with fish tissue mercury concentrations from most sampling sites. Composite samples of largemouth bass fillets, 305- 406 mm in length, were analyzed for total mercury along with 23 water quality variables and 19 habitat indicators in these lakes and streams. Excellent relationships were found ($P < 0.001$) between fish length and fish total mercury concentration, permitting fish consumption advisories to be issued as a function of fish size. Variance in fish tissue mercury concentrations (normalized for size) was significantly accounted for by sulfate, alkalinity, TOC, hydrogen ion and manganese concentrations (lakes only for Mn). Manganese might be a surrogate for redox potential in lake hypoxemia. Spatial association analyses investigated the influence of watershed drainage area, proportion of the lake/stream perimeter associated with wetlands, watershed surficial geology and soils, and lake/stream morphometry on fish mercury contamination. The association of possible mercury sources, environmental conditions and food web structure was critical in determining where fish contamination occurred in AR. These associations are presented in this paper.

Status and Distribution of Alligator Snapping Turtles in Arkansas

Brian K. Wagner, Dave Urbston, and Dennis Leek
Arkansas Game and Fish Commission
#2 Natural Resources Drive, Little Rock, AR 72205

The alligator snapping turtle (*Macrolemys temminckii*) occurs throughout most of the southeastern United States, but concern exists regarding possible decline in populations throughout the range of the species. Little is known about the alligator snapping turtle in Arkansas. The species was previously documented from only 20 counties in the state. We

sampled 1905 net nights with baited hoop nets and captured 445 alligator snapping turtles in 56 counties. Captures in 41 counties were new records. We failed to capture an alligator snapping turtle in 5 counties where the species was previously reported. The alligator snapping turtles that we raptured averaged 330 mm in carapace length. Catch rates were higher in counties that were previously open to commercial turtling than in counties not previously open to commercial harvest. There was no difference in average size of turtles between counties with and without a history of commercial harvest.

(Previously presented at the 50th Southeastern Association of Fish and Wildlife Agencies conference)

Environmental Costs of In-Stream Gravel Mining in Five Arkansas Streams.

R. Grippo, G. Harp, Dept. of Biological sciences, j. Kaminarides, Dept. of Business Research and Services, R. Kesselring and D. Marburger, Department of Economics and Decision Systems, Arkansas State University, State University, AR.

Development of a cost-benefit analysis to aid in environmental management is often problematic because the comparison is usually between societal benefit (in dollars) and environmental cost (in- ecosystem values), resulting in an "apples vs. oranges" situation. This is because it is difficult to identify measurable components of-ecosystems that, if degraded, can be capitalized as costs. The mining of gravel from streams for use in construction is a multi-million dollar industry in Arkansas but often results in significant environmental impact. Based on the results of an ecological impact assessment and data already available from state and federal agencies, we have developed a series of simple models which quantify some of the environmental costs, in dollars, associated with the removal of gravel from Arkansas streams. The models develop costs due to habitat degradation (as change in fish replacement value), stream bank erosion (as decreases in land values and agricultural potential), and aesthetics (as decreases in recreation and tourism income). The costs are projected over 10 years assuming a stream recovery rate of 5% per year. Our results suggest that in-stream gravel mining has a high environmental cost that probably exceeds the economic benefit of this activity and probably should continue to be regulated.

Dr. Richard Grippo
Department of Biological Sciences Arkansas State University
State University, AR 72467 USA
T 501-972-3082 F 501-972-2638

ARKANSAS STREAM TEAM PROGRAM

Paul Brady
Natural Resource Conservation Service Little Rock, AR

Recently, a group of citizens, natural-resource managers and landowners got together because they were tired of seeing Arkansas streams and streambanks getting trashed and polluted. This meeting led to the formation of the Arkansas Stream Team.

Governor Mike Huckabee says Arkansas water is as valuable to Arkansans as oil is to Texans. Over 90,000 miles of streams lace the Natural State, from the mighty Arkansas River to small creeks you can jump across. These rivers, streams, bayous, creeks and spring runs provide millions of hours of recreational activity, millions of gallons of drinking water, water for irrigation and industry, and millions of dollars of income to the state and its citizens. Unfortunately, we've hurt the quality of many Natural State waterways. We've lost thousands of miles of free-flowing, natural streams to damming, industrial and agricultural pollution, in-stream and off-stream mineral mining, and numerous other impacts. In fact, recent studies indicate we've lost over 25 percent of the state's smallmouth bass streams this century. Volunteers are needed to help resolve these problems.

Arkansas' Stream Team program provides opportunities for concerned citizens to get involved in stream and watershed conservation. Efforts revolve around three primary aspects of stream conservation:

Education: The Stream Team Program provides information to increase understanding and appreciation of Arkansas stream systems. Volunteers receive training in water-quality monitoring and streambank maintenance and restoration techniques.

Stewardship: The Stream Team program helps landowners and stream users plan and carry out projects by matching them with the appropriate agency or ongoing organizational efforts. Litter control, streambank stabilization, streamside tree plantings, improvement of fish and wildlife habitat, water-quality monitoring and other special projects are all possible.

Advocacy: People with first-hand knowledge of problems, needs and solutions are better equipped to weigh both sides of a stream issue and speak out on behalf of Arkansas' rivers and streams. The Stream Team program teaches volunteers how to work for the proper conservation of Arkansas' resources.

Missouri started its Stream Team Program in 1985. Today, they have more than 800 Stream Teams with over 24,000 people working to improve the condition of Missouri Streams. Working with landowners, volunteers have repaired hundreds of miles of eroding streambanks. They've monitored water quality on thousands of miles of streams and have picked up tons of litter. It is hoped the Arkansas program will be equally successful.

Lakes Hamilton and Catherine Angler and Recreational Use Survey

Brett Hobbs,

Arkansas Game and Fish Commission, 2 Natural Resource Dr., Little Rock; AR 72205

Abstract. A roving creel survey for a 6-year period (Oct 1989-, August 1995) from Lakes Hamilton and Catherine has provided current harvest and use data. Lake Hamilton is a 2,854 ha reservoir on the Ouachita river impounded in 1932. Fishing pressure averaged 60.0 hours/ha for four survey years. Total fish harvest averaged 6.4 kg/ha. Average annual harvests of major game species were: 2.5 kg largemouth bass, 2.2 kg/ha hybrid stripers, 0.9 kg/ha spotted bass, 0.8 kg/ha crappie, 0.6 kg/ha white bass, 0.4 kg/ha striped bass, 0.3 kg/ha rainbow trout, 0.2 kg/ha bream, 0.2 kg/ha channel catfish, 2 kg/ha blue catfish and 0.1 kg/ha walleye. Angler hours accounted for 24% of the total use estimate while pleasure boater hours accounted for the remaining 76%.

Lake Catherine is a 916 ha reservoir on the Ouachita river impounded in 1924. Lake, Catherine is immediately below Lake Hamilton. Fishing pressure averaged 64.2 hours/ha for two survey years. Total fish harvest averaged 7.7 kg/ha. Average annual harvests of major game species were: 2.1 kg/ha rainbow trout 1.8 kg/ha largemouth bass, 1.3 kg/ha crappie, 0.6 kg/ha spotted bass, 0.6 kg/ha channel catfish, 0.3 kg/ha bream 0.2 kg/ha hybrid stripes, 0.2 kg/ha white bass, 0.1 kg/ha blue catfish, and 0.1 kg/ha striped bass. Angler hours accounted for 60% of the total use estimate while pleasure boater hours accounted for the remaining 40%.

Both lakes exhibited below state average fishing pressure (95.8 hours/ha) and are well below the national average (13.7 hours/ha). Total fish harvest on both lakes is just above the state average (6.3 kg/ha) but well below national average (20.6 kg/ha). Angler species preference on Lake Hamilton is heavily weighted toward black basses (63.20/0) while Lake Catherine anglers prefer black basses and rainbow trout (32.0% and 27.3%, respectively).

Instream Flows for Trout, Paddlefish, and a Delta River Fish

Steve Filipek

Game and Fish Commission 2 Natural Resources Dr. Little Rock, AR 72205

The formal setting of instream flows in Arkansas is a relatively new issue with enabling legislation giving this responsibility to, the Arkansas Soil and Water Conservation Commission in 1995 (Act 1051). Since the mid-1980's, the Arkansas Game and Fish Commission has been working on this important issue but can only recommend instream flows to the ASWCC; it has no jurisdiction under Act 1051 to be on equal ground with ASWCC in actually setting flows. ASWCC did not formally start setting instream flows until the early 1990's and the first flow setting exercise was on the Arkansas River, the state's largest river (exclusive of the Mississippi river making up the eastern border). There were few major conflicts over instream flows on the Arkansas between ASWCC and natural resource conservation agencies (AGFC, Pollution Control & Ecology, Parks & Tourism Scenic River, Natural Heritage) Since this river has numerous navigational locks and dams on it which have changed it from a natural flowing system to a series of pools,

The second river to receive attention in the state was the White River, which while impounded in its upper basin it is relatively natural in its lower section. Preliminary flow setting by ASWCC on the White gave little attention to AGFC and other natural resource agency recommendations on instream flow needs for fish and wildlife in this river. Fish and wildlife, navigation, and upstream farming interests pressured ASWCC into a reconsideration of the instream flow need for the White with a strong recommendation from the public to let the experts in each field recommend flows for the White. This was done and this presentation will highlight the flows that a Fish and Wildlife, Recreation, and Water Quality Committee gave to ASWCC. These include IFTM results from earlier USFWS work on the trout section of the White, IF recommendations from paddlefish biotelemetry for the middle section of the river, and a method utilizing wetland vegetative communities (Florida method) along with a standard setting technique (Arkansas Method) for the lower gradient floodplain section of the river

AQUACULTURE IN ARKANSAS

Mike Freeze, Reo Fish Farm, Inc.

Aquaculture in Arkansas is diverse. Arkansas' aquaculturists have faced certain regulatory and production challenges for years, while other constraints have only recently surfaced.

Existing challenges that Arkansas fish farmers have long had to contend with include:

A. Bird Depredation

This age old problem seems to get worse every year but fish farmers are surviving as long as depredation permits are an integral part of their deterrent programs. A "blanket" USF&WS depredation order for double crested cormorants at aquaculture facilities in the Eastern United States plus Texas and

Oklahoma should be issued during 1997. Sport fishing groups are taking an interest in this problem.

B. Lacy Act

Elevates a misdemeanor into a felony. Past U.S. Fish and Wildlife Service Director John Turner issued JDirector's Order # 27 that put a low priority on using the Lacy Act against fish farmers except in instances where disease transmission or non-indigenous fish species were involved. What are the laws? Very difficult to find out!

C. Discharge Permits

Currently exempt if warmwater facility produces less than 100,000 lbs. or only discharges during periods of rainwater overflow. Look for this to change!

D. Lack of Registered Therapeutants

After pushing INADs for several years, FDA has suddenly changed direction and is now saying no more INADS. FDA wants fish farmers to use therapeutants prescribed by a veterinarian under extra label use. Additionally, FDA has encouraged states and private entities to "add on" to existing USF&WS INADS, but USF&WS has refused to allow this, even though FDA has stated it will not hold USF&WS liable for other entities data collection.

E. Endangered Species Act

Addition of 200+ new animals and plants will dramatically change the impact of this act upon fish farmers and the average citizen. This act is up for re-authorization and it must be changed. In Colorado USFWS has proposed no stocking of warmwater fish on the West slope and it is believed that they will propose no stocking of Coldwater fish in the near future. California was forced to cease all striped bass stockings due the this Act.

New challenges that have only surfaced in the last few years include:

A. Zebra Mussel Transfer

Many states are considering restricting the sale of live fish from one watershed to another as a logical method to prevent the spread of this exotic pest. Some states already have zebra mussel free certification programs in place.

B. National Reportable Disease System

The lack of a National Reportable Disease System is preventing fish farmers from exporting their live fish products to certain countries (ie. European Union). The Aquaculture Committee of the USAHA is currently developing such a plan in consultation with AAVLD and APHIS. Hopefully, the creation and adoption of such a plan by USDA will lead to conformity in the regulations of different states as a lack of conformity between states has been a problem in the interstate transportation of fish.

C. The Use of Advanced Technologies in Fish Health Management

The premature use of advanced technologies for the detection of nucleic acids or other components of aquatic animal pathogens, prior to their specificity validation and standardization regarding use, application and interpretation of results can lead to inappropriate devaluation and condemnation of fish stocks. Simply put: advanced testing methods are detecting diseases at much lower levels that may or may not justify the destruction of fish stocks based on older existing action levels.

D. Lack of a National Aquaculture Act

Aquaculture is agriculture and aquaculture's lead agency should be USDA, not Interior or Commerce.

HABITAT AVAILABLE TO COOL-WATER FISHES IN FOUR ARKANSAS RESERVOIRS

James E. Johnson, Rebecca J. Allee, and Kenda S. Flores Arkansas Cooperative Fish and Wildlife Research Unit University of Arkansas Fayetteville, Arkansas 72701

Beaver, Bull Shoals, Norfolk, and Ouachita reservoirs were sampled between 1993 and 1995 to determine habitat available to cool-water fishes (striped bass, walleye) . Water temperature and dissolved oxygen levels were used to plot suitable habitats. Between June and September of each year, surface temperatures exceeded 25°C, the upper level preferred by cool-water fishes, forcing them to seek cooler water in the thermocline. However, those cooler waters also became unsuitable when dissolved oxygen levels fell below 3.5 mg/L. By the end of summer, cool-water fishes were often isolated in a small volume of the thermocline near the dam. In 1994 and 1995 Norfolk Reservoir lost most of its cool-water fish habitat, as did Ouachita Reservoir in 1993. Bull Shoals Reservoir retained good to fair cool-water fish habitat throughout both 1994 and 1995. Beaver Reservoir maintained most of its cool-water fish habitat in 1994, a normal water year, but lost most of the habitat in 1995, a high water year. It appears Bull Shoals and Beaver reservoirs will provide our best cool-water fisheries, while Norfolk and Ouachita reservoirs may experience

cool-water fish die-offs during especially warm and/or wet years.

SPRING RIVER STATE FISH HATCHERY

Melissa Jones

Arkansas Game and Fish Commission Mammoth Spring, Ar. 72554

Spring River State Fish Hatchery is one of the largest trout culture facilities in the eastern U.S. and the only cold-water fish hatchery operated by the Arkansas Game and Fish Commission. The hatchery was donated to the Commission in 1985 by the Kroger Company of Cincinnati, Ohio. This hatchery is one of only two or three fish culture facilities in the world that uses the in-ground silo concept. There are 36 silos on the hatchery grounds that function like "vertical raceways". Each silo is 13.5 feet deep and 17.5 feet in diameter, with a capacity of 22,000 gallons of water. The hatchery also has 14 concrete raceways used for fish culture. Each raceway is, about three feet deep, 8 ft. wide and 60 ft. long. The primary water source for the hatchery is the Spring River. Water for the silos is gravity fed through a system of underground pipes. Each year some 500,000 12 inch rainbows are grown at the hatchery and stocked in Arkansas trout waters. Once the fish reach the proper size water in the silo is drawn down. The fish are then crowded into a special pump designed so fish aren't injured during the pumping process and transferred into large harvest raceways. Next, fish are loaded on transport trucks and delivered to stocking sites such as the Spring, White and Little Red Rivers.

One problem encountered at the Spring River Hatchery is periodic flooding on the Spring River. High water may block water inlets with trash and vegetation. This can cause water flow problems and oxygen depletion that could result in fish kills. There also seems to be direct correlation between high water and an increase in diseases at the hatchery.