

IMPACTS TO ARKANSAS' AQUATIC RESOURCES AND RELATED BIOTA

ABSTRACT - Filipek, S., Arkansas Game and Fish Commission. Arkansas has an incredible diversity of stream and lake resources, ranging from clear, headwater mountain streams and deep, clear mountain reservoirs in the Ozarks and Ouachita Mountains, to the low-gradient, slow moving bayous and productive oxbow lakes of the Delta. There are over 242,915 ha (600,000ac) of lakes/reservoirs and 19,200km (12,000mi) of major (2nd order and larger) streams in the state. This diverse aquatic environment is feeling more and more negative impacts due to the increasing human population and agriculture, channelization, wastes from confined animal operations, instream sand and gravel mining, municipal and industrial waste, clearing and snagging, impoundment, silviculture, and water diversion, to name a few. These activities are affecting our invaluable waterbodies, usually in a negative manner. For example, the livestock and poultry industry contributed the equivalent amount of waste of 80 million people into Arkansas, or 32 times the state's present human population. Studies are showing that a substantial amount of this waste is running off into streams and lakes. Over a quarter of our streams have bacterial levels not only above natural levels but high enough to impair at least one of several beneficial uses of those leachates have impaired or totally decimated over 59% of the smallmouth bass streams in the state. A brief summary of anthropogenic activities on Arkansas' aquatic resources is presented.

FISH AND WILDLIFE COORDINATION ACT AND SECTION 7 CONSULTATION

ABSTRACT - Mueller, Allan, US Fish and Wildlife Service. Section 7 of the Endangered Species Act requires all federal agencies to determine if their actions "may adversely affect" any listed threatened or endangered species. If the federal action agency decides that their action may adversely affect, they must request formal consultation with the U.S. Fish and Wildlife Service, or National Marine Fisheries Service for marine species. - The Fish and Wildlife Service prepares a Biological Opinion which answers the question, "Is this action likely to jeopardize the consideration?" Federal agencies are prohibited from taking any action that would "jeopardize" a species. If the Biological Opinion does not conclude that the action would cause jeopardy, the Fish and Wildlife Service can include conditions that would reduce incidental take of the species, but cannot block the proposed action.

The Fish and Wildlife Coordination Act was passed in 1934 with amendments in 1946 and 1958. Its purposes are to 1) recognize the vital importance of fish and wildlife resources, 2) assure that fish and wildlife conservation shall receive equal consideration and be coordinated with other features of federal water resource development programs, and 3) require that the recommendations of the Fish and Wildlife Service, the National Marine Fisheries Service, and state conservation agencies receive full consideration. Federal action agencies are required to consult with these three agencies on any discharge of pollutants, construction/operation of dams, levees, or water diversions; construction/operation of navigation features; and any other action that would divert, control, or modify a stream or other body of water. Federal action-agencies are not obligated to accept the recommendations received from the conservation agencies; but they are obligated to give equal consideration to their recommendations.

ELECTRORECEPTION OF OZARK CAVEFISH

ABSTRACT - Shepherd, Cindy. Arkansas Cooperative Research Unit, Department of Biological Sciences, University of Arkansas. Ozark cavefish (*Amblyopsis rosae*) are endemic to limestone cave streams of Arkansas, Missouri, and Oklahoma. During development, the eyes degenerate to a primitive optic nerve. The cavefish also possess decreased optic regions in the brain. Other fish with similar depreciation of visual senses, such as Gymnotiformes and Siluriformes, use passive electroreception to maneuver and find prey. However, nobody has ever tested cavefish for electroreception. In order to test the sensitivity of *A. rosae* to minute electrical currents, a test chamber was set up with a 6 volt battery, carbon electrodes, and a variable resistor. Currents tested ranged from 3.1 mA to 0.5 mA. *A. rosae* showed behavioral responses to every current amplitude tested. This suggests the *A. rosae* can detect electrical fields. Future studies include looking at lower current ranges as well as testing the sensitivity of the cavefish to AC fields.

DISPERSAL AND PERSISTENCE OF 2,3,7,8- TETRACHLORODIBENZO-P-DIOXIN (TCDD) IN A CONTAMINATED AQUATIC ECOSYSTEM, BAYOU METO, ARKANSAS

ABSTRACT - Johnson, James E. Arkansas Cooperative Research Unit, National Biological Survey, University of Arkansas. Dioxin (TCDD) is an extremely toxic polychlorinated compound, considered to be the most toxic synthetic compound ever tested. During the early 1970s, a point source of dioxin was identified in Bayou Meto, a lowland stream originating in Jacksonville, AR. Dioxin contamination of fishes resulted in closure of parts of the river to all fishing and the entire river to commercial fishing. We evaluated the dispersal and biomagnification of dioxin in sediments and fishes in 1991-92. Dioxin persists in fishes and sediments, but concentrations were reduced from levels found in 1982 and 1987; differences in sampling and testing methodologies may influence these comparisons. Highest dioxin concentrations were found in sediments (276 parts per trillion-ppt), forage fish (young bluegill-296 ppt), omnivores (buffalo-123 ppt), and piscivores (crappie, bass-48 ppt) immediately downstream from Rocky Branch, a first order tributary of Bayou Meto. Dioxin concentrations decreased rapidly downstream, with omnivorous and piscivorous fishes falling below EPA foodstuff limit of 25 ppt 41 km below Rocky Branch and below background levels 67 km below that source. Young bluegill and sediments retained elevated levels of dioxin 21-4 km below Rocky Branch. No indication of biomagnification was noted. In part, as a result of this study, the lower reaches of Bayou Meto have been reopened to commercial fishing.

ALLIGATOR SNAPPING TURTLE PROJECT 1994

ABSTRACT - Wagner, Brian, D. Urbston, D. Leek, J. Barnett, E. Poe, J. Ahler, D. Broach, R. Darter, E. Ingle. Arkansas Game And Fish Commission. The alligator snapping turtle (*Macrolemys temmincki*) is found throughout the southeastern United States, but there is concern about possible declines in populations throughout its range. Little is known about the species in Arkansas, and it has previously been documented from only 20 counties in the state. During this study 1800 net nights of sampling with baited hoop nets were conducted throughout the state,

capturing a total of 425 alligator snapping turtle. Alligator snapping turtles were located in 49 counties, 36 of which did not have previously documented records. Sampling failed to yield alligator snapping turtles in 7 counties where they had been previously reported. The alligator snapping turtles captured averages 13 inches (33 cm) in carapace length. Catch rates were significantly higher in counties which had been previously open to commercial turtling, but average sizes were not. It is recommended that additional sampling be conducted in order to complete this survey.

FISHERIES INVESTIGATIONS ON PRADO RESERVOIR, COLOMBIA

ABSTRACT - Shirley, Kenneth E., Peace Corps Volunteer. In 1969, Columbia's largest warm-water reservoir was completed. An excellent fishery drew commercial fishermen to the lake in large numbers. By 1973, however, the fishery had begun to decline causing economic distress. In 1974, a large scale study of the limnology and fishery was begun to determine the causes for the decline and develop solutions. The major portion of the study was a creel survey of the commercial fishery. By 1974, four species of riverine characins which had supported the bulk of the fishery were declining, comprising less than 25% of the total weight of the harvest. Only adults were observed. By 1976-78, two had apparently totally disappeared and the others comprised less than 2% of the harvest. Less valuable lacustrine cichlids made up 76% of the harvest by 1976-78. The cause of the fishery's collapse was determined to be the combination of the natural decline in productivity experienced by all new reservoirs, the inability of the most valuable species to reproduce in the short river reaches remaining above the lake, and excessive harvest.

Several solutions to the problem were developed. Small nicuro catfish were captured below the dam and stocked into the reservoir where they grow better. A hatchery was designed (constructed after my tour) for production of the riverine characins using hypophysation techniques which we have investigated. Finally, small farm aquaculture projects were developed in the area to increase local protein production and "ween" the populace from dependence on the limited natural fish production of the region's lakes and rivers.

PRELIMINARY EVALUATION OF THE CULTURE POTENTIAL OF *Oreochromis esculentus*

ABSTRACT - Rowan, Martha and Nathan Stone. Agricultural Experiment Station, University of Arkansas at Pine Bluff. Changes in the ecology of Lake Victoria in East Africa have resulted in a disruption of the lake's endemic fish community that has left many species endangered or extinct. The University of Arkansas at Pine Bluff is cooperating in a captive breeding and research program by propagating and providing to other researchers the tilapia *Oreochromis esculentus*. In conjunction with this, a study was conducted to evaluate the growth and culture potential of *O. esculentus* in ponds.

Oreochromis esculentus (average weight 17.64g) were stocked into 4, 0.01 a ponds at a rate of 6000 fish/acre and harvested after 104 days. All ponds were fertilized frequently with organic and inorganic fertilizer, and fish in two ponds were fed once daily with an extruded tilapia feed at an initial rate of 4% body weight and a maximum rate of 17.6 lbs/acre/day. Net yield averaged 848 lbs/acre from fertilized ponds, and 1618 lbs/acre from ponds where fish received feed. Relatively poor growth rate (compared to other tilapia species currently cultured) and other behavioral traits appear to limit the commercial culture potential of this species.

BIRD DEPREDATION AT SPORTFISH HATCHERIES

ABSTRACT - Layher, William G., Pine Bluff Cooperative Fisheries Research Project, National Biological Service. Twenty-five species of avian fauna were observed at two state fish hatcheries for one and one-half years. Counts were conducted to determine numbers of birds at hatcheries. Feeding rates for different species were obtained from data collected through observation of feeding behaviors. Collection of bird specimens and subsequent gut analysis yielded information of items used as prey for each bird species. Potential depredation problems exist for some species, but not all bird species thought to cause problems by managers. This paper summarizes findings for all bird species studied and potential fish production impacts.

CORRELATION OF POPULATION WITH BIOCHEMICAL STRESS IN AN ARKANSAS BAYOU

ABSTRACT - Perkins, R.J., W. G. Layher', Y.S. Zhanci', and-D- ' --Schlenk'- Division of Toxicology, University of Arkansas for Medical Sciences, Little Rock, AR; 'US National.. Biological Survey, Pine Bluff, AR.; and 3Department of Marine. Biology, Third Institute of Oceanography, State Oceanic Administration, Xiamen, PRC

A great deal of interest in biomonitoring techniques to assess environmental contamination by various toxins has been generated in recent years. However, few attempts at designing a multi-system approach to integrate biomarker data with indices of environmental health have been attempted. Therefore, we wanted to look for correlation between the data from biological stress indicator analysis-(CYPIA and Metallothienin) and population effects (Shannon Weaver Index) in the field. Samples were collected by electrofishing from thirteen sites in Bayou Bartholomew in the months of June and July of 1994. All samples were catalogued, and individuals from a range of species were selected for enzyme analysis. Livers were excised from the selected individuals immediately after death, frozen on dry ice, and stored at -80C for later analysis. Catalogue data was used to establish a D-Bar values for each site. Microsomal fractions were prepared from each stored hepatic sample and were subsequently analyzed for Ethoxyresorufin 0-dethylase (EROD) activity as well as for CYPLA content. Any remaining liver tissue was used in an RNA protection assay to measure MT mRNA expression. Data failed to show any significant correlation between-sublethal effects

and species diversity in comparison with 1994 SWI values. However, when compared to mean SWI values (1992-1994), potential relationships appeared between MT (White crappie and Large mouth bass) and CYP1A (Female Carp) and Species diversity. MT analysis showed a significant elevation of MT mRNA levels in four sites under Mercury advisory.

POTENTIAL CONSUMER ACCEPTANCE OF CANNED BIGHEAD CARP

ABSTRACT - Engle, Carole R. and Pierre-Justin Kouka Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff. Bighead carp (*Hypophthalmichthys nobilis*) have been raised in Arkansas in polyculture with catfish in commercial fish ponds in an attempt to improve water quality since the 1970s. A high-volume market outlet, such as a cannery, would provide stability and a constant market for bighead carp. Preference tests were conducted to assess consumer attitudes and preferences to the taste, texture, appearance, and aroma of canned bighead carp. The effects of sociodemographic factors on consumer ratings of product attributes of an experimental canned bighead product were analyzed. OLS and logit regression techniques were used to evaluate 1.) the effects of experience consuming other canned fish products, race, gender, age, and income on the taste, texture, appearance, and aroma of canned bighead; 2.) effects of these sociodemographic variables on binary choice variables related to preference comparisons and willingness-to-pay as much for canned bighead as for canned salmon and canned tuna. Income, region, and gender significantly affected ratings on product attributes while taste variables significantly affected consumers' willingness-to-pay as much for canned bighead as for canned tuna. Probabilities estimated showed that canned bighead competes more favorably with canned tuna than with canned salmon. Marginal impacts for the highest population area for the canned tuna comparisons were highest for white female shoppers.

CORRELATING METRICS OF FISH HEALTH WITH CELLULAR INDICATORS OF STRESS IN AN ARKANSAS BAYOU

ABSTRACT----Schlenk, D., R. J. Perkins, W.G. Layher and Y.S. Zhang 'Division of Toxicology University of Arkansas for Medical Sciences, Little Rock, AR; 'US National Biologic'al Survey, Pine Bluff, AR.; and "Department of Marine Biology, Third Institute of Oceanography, State Oceanic Administration, Xiamen, PRC. A major disadvantage of using cellular indicators of stress or "biomarkers" to evaluate the health of fish is the lack of a documented relationship between the cellular response and detrimental changes to the organism's health. In an attempt to correlate individual animal health with cellular stress, a Fish Health Index (FHI) was constructed to assess the health of feral large mouth bass (*Micropterus salmoides*) at 13 sites in Bayou Bartholomew. Fish (n=9) were obtained from 7 of the 13 sites, livers were analyzed for expression of the cellular stress protein, metallothionein as well as CYP 1A and heme oxygenase (HSP30.). Linear regression analysis revealed a direct ($r^2 =$ correlation between CYP 1A and FHI 0.66). Although MT appeared to be inversely related to FHI, no significant correlation was observed ($r^2 = 0.09$). Comparing FHI with a metric of species diversity (Shannon-Weaver Index) also failed to show a significant correlation ($r^2 = 0.21$), but evaluation of the scattered data did indicate an inverse relationship. Studies are currently underway to evaluate heme oxygenase in these samples. Thus, induction of CYP 1A protein may not be an exclusive indicator of poor animal health.

FISH MORTALITY AND BEHAVIORAL IMPACTS ASSOCIATED WITH LARGEMOUTH BASS FISHING TOURNAMENTS IN MINNESOTA

ABSTRACT - Kwak, Thomas J. Arkansas Cooperative Fish and Wildlife Research Unit Department of Biological Sciences, University of Arkansas Fayetteville and Mary G. Henry, Minnesota Cooperative Fish and Wildlife Research Unit, University of Minnesota Competitive angling has become an increasingly popular and widespread use of fishery resources in the United States, creating a need for factual information on which to base management decisions. We studied impacts associated with two live-release largemouth bass tournaments held on 6-7 September 1991 and 16 May 1992 on Lake Minnetonka, a 5900-ha lake in east-central Minnesota. Mean mortality at weigh in was 1.4%, and mean delayed mortality, determined by holding fish on site for 3 days in mesh pens, was 3.0%. Mean total mortality was 4.4%. Mortality during the spring tournament was about twice that of the late-summer tournament. Angler interviews and water quality measurements from livewells revealed no single cause for mortality. Radio telemetry studies to determine dispersal patterns of tournament-caught fish released at weigh-in sites revealed seasonal differences in behavior. Most fish displaced during the late-summer tournament did not disperse from their release site until the following spring, but fish displaced during the spring tournament all dispersed within two weeks of their release. These types of studies will provide insight into fish behavior and objective information needed to improve guidelines for tournament operation and future management of the resource.

BLACK BASS EXPLOITATION STUDY NORFORK LAKE

ABSTRACT - Oliver, Mark and Kenneth Shirley. Arkansas Game and Fish Commission. In April 1994-1977 black bass (727 largemouth, 151 spotted, 74 smallmouth and 5 smallmouth x spotted hybrid) were tagged with reward anchor tags in Norfolk Lake. Of these 590 were tagged during the Bass Cat Bass Tournament weigh-in and 387 were tagged during routine electrofishing samples. Project goals include estimating total and tournament catch and harvest rates, the 'anglers' skill at identifying the three species of bass, delayed mortality following the tournament, the movement of bass following their release, and the use of Arkansas Game and Fish attractors by bass anglers. The study was funded by Bass Cat Boats, Mountain Home, Ar.

To date (October 1994), 225 (23%) tagged bass have been reported of which 61 % were released. About 49 % were caught by Baxter County, Arkansas anglers.. Illinois anglers have 'Caught 14.4% of the bass, almost as many as all other states, including Missouri, combined. Return rates of bass tagged during the tournament and during electrofishing samples were virtually identical indicating insignificant differential mortality between the two collection methods. Approximately 13% of the bass were taken during tournaments, but only 7% of the harvested fish were taken during tournaments. Only 6.4%.of the bass were caught on the fish attractors, most after July 7 when the falling water level finally exposed all shoreline vegetation. Over 80% of the anglers correctly identified largemouth and smallmouth bass, but 33% mis-identified spotted bass.

CHALLENGES FACING ARKANSAS FISH FARMERS

ABSTRACT - Freeze, Mike,-Keo-Fish Farm, Inc. Aquaculture in Arkansas is more diversified than in any other state I am aware of. This diversification means that Arkansas fish farmers face some challenges that are unique to their specific species, while all Arkansas fish farmers share certain challenges that are regulation or production oriented. Common challenges include bird depredation, the Lacey Act, discharge permits, the lack of registered thy, and of course increased profitability.

Fish farming in Arkansas can be broadly broken into five segments: foodfish production; fingerling production; baitfish production; ornamental production and the production of fish used as biological control agents. Farmers from each of these segments must confront challenges that will directly determine their success. In order, the number one challenge for each segment is: breaking the historic foodfish cycle of over production followed by under production; developing a genetic selection program for favorable fingerling traits; eliminating the wild harvest of baitfish; developing a preventive disease program; and insuring the continuation of a certification program that will insure states they are receiving sterile biological control agents.

ROLE OF FISH DIAGNOSTIC LABORATORIES: HEALTH CHECKS AND DISEASE-FREE CERTIFICATION

ABSTRACT - Park, E. D., Extension Fish Health Specialist University of Arkansas at Pine Bluff Cooperative Extension Program. The largest cause of economic loss' in aquaculture is directly attributable to disease problems of aquacultured fish. For this reason, diagnostic laboratories can play a vital role in the expansion of the aquaculture industry in a number of ways including (1) health checks and (2) disease- free certification of fish.

The traditional way fish disease has been approached has been to bring fish samples to a diagnostician only after a significant number of fish have died either in the pond or during handling/transportation. Therefore, by the time a diagnosis is made, it is often too late and very difficult to do anything that will significantly alter the diseases natural course. Routine fish health checks, especially immediately prior to (i. e handling/transportation) or immediately following (i. e., poor water quality) known high stress conditions, can help prevent or at least lessen the severity of a disease flare-up thereby reducing the economic impact of a specific outbreak to a producer.

In this era of ever increasing governmental regulation the requirement for fish to be certified as disease-free or specific pathogen-free is inevitable. This is especially true when referring to the live shipment of fish either interstate or internationally. The type of disease-free certification generally depends on the species of fish being shipped and it's destination. Therefore, the availability of a laboratory certified to perform such inspections can make these markets accessible to the producer. The certification of fish as disease-free, even in cases not required by law, can also be a useful marketing tool to the aquaculture industry by further emphasizing and verifying the quality of a producers product.

DISCHARGE REGULATIONS AND FISH FARMS

ABSTRACT - Finch, Bernie Arkansas Department of Pollution Control and Ecology. An overview of the Water Division of the Arkansas Department of Pollution Control and Ecology (ADPC&E). Specifically, the state administered National Pollutant Discharge Elimination System (NPDES). Also, permitting of discharges of process and non-process waste water from aquaculture production and processing facilities. Permitting requirements related to "No-Discharge" and "Discharge" (NPDES) permits in Arkansas.

CURRENT STATUS AND DISTRIBUTION OF ZEBRA MUSSELS IN ARKANSAS

ABSTRACT---Harris,- John L., Arkansas Highway and Transportation Department.

In 1986 a ship released ballast water into Lake St. Clair, Michigan, releasing freshwater organisms it had picked up in a freshwater European port. In the ballast were larvae of a freshwater mollusc, the zebra mussel (*Dreissena polymorpha*), which is originally native to the Caspian Sea and Ural River in Asia. This small mussel is usually no more than five centimeters long and is characterized as a macrofouler which quickly colonizes new areas and rapidly achieves high densities. Zebra mussels spend their adult lives attached to hard substrata such as rocks, logs, native mussel shells, crayfish shells, plastic, concrete, wood, fiberglass, iron and polyvinyl chloride pipes, and surfaces covered with conventional paints.

Zebra mussels spread rapidly throughout the Great Lakes following their initial introduction and are now moving southward at a similar rate. By 1992, zebra mussels had moved up the Ohio River to at least Cincinnati, Ohio, 312 km up the Cumberland River to Chattanooga, Tennessee, and down the Mississippi River all the way to New Orleans, Louisiana. Zebra mussels were first found in Arkansas in 1992 in the Arkansas River at Little Rock and Russellville. They have since been documented to occur throughout the length of the Arkansas River within the state, and in 1994, zebra mussels were found in the White River at Clarendon, Arkansas. This presentation will summarize the distribution and population densities of zebra mussels from monitoring sites within Arkansas.

STOCKING PROGRAMS OF THE ARKANSAS GAME AND FISH COMMISSION

ABSTRACT - Gibson, Michael D., Arkansas Game and Fish Commission.,

The Arkansas Game and Fish Commission operates four warm-water hatcheries located throughout the State of Arkansas and one trout culture facility. The main objective of these hatcheries is to provide the number of species of fish requested by district fisheries biologists for various management programs in their district. These hatcheries provide fish for the private farm pond program and fishing derbies sponsored by the Aquatic Resources Program. The AG&FC also operates three net pen facilities that provide fish for management purposes.

The total hatchery system of the Arkansas Game and Fish Commission consists of 480 surface acres of water. From this system, in 1994, fish were stocked into approximately 346,789 water acres. Seventy-one of 75 counties in the state received fish. Also, 106 access areas located on 22 different river systems, 13 creeks and bayous were stocked with fish.

USE AND REGULATION OF HORMONES AND CHEMICALS FOR FISH

ABSTRACT - Griffin, Bill, Fish Farming Experimental Laboratory, National Biological Service. Chemicals are used in every aspect of fish and shellfish production in the United States. Herbicides are used to control algae in production ponds or tanks, parasiticides are used to control external parasites, antibiotics and vaccines are used for disease control and for marking for identification, gonadotrophic hormones are used to induce ovulation and to manipulate gender of larvae. Chemicals are used in certain harvesting procedures, in tank water for transportation, and to anesthetize fish for shipping or for experimental work. Most recently hormones and hormone controlling genes are being tested as growth stimulants. Chemicals are used in the production and distribution of catfish, shrimp, lobsters, crawfish, trout, salmon, tilapia, striped bass, baitfish, goldfish, ornamental fish, chinese and european carp, and others, as well as sportfish such as largemouth and smallmouth bass, crappie, and sunfish.

Regulation of chemicals used in fish production is exercised by 4 branches of the U.S. government.

The U.S. Food and Drug Administration (FDA) is responsible for regulating animal drugs and feed additives. The Environmental Protection Agency (EPA) is responsible for pesticides used in the environment. The U.S. Department of Agriculture (USDA) is responsible for veterinary biologics such as vaccines. The Drug Enforcement Administration (DEA) is responsible for regulation of narcotics and other controlled substances. State bureaus that may regulate the use of chemicals in fish and shellfish production include game and fish commissions, public health departments, food regulatory agencies, animal and plant health inspection services, and others. The most influential regulatory agencies are FDA and EPA. The regulatory roles of these agencies will be discussed.

RESEARCH DIRECTIONS FOR ARS IN AQUACULTURE

ABSTRACT - Freeman, Don, Agricultural Research Service, Aquaculture Systems Research Unit, UAPB. The-Agricultural Research Service (ARS) and the University of Arkansas Center of Excellence for Aquaculture and Fisheries at Pine Bluff have entered into a cooperative partnership to promote and facilitate the expansion of aquaculture in Arkansas and surrounding areas of the Mississippi Delta. The ARS Aquaculture Systems Research Unit was established at UAPB in July 1 994 to conduct studies that address both production and post harvest issues. The mission of the ARS Unit is to evaluate and develop new components of aquaculture production systems to improve the efficiency of freshwater fish farming including cultural and processing methods to enhance and sustain product quality. Initial research will focus on assessing various production scenarios, including stocking and feeding strategies, that optimize profit potential for production of channel catfish. Improving and developing post harvest procedures that enhance marketability of farm- raised fish, including development of value-added products from non- traditional fish such as carp, also will be emphasized in allied research studies.

CATFISH YIELD VERIFICATION IN CHICOT COUNTY: INTERFACE BETWEEN RESEARCH, EXTENSION, AND PRODUCERS

ABSTRACT - Heikes, D. L., C.E. Hayden, and H.S. Killian. University of Arkansas at Pine Bluff, Cooperative Extension Program-Hamburg and University of Arkansas at Pine Bluff, Cooperative Extension Program-Lake Village

The Arkansas Cooperative Extension Service has initiated a Yield Verification program to provide an active interface between catfish producers, researchers and extension specialists. Specific objectives are: To verify that current Extension recommendations can produce profitable yields; To estimate the cost of production for individual ponds and the corresponding feed conversion ratio (FCR), yield, and survival; To identify research needs and update extension recommendations; and, To develop protocol for future trials. Cooperators agreed to manage ponds according to extension recommendations for a period of three years. Conclusive results will be available after May 1 996. Results presented here are preliminary estimates based on 1 2-1 7 months of production. Value ranges reflect inventory seining efficiencies of 100%-75%. One 20 acre pond was stocked in May 1993 with 6370 fingerlings/acre (54 lbs/1000) and under-stocked in May 1994 with 4839 fingerlings/acre (92 lbs/1000). Partial harvests occurred in June, August, and October of 1 994. Inventory on November 2, 1 994 indicated a yield of 7108-751 1 lbs/acre over 17 months with an FCR of 1.66-1.57 and 73%-82% survival (0.14% observed mortality). One 16.7 acre pond was stocked in May 1993 with 6454 fingerlings/acre (57 lbs/1 000) and under-stocked in May 1994 with 6241 fingerlings/acre, (91 lbs/1000). Partial harvests occurred in June, August and October 1 994. Inventory on November 3, 1 994 indicated a yield of 7063-7869 lbs/acre over 1 7 months with an FCR of 1.73-1.67 and 51 %-56% survival (0.22% observed mortality).

**THE INFLUENCE OF SUSPENDED SEDIMENT ON LARVAL RAZORBACK
SUCKERS (*Xyrauchen texanus*) VULNERABILITY TO PREDATION BY GREEN
SUNFISH (*Lepomis cyanellus*) AND JUVENILE COLORADO SQUAWFISH
(*Ptychocheilus lucius*)**

ABSTRACT - Hines, Robert, Cooperative Fish and Wildlife Research Unit Department of Biological Sciences, University of Arkansas. The razorback sucker is an endangered catostomid endemic to the Colorado River basin. The largest remaining population of razorback sucker resides in Lake Mohave, Arizona-Nevada. Impoundment modified the physical and chemical characteristics of the Colorado River, moderating flow and temperatures, and reducing turbidity. In addition, creation of clear-water reservoirs provided lacustrine habitat for transplanted non-native fishes. Razorback sucker spawn annually along the shores of Lake Mohave, but natural recruitment has been undetected since dam closure 40+ years ago. Identifying causes of recruitment failure is problematic, but predation on early life-stages by non-native fishes is considered the primary factor. An additional cause may be physical changes to the river following impoundment. Historically, habitats more turbid than present day Lake Mohave were utilized by adult and larval razorback sucker. In contrast, non-native fishes in general evolved in clearer habitats. These non-native predators forage visually, and may be adversely affected by turbidity, which reduces reactive distances and growth rates in many fish species. Therefore, an experiment was designed to determine if larval razorback sucker vulnerability to foraging green sunfish and juvenile Colorado squawfish decreases with elevated suspended sediment concentrations. Predation trials were performed in aquaria at suspended sediment concentrations (bentonite clay) of 0, 250, and 2000 ppm. Results indicate that larval razorback sucker are less vulnerable to foraging native and non-native predators with increased suspended sediment concentration. In addition, larval razorback sucker experienced differential vulnerability, being more vulnerable to green sunfish at 0 ppm and to squawfish at 2000 ppm.

**POPULATION DYNAMICS OF OZARK CAVEFISH IN LOGAN CAVE, NWR
ARKANSAS**

ABSTRACT - Brown, Zack J., Arkansas Cooperative Research Unit, University of Arkansas. The Logan-Cave (AR)--population of Ozark cavefish was surveyed over a twelve month period starting in September 1993. Eighty new cavefish were visual implant tagged in addition to the 80 that had been tagged during a previous study in 1992. Eleven of the 80 cavefish marked during the 1992 study were recaptured during the present study (13.8%). Unmarked cavefish in the periodic collections decreased from September to February (78% to 12.5%) and averaged 10.3% from March through May. The percentage of unmarked cavefish in periodic collections began to rise from June through August (55%, 73%, 46%) and then began to decline again. This indicates that new fish movement into the accessible portion of the cave is not consistent over the entire year and appears to be seasonal. Currently, the capture histories of the 80 most recently marked fish are being analyzed using the population dynamics program JOLLY and will yield estimates of survival rate, population size, and recruitment.

**GENETIC STRUCTURE CORRELATED WITH AGE AND GROWTH OF THE
LARGEMOUTH BASS POPULATION
IN LAKE ASHBAUGH, ARKANSAS**

ABSTRACT - Johnson, Ronald L., Department of Zoology, Arkansas State University.

Lake Ashbaugh, located in northeast Arkansas in Greene County, is 243 hectares and is owned and managed by the Arkansas Game and Fish Commission. For the past several years Lake Ashbaugh has had difficulty sustaining its largemouth bass population. Genetic analysis of the largemouth bass of Lake Ashbaugh has recently demonstrated the presence of the Florida largemouth bass alleles. A Fish Health Assessment of the bass indicated that they were in very poor condition. The present study was designed to compare the growth of Northern, F, and Fx largemouth bass. Fish were collected by electrofishing in conjunction with the Arkansas Game and Fish Commission in June, 1994. Scales were removed for age-growth analysis using the formula of Weatherley and Gill. The liver was removed and frozen at -70 °C for determination of genotype for the following allozymes: AAT-B, IDH-6 and MDH-1. The population structure within the lake demonstrates a high proportion of the fish sized between 11 and 12 inches. Growth rates were low for the largemouth bass of Lake Ashbaugh.

**EFFICACY OF FISH SILAGE IN PRACTICAL DIETS FOR CHANNEL CATFISH IN
AQUARIA**

ABSTRACT - Brown, Ramone and Rebecca Lochmann, University of Arkansas at Pine Bluff.

Twelve silages made from one of three fish (gizzard shad, golden shiner or tilapia) mixed with one or more of four acids (phosphoric, hydrochloric, acetic and propionic) were produced and assessed for appropriateness as feed ingredients in practical diets for channel catfish (*Ictalurus punctatus*). Criteria used to evaluate nutritional quality of the silages were protein and amino acid content, lipid content and stability during storage. Stability did not differ greatly between silages. However, the tilapia-HCL combination contained the best nutrient profile for channel catfish. This silage was neutralized, lyophilized, incorporated into practical diets and used in a feeding trial with juvenile channel catfish. The trial was conducted to establish the effectiveness of fish silage, alone and in combination with fish meal or blood meal, as a dietary protein source for channel catfish. The five diets contained approximately 9.8 kcal/g and 34% protein with two different levels of animal protein designated "low" (3%) and "high" (6%).

Fish averaging 0.5 g initially were maintained in triplicate groups of twenty in a flow-through system with a water temperature of 21-26°C. After 8 weeks there were no significant differences in weight gain or feed efficiency of catfish fed isonitrogenous levels of fish silage, fish meal or silage/fish meal and silage/blood meal combinations. Growth was slightly higher in fish fed the high animal-protein diets. Fish silage was comparable to fish meal in its effects on performance of channel catfish at relatively low water temperatures. However, temperature affects protein utilization and additional experiments will be conducted at higher water temperatures.

COMPARISON OF SPORT FISH HABITATS IN FOUR ARKANSAS RESERVOIRS

ABSTRACT - Flores, Kenda --Arkansas Cooperative Research Unit Department of Biological Sciences, University of Arkansas Fayetteville.

Water quality data from four Arkansas reservoirs has been collected monthly during 1993 and 1994 from 30 sampling stations. Temperature, dissolved oxygen, pH, dissolved solids, conductivity, and redox are measured at meter intervals from the surface to the bottom depths. Stratification persists from early summer to late autumn. Results indicate that 1994 temperatures were cooler than in 1993 during the stratification period. Beaver and Ouachita reservoirs provided excellent water quality during August, 1994. Average dissolved oxygen concentrations at the dams in 1994 were higher than in 1993. Only Norfolk reservoir fell below 2 mg/L dissolved oxygen in the hypolimnion in August. Results indicate a minimal loss of habitat with respect to total reservoir volume for 1993 and 1994 sampling periods.

CHLOROPHYLL MAPPING ON TWO ARKANSAS RESERVOIRS USING A GEOGRAPHICAL INFORMATION SYSTEM

ABSTRACT - Allee, Rebecca and James E. Johnson, Arkansas Cooperative Research Unit, Department of Biological Sciences University of Arkansas, Fayetteville.

Two Arkansas reservoirs, Bull Shoals and Ouachita, were sampled monthly over the summer of 1994 for surface chlorophyll concentrations. Chlorophyll was measured in the field using a Turner fluorometer. Measurements were taken at thirty stations dispersed throughout the reservoirs. Water samples were also collected for chlorophyll analysis by spectrophotometer in order to calibrate the fluorometer, readings to chlorophyll concentrations in micrograms per liter. The regression equation had an R value of 0.99. The data collected from the thirty stations were used to produce surface-chlorophyll maps of each reservoir utilizing the Geographical Information System, GRASS. The resulting maps were accomplished using a distance-weighted interpolation procedure. Statistical analyses were also performed to determine if chlorophyll concentrations differed significantly throughout the reservoirs. On both reservoirs, chlorophyll concentrations were considerably higher in the upper reservoir. Chlorophyll concentrations throughout the majority of each reservoir, however, were similar. On Bull Shoals, chlorophyll concentrations reached a maximum of 7.1 ug/L in July. On Lake Ouachita maximum concentrations reached 5.8 ug/L in August. Average chlorophyll concentrations were 2.32 ug/L for Bull Shoals and 1.62 ug/L for Lake Ouachita for the summer season.

INDUCING GONADAL MATURATION AND SPAWNING IN THE GOLDEN SHINER (*Notemigonus crysoleucas*)

ABSTRACT - Rodriguez, Mary, Trevor Clark, Martha Rowan and Nathan Stone, Agricultural Experiment Station, University of Arkansas at Pine Bluff.

Golden shiners, which account for nearly half of the \$43 million Arkansas baitfish industry, normally spawn in Arkansas in the spring. This study was conducted to determine if golden shiners could be induced to spawn off-season as a means of producing eggs and fry for research purposes. Age 0 (7- to 9-month-old) and age-1 (19 to 21-month-old) golden shiners (*Notemigonus crysoleucas*) were taken from ponds during winter and held in tanks at $25 \pm 20^{\circ}\text{C}$ at a photoperiod of 15.5 h of light and 8.5 h of dark for two trials (November 16-December 17; January 24-March 10). Gonadosomatic indices (GSI's) of age-0 females increased significantly ($P < 0.05$) during each trial; age-1 female GSI's increased significantly in the second trial. . Eggs and fry were produced by both age-0 and age-1 fish by the 4th week of the second cycle. Over the next 11 d, eggs produced by 14 age-0 and 15 age-1 fish resulted in 2,565 and 1,713 fry respectively. Spawning occurred 6-8 weeks before fish would normally spawn in the spring. Off-season tank spawning of golden shiners could be used to produce small quantities of eggs and fry.

AMBIENT TOXICITY WITHIN TRIBUTARIES OF THE OUACHITA RIVER AND THE POTENTIAL FOR IMPACT ON FISHERIES

ABSTRACT - Knight, Tim, Ouachita Baptist University, Department of Biology. Ambient toxicity tests were conducted on six different tributaries of the Ouachita River during the past two years. The tributaries sampled include: Cove Creek, East Two Bayou,- West Two Bayou, Smackover Creek, Champagnolle Creek and Coffee Creek. The results of the tests indicate that sporadic toxicity occurs at several locations on these tributaries. However, toxicity is rarely ever detected within the Ouachita River proper. Speculation will be made as to the potential for impact these toxic events may have on the fisheries of the Ouachita River.

The species utilized in the toxicity screening tests were the water flea, *Ceriodaphnia dubia* and the Fathead Minnow, *Pimephales promelas*. These organisms are routinely utilized as toxicity test species by the Environmental Protection Agency within the National Permit Discharge Elimination System. Additionally, these organisms have been useful in ambient monitoring of surface waters throughout the United States.

The data presented here are a subset of the data collected by the Lower Ouachita River Work Group (LORWG) on the Ouachita River System.

CHANGES IN DENSITY OF LARVAL ZEBRA MUSSELS (*DREISSENA POLYMORPHA*) IN LAKE DARDANELLE, ARKANSAS

ABSTRACT - Shook, Shannon D., Charles S. Gagen, and Joseph N. Stoeckel, Department of Biological Sciences, Arkansas Tech University

The zebra mussel explosion in the Great Lakes has greatly altered that aquatic ecosystem and adversely impacted local industries. As these exotic mussels colonize the Mississippi River and its tributaries, the ecology of these systems probably will be altered. In September of 1992, the first zebra mussels were found in Lake Dardanelle, a 34,000 km² reservoir on the Arkansas River. We began quantitative sampling of zebra mussels at four sites on the reservoir in July of 1993. We sampled the free-swimming larval (veliger) stage biweekly with a 64- micron plankton net, and used PVC plates suspended in the water column to collect settling juveniles. In 1993, peak veliger density - occurred in October and averaged 100/m³ for all sites combined. In 1994, peaks in density two orders of magnitude greater than the 1993 peak occurred in June and October; means of (65,000/m³) and (33,000/m³), respectively. To date, we have found only 14 settling juveniles on the PVC plates. However, we anticipate that the recent increase in veliger density will result in an increase in the density of juveniles and subsequently adults in Lake Dardanelle. Periodic examination of rocks along the shoreline provided an index of abundance for adults. Thus far, the adult population density is low (8/m² in suitable habitat) when compared to that in the Great Lakes (30,000 to 200,000/ml). Establishment of a dense population of zebra mussels in Lake Dardanelle could lead to increases in water clarity and aquatic macrophytes; decreases in zooplankton and larval fish; and could alter nutrient dynamics.