

## **Stomach Contents of the Ouachita Madtom (*Noturus lachneri*) Collected in 1991 and 1992 From Streams in the Saline River Drainage, Arkansas**

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The U.S. Fish and Wildlife Service has considered listing the Ouachita madtom (*Noturus lachneri*) as "threatened" due to its limited geographical distribution, small population size and habitat vulnerability. This study was a continuation of a previous study to identify typical foods eaten by this endemic madtom. Samples for feeding habits were collected in August 1991, October 1991, January 1992, and April 1992. A total of 24 kick-net samples and 117 Ouachita madtoms were collected from pool and adjacent riffle habitats in 3 streams in the upper Saline River drainage. The most frequently occurring invertebrates in the kick-net samples were Ephemeroptera (75%), Isopoda (75%), Diptera (59%), and Coleoptera (54%). The most frequently occurring invertebrates in the stomachs were Diptera (61 %), Ephemeroptera (38%), Isopoda (37%), and zooplankton (30%). Ouachita madtoms seemed to consume few insect larvae of the order Coleoptera relative to their widespread occurrence. Conversely, zooplankton were well represented in the stomachs, but were not sampled by the kick-net methodology (mesh size was too large). In agreement with the previous years data similarities between frequency of occurrence in kick-net samples and frequency of occurrence in stomach contents indicated that Ouachita madtoms were not highly selective. However, they did seem to avoid representatives of the order Coleoptera.

### **UNTITLED**

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*Notropis bairdi* and *Notropis potteri* are closely related, morphologically similar species of stream fishes that co-occur extensively in the Red River and its tributaries in southwest Oklahoma. We sampled 87 sites in this area between March and June 1989. Correlation between the two species' abundances among sites was not significant. We sampled five sites within the overlap in range of the two species monthly between September 1990 and September 1991. Populations were separated into year classes using length-frequency nodal-progression analysis. Significant correlations were found between all year classes compared between the two species. The lack of correlation between the two species' abundances among the 87 sites was probably due to the cancelling effect of positive and negative covariation between different year classes, and underscored the need to view species with indeterminate growth as occupying different niches over their lifetimes.

## **Nesting Success in a Natural Population of Largemouth Bass: Effects of Habitat Enhancement and Nest-Site Selection**

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Nest-site selection and availability of specific habitat characteristics may strongly impact nesting success but are largely unexamined in relation to one another for centrarchid fishes reproducing under natural conditions. We located 139 nests of largemouth bass (*Micropterus salmoides*) on eight permanent transects and measured depth, temperature, substrate and associated structure for each nest. Nests were monitored every 2-4 days for brood age and condition; artificial log structure was added, and natural structure removed, on two experimental transects to assess the effects of habitat enhancement on spawning and reproductive success. We measured habitat availability for 1000m of unmanipulated shoreline. Bass nested on gravel substrate nearly four times more often than expected by chance (use = 78%, availability = 20%). Cobble, sand/silt and boulder substrates were each selected less than expected by availability. Structure was associated with 93% of nests; bass preferred large woody structure to other forms of structure and to no structure and selected log sites three times more often than expected by availability on natural transects. Nesting density was increased on experimental transects, where 100% of nests were associated with structure. Nesting success was equivalent on natural and enhanced transects (52%), but was higher on nests associated with artificial logs (63%). Adding structure makes poor nesting habitat better for nesting bass than natural habitat with adequate habitat.

## **Fish Community Structure of the Buffalo National River, Arkansas**

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We examined fish community structure and major factors that influence fish assemblages of various habitats on the Buffalo National River, Arkansas. Riffles were sampled using backpack electro-shock in 3m quadrates. Methods for sampling pool habitats included minnow seine, backpack electro-shock, and diver transects. Percidae and Cyprinidae were the most diverse and abundant fish families represented in collections. *Luxilus pilsbryi*, *Camptostoma oligolepis*, and *Etheostoma julae* were the most abundant riffle species. *Lepomis megalotis* were found in greatest numbers in pools. Stream order and riffle/pool geomorphology were major influences on fish assemblages.

## **Movement and Migration of the Ozark Cavefish (*Amblyopsis rosae*) in Logan Cave National Wildlife Refuge, Benton County, Arkansas**

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The population of threatened Ozark cavefish in Logan Cave National Wildlife Refuge is being studied using mark/recapture techniques to determine movement patterns and migration. A total of 72 cavefish have been tagged to date with visible implant tags and surveyed every two weeks for the past 6 months. Movement and migration is also being evaluated relative to fish size and water chemistry changes within the cave system. The largest fish tagged to date has been 65mm and the smallest fish seen has been 9mm. Cavefish tend to congregate in pools and eddy areas to avoid riffles and rapidly moving water. Continuous lateral movements of individual fish have ranged from less than 2m to over 600m over the study period. Downstream movement was much more prominent than upstream movement.

## **Nonpoint Source Pollution Abatement in the Delaware River, Kansas and Potential Economic Benefits from Sportfish Angling**

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Habitat suitability Index (HSI) models were used to evaluate existing habitat for fishes commonly caught by anglers in the Upper Delaware River and tributaries. The Soil Conservation Service (SCS) and the Kansas Department of Health and Environment (KDHE) have implemented a plan to reduce levels of phosphates, nitrates, turbidity and associated factors caused by nonpoint source pollution with projected target levels of cleanup. HSI models were used to predict future habitat quality after project. Models indicated that habitat units would increase; 305% for common carp; 1,955% for green sunfish; 440% for channel catfish; and 2,633% for largemouth bass. Creel surveys for affected streams were examined to obtain existing angler use data. Average, angler expenditures statewide indicate a per annum angling expenditure in the project area of \$131,400 in tributaries and \$424,980 per annum in the mainstream. Assuming that angling use increases with biomass and that fishes in the study are equally sought after, the Delaware River would provide 13.33 times its existing use while tributaries would provide a doubling of existing uses. Potential dollars spent on angling could increase theoretically from \$424,980 per year to over \$5.6 million. However, much adjacent land is under private ownership and more realistically a tripling of sportfishing might be expected to occur. This represents a local economy contribution of 1.2 million dollars annually. A ten year study conducted by the National Ecology Research Center, Kansas Department of Wildlife and Parks, and the Pine Bluff Cooperative Fisheries Research Project is underway to assess model predictions, examine species and community structure changes, and evaluate fish response to drought and flood conditions.

## **Effects of Dioxin on Benthic Macroinvertebrate Community of Bayou Meto, Arkansas**

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The benthic macroinvertebrate community structure of Bayou Meto, Arkansas, was examined in order to evaluate the effects of industrial and municipal point-source organic pollution. Objectives involved comparing community structure among sites and relating potential differences to one or both sources of contamination. Of specific interest was determining if existing dioxins contamination resulting from industrial sources was exerting any adverse effects on the invertebrate community. Benthic macroinvertebrates collected from two sites above and two sites below effluent discharges were enumerated, identified, and separated into functional feeding groups. Macrobenthos communities were summarized at each site using abundance data, importance values, and indices of community structure. One of the contaminated sites was found to have significantly higher diversity and richness than the other three sites. Possible factors responsible for these findings include substrate composition and nutrient enrichment from treated sewage effluents. Sediment-bound dioxins were not determined to be adversely affecting benthic macroinvertebrates at the community level.

## **Larval Drift of *Cottus carolinae* in Logan Cave Spring, Benton County, Arkansas**

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Larval fish typically exhibit seasonal drift periodicity correlated with spawning. Larval drift has been shown to be a part of the life histories of three species of *Cottus* and may be characteristic of all freshwater sculpins. Drift nets placed at four stations in Logan Cave Spring, Benton County, Arkansas, were used to collect larval *Cottus carolinae*. Simultaneously, upstream traps were used to collect large mature sculpins entering the cave spring. Seasonal periodicity was observed in the drift of larval *C. carolinae* at Logan Cave Spring. Drift densities of these larvae may be related to age as measured by total length of the larvae. Ongoing research at Logan Cave Spring will determine if rhythmic diel periodicity of the drift of the *Cottus* larvae is occurring.

## **Lower Ouachita River Survey**

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An assorted group of state, federal, and private agencies has joined in a cooperative effort to sample the lower Ouachita River from Rammel Dam down to the Louisiana state line. The name for this group is the Lower Ouachita River Work Group (LORWG). Preliminary sampling has revealed a measurable impact to the fishery community in the Camden segment. Additionally, the river from Smackover Creek downstream has been placed under a consumption advisory due to mercury contamination in fish flesh. The Department of Pollution Control and Ecology has recently funded the Ouachita River Institute at Ouachita Baptist University to expand sampling efforts on the Ouachita River to look at all aspects of the Ouachita River from Rammel Dam downstream to the Louisiana state line.

### **Dioxin Contamination Levels, Diversity, and Growth Rates, of the Fishes of Bayou Meto, A River in East Central Arkansas.**

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Dioxins are a family of extremely toxic polychlorinated compounds. Specifically 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) is the most toxic synthetic compound ever tested, and is known to accumulate in fishes. A point source of dioxins is located at Vertac Chemicals, Inc., in Jacksonville, AR. During the early 1970s through 1986, Hercules Corporation and later Vertac discharged dioxin burdened waste into Jacksonville Sewage treatment plant and Rocky Branch, both of which flow into Bayou Meto. Bayou Meto is a low-gradient, highly turbid stream that originates near Jacksonville, Arkansas, and flows southeastward through the Gulf Coastal Plain 290 km to the Arkansas River. A baseline level of dioxin was determined in 3 trophic levels of fish from Bayou Meto in 1992: a forage fish, young of the year bluegill (*Lepomis macrochirus*); a predator, white crappie (*Pomoxis annularius*); and an omnivore, smallmouth buffalo (*Ictiobus bubalus*). Two control stations were located above the point source, stations 3 through 13 were downstream of the contamination source, and station 14 was on Wattensaw Bayou an uncontaminated comparison stream. All trophic levels showed levels of dioxin contamination up to 296 parts per trillion (ppt). Dioxin levels in fish remained above background levels (control site levels) down to the lower most Bayou Meto station, grading in a classic pattern of dispersion from a single source. Sites differed Physically in response to stream order and chemically only to dissolved oxygen and phosphorus, resulting from sewage treatment effluent. Diversity decreased in response to dioxin levels and or sewage effluent. Growth rates responses were species dependent with predators and omnivores more negatively correlated to dioxin levels than forage fish.

## **Critical Current Speeds of Darters and Cyprinids from the Ouachita River**

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Certain fish species utilize small streams and ephemeral drainages for spawning. The paleback darter (*Etheostoma pallidorsum*) is one such fish of concern to the U. S. Forest Service as it is a restricted species with most spawning areas located within the boundaries of the Ouachita National Forest. Other darter species were selected to develop procedures to delineate fish swimming speeds. The central stoneroller (*Campostoma anomalum*) was also used. An apparatus was designed and built to allow and subject fish to known current velocities. Fish length was compared to water velocity to determine relations to predict those velocities which caused fish difficulty in maintaining position and those velocities at which the fish could not hold a position. Data from these darter species ng speed tests can be used to assist in culvert designs used on logging roads to afford fish passage to spawning areas.

## **Culvert Modification to Provide Passage for Orangebelly Darters**

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A 1.8 m diameter, 12.1 m long corrugated metal pipe culvert and outlet channel on an intermittent stream was modified to eliminate a 35.6 cm waterfall at the pipe outlet to determine if passage of orangebelly darters (*Etheostoma radiosum*) and other fish could be restored. Constructing pipe headwalls and paving the invert with concrete was originally planned. The contract was modified to include troweling depressions and embedding rock in the concrete in the pipe to baffle the flow, a grouted riprap ramp to eliminate the waterfall, and excavation of exposed bedrock. The ramp and baffle construction added \$1,200 for a total cost of \$2,625. No fish were found above this culvert prior to repair. Post-repair electrofishing was conducted weekly February 7, 1992 through April 8, 1992 with collected fish released downstream after fin-clipping. Collections ranged from 19-124 orangebelly darters from the pipe upstream 260 m to a natural barrier, 0-8 darters in the pipe and 0-10 on the ramp. Recaptures ranged from 1-59, 0-2, and 0-2, respectively. No other fish species were found on the ramp, in the pipe or upstream of the pipe through April 8, 1992, by which time the stream had become intermittent.

## **Microhabitat Use by Smallmouth Bass in the Buffalo River, Arkansas**

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Although habitat use by adult smallmouth bass (*Micropterus dolomieu*) has been studied extensively, relatively little quantitative habitat use data exists for young-of-the-year (young) in stream systems. Information on young fish should be important to management of the species, especially if the young utilize different microhabitats than adults. I recorded microhabitat variables including substrate type, cover type, depth, distance off bottom, and light levels, for focal point observations of smallmouth bass while snorkeling transects in the Buffalo River, Arkansas. Logistic regression models were used to determine which habitat variables were important in discriminating between the presence of adults and young. In pool habitats, young rarely occurred in the deepest water (> 2 m), though adults often did. However, young were often present over cobble substrates when adults were not. In runs, some microhabitats were occupied predominantly by adults, including those which had gravel and/or sand substrates but no aquatic vegetation, and usually no boulders. Although there appears to be extensive microhabitat overlap between adults and young, segregation did occur in some microhabitats and may warrant further investigations in other stream systems.

## **A Creel Survey of the Buffalo National River**

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A two year creel survey of the Buffalo National River was initiated in March, 1991, funded by Arkansas Game and Fish Commission. A stratified random sampling design was utilized whereby weekdays and week-end days were equally sampled at nine access points. During 1991, a total of 368 hours was sampled during which time 736 canoes or jonboats were encountered. These boats contained 1,536 people of which 158 were fishing. These data were expanded using rental receipts from outfitters. Total boat traffic for 1991 was 66,758 boats with 142,677 people, of which 19,996 were anglers. Of recreators on the water on the upper river, 3.4% were anglers, 8.1% on the middle section, and 24.3% on the lower river. The average angler spent 2.28 hours fishing and caught .26 fish per hour (CPUE). There were an average of 72.2 hours fishing per hectare with 22.4 fish caught/ha. Total weight of fish caught was 3,017.3 kilos for the entire Buffalo National River, or 4.63 k/ha. A total number of 4.63 smallmouth bass/ha was caught, while weight of smallmouth bass was 3.25 k/ha, or .096 smallmouth bass/hr.

## **Food Habits, Dispersal, Growth, and Contribution of Stocked Channel Catfish in the Buffalo National River, Arkansas**

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We assessed the food habits, dispersal, growth, survival, and relative contribution of catchable size channel catfish (*Ictalurus punctatus*) stocked in the Buffalo River, Arkansas. A total of 3,600 channel catfish were stocked on 25 September 1991 at three sites near the upper, middle, and lower reaches of the river. All fish received one of three fin clips (adipose, right or left pelvic) so that original stocking locations could be determined at the time of recapture. For six weeks post-stocking, channel catfish released at each location exhibited schooling behavior, showed no movement from the original stocking location, and did not consume any significant natural food items; however, a period of flooding during November appeared to result in dispersal from original stocking locations. During July and August 1992, a total of 94 marked fish were recaptured using baited hooped nets deployed at reaches throughout the river, above and below each of the original locations. Most marked fish (>75%) had moved downstream from original stocking locations and accounted for a significant proportion (> 40%) of the total number of channel catfish collected from the river (n = 235) during 1992. Following an 11-month period of growth in the river, stocked catfish fed on a variety of natural food items and had an overall mean increase in size of about 95 mm and 310 g, with an average increase in condition of 0.12. Using marked hatchery fish in a Peterson type estimate, we estimated the population of channel catfish in the Buffalo River was between (95% C. I.) 4,400 and 6,100 fish, or about 23 catfish per river km. Evidence from pectoral spine cross-sections obtained from all channel catfish collected in the Buffalo River in 1991 and 1992 (n = 280) revealed > 93% of the catfish population in the river originated from hatchery stocks. Stocked channel catfish have rapid growth rates through age 6, with an average annual mortality rate (including emigration out of Buffalo River) of about 42%.

## **Effects of Timber Harvest on Stream Fish Assemblages in the Ouachita National Forest, Southwest Arkansas**

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High-gradient streams of the Ouachita Mountains are riffle-pool systems dominated by cyprinids, percids, and centrarchids. Timber management in watersheds within the national forest is on the basis of small tracts, with even-age and uneven-age techniques, in contrast to large clearcuts commonly used on private lands. We evaluated effects of timber harvest on stream fish assemblages in four national forest watersheds (2 harvested; 2 non-harvested) in a balanced design incorporating influence of harvest, river system, year, season, and size of stream. Multi-variate analyses revealed no trenchant differences between fish assemblages in harvested and non-harvested streams of the national forest, and multi-way ANOVA identified sources of variance due to main effects above and their interactions. In addition to the comparisons above, we are opportunistically following effects of a more severe streamside logging operation that took place on private lands located within the national forest boundary.

## **Habitat Characteristics and Distribution of Largemouth Bass in Oklahoma Streams**

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Eighteen major drainage areas were designated across Oklahoma to survey distributional characteristics and genetic diversity of native stream-dwelling largemouth bass. Initial collections were made in 12 drainages. A total of 102 sites were evaluated. Largemouth bass were included in collections at 34 of 71 sites where collections were made. A multi-variate summary of distribution and habitat characteristics of these collections in relation to bass abundance will be presented. Following a genetic analysis, the relationship between genetic diversity and various factors in an environmental data base will be analyzed.

## **Age and Growth of Fishes from the Bayou Bartholomew**

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Fish scales were removed from randomly selected fishes obtained during depletion samples at sites in the Bayou Bartholomew. Scales were examined using a microprojector to identify annulus marks. Measurements from focus to annuli, scale radius, and total fish length were used in a back-calculation equation (Ricker modification of the Lee method). These results can be used to compare fish growth to other growth rates of fishes from Arkansas streams and reservoirs. Fish growth can be compared to prior stream conditions in previous years. This information may then be used to examine flow related habitat models when applied to historical stream conditions, making the assumption that better habitat quality produces faster growth rates.

## **Fish Guild Biomass Relations to Physical and Chemical Habitat Characteristics in Streams**

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Some instream flow methodologies are not suitable for use in warmwater streams, especially of low gradients. Many such methodologies require extremely complex modeling capabilities to assess impacts as well as very labor intensive microhabitat analysis. This study represents an effort to develop guild models by relating physical and chemical variables to fish guild biomass. Data from 420 stream sites in Kansas will be used to develop suitability curves for fish guilds that occur in the Bayou Bartholomew. Flow data from periods of record will be used in conjunction With recently collected habitat data on the stream to describe habitat conditions and suitability at various flow levels. Several types of models will be developed to predict biomass changes of fish guilds with regard to flow levels. These models will be tested by continued examination of flow data, physical and chemical variables, and fish populations in the Bayou Bartholomew.

## **Distribution of Fishes in the Bayou Bartholomew from Headwaters to the Louisiana Border**

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Thirteen sites were selected jointly by the Arkansas Game and Fish Commission, the National Ecology Research Center, and investigators at the University of Arkansas at Pine Bluff. Depletion samples utilizing a boat mounted electrofishing unit were conducted at each site. Each stream segment was blocked with nets to meet the assumption of a closed population. Fish were measured to the nearest millimeter and weighed in grams in the field. Population estimates were made by species by site. Longitudinal fish distributions were examined. Species composition was examined by numbers collected, estimated populations, and biomass at each site. This data will be used to develop models using habitat variables in an effort to explain fish standing stocks and guild structure.

## **An Examination of Physical and Chemical Habitat Descriptors of the Bayou Bartholomew from a Longitudinal Perspective**

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A total of thirteen stream segments within the Bayou Bartholomew were examined to describe fish habitat quality. Viewing the habitat descriptors from upstream to downstream revealed a number of trends. Physical measurements included mean depth, mean width, velocity, volume of flow, and substrate composition. Chemical variables measured included dissolved oxygen, conductivity, total dissolved solids, ammonia, nitrates, phosphates, pH, and turbidity. Several factors showed an increasing trend from upstream to downstream stations. These included percent mud, pH, conductivity, total dissolved solids, dissolved oxygen, mean depth, mean width. Other variables showed decreasing trends moving downstream. Examples were water temperature, turbidity, percent silt, and ammonia. Data was collected as part of an instream flow modeling study.

## **Arkansas' Aquatic Education Mobile Aquarium**

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In January 1992, The Arkansas Game and Fish Commission purchased a thirty-six foot trailer mounted aquarium for use in its Aquatic Education Program. Although quite costly and somewhat labor intensive, this project has proven to be one of the finest public relations tools anyone could have imagined. Over one-half million people viewed the 3,500 gallon display in its first year of operation. Spectators are able to view many species of both game and rough fish that many people never get the chance to see. Reaction to the project has been nothing but positive from both the agency and the public viewpoint.

### **Introduced/Exotic Fishes: Pros and Cons Can We Find the Middle Ground? A Panel Discussion**

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There is growing concern with the use of non-native fishes by fishery managers, aquatic pest control managers, aquaculturists, and aquarium hobbyists. At recent symposia sponsored by the AFS and at public hearings held by the federal interagency Aquatic Nuisance Species Task Force there has been polarization between those opposed to the use of introduced species, and those who hold that they play a necessary and irreplaceable role in aquatic habitat management.

The main argument against the use of non-native aquatic species (NNAS) is that even under controlled circumstances some will always escape into the wild where they may cause ecological and economic damage that cannot be predicted but which can include: predation on and decimation of small native species; subtle but far reaching habitat alterations; competition with native species for resources; introduction and spread of pathogens; alteration and unbalancing of ecological interactions among native species; extinctions, both directly and indirectly; and proliferation to the point of becoming a pest with economic significance.

Those favoring the use of NNAS argue that introductions are necessary because: the world food supply depends on agriculture of non-native species and will increasingly depend on aquaculture of NNAS; most managed aquatic ecosystems are either artificial or highly altered to the point that they are already "unbalanced" and require NNAS for correction; introductions are one of the few tools that managers have and many NNAS have been used successfully for years without causing ecological catastrophe; use of NNAS in biological control of pests causes less ecological perturbation than alternative (chemical) methods; most NNAS (especially domesticated ones) that escape accidentally do not survive in the wild; damage by NNAS is usually in highly distressed or endangered habitats; and most damage from NNAS has been from unintentional and incidental releases such as from ship ballast water and not from purposeful introductions.

It is the goal of moderates to find and promulgate rules and procedures that will allow the responsible use of NNAS while avoiding those species that are actually dangerous and while protecting delicate and/or sensitive habitats.

## **Effects of a Special Catch and Release Fishing Regulation on Dry Run Creek, Arkansas**

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A special catch and release fishing regulation was initiated beginning January 1, 1988 on Dry Run Creek (Norfolk National Fish Hatchery Effluent). Coldwater discharges ( $0.9 \text{ m}^3/\text{sec}$ ;  $0-12 \text{ C}$  from the Norfolk Hatchery created year round trout habitat in the lower  $0.77 \text{ km}$  of Dry Run Creek. The stream averages  $8.8 \text{ m}$  wide ( $\text{SD} = 2.3 \text{ m}$ ; range  $4.5 \text{ m}$  to  $13.8 \text{ m}$ ) and  $42 \text{ cm}$  deep ( $\text{SD} = 21 \text{ cm}$ ; range  $6 \text{ cm}$  to  $120 \text{ cm}$ ). The special regulation permitted catch and release fishing with single hook artificial lures by properly licensed disabled individuals and those under 16 years of age from sunrise to sunset only. Dry Run Creek had been closed to fishing for 30 years. Rainbow trout population estimates in Dry Run Creek varied by season ranging from highs in the winter months of 8,872 to lows in the summer of 3,924. Public acceptance and the effects of this special catch and release regulation on the existing trout fishery of Dry Run Creek are discussed. Hatchery management practices, flood events and seasonal variability appeared to be influencing the existing fish population more than the effects of the new regulation (hooking mortality, poaching or non-compliance).

## **The Mountain Fork River Trout Fishery**

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On January 1, 1989 the Oklahoma Department of Wildlife Conservation initiated a study to evaluate the feasibility of a year-round trout fishery in 12 miles of the Mountain Fork River below Broken Bow Dam. This project has become very popular with anglers and provides a positive impact to the local economy. It has proven to be cost effective; generating sufficient revenue from license sales to pay associated expenses.

## **Some Examples on the Use of Radiotelemetry in Fisheries Management**

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Radiotelemetry has been used in the fisheries field for decades in a wide variety of applications. Over the years, it has been viewed by some as too "researchy" and expensive for wide use in everyday fisheries management. Two examples of the use of radiotelemetry in fisheries in Arkansas are given along with their management applications. Both telemetry studies took place on the White River. The objectives of the first study were to gather life history, habitat preference, migration and find possible spawning sites for paddlefish (*Polyodon spathula*) in the most consistent paddlefish fishery in Arkansas. Out of 360 paddlefish that were netted, 29 adult fish were implanted with transmitters and tracked. Fish movements ranged from 0.1 to 200 miles with a daily maximum of 22 miles. Results of this work led to several management regulation changes for better managing these primitive fish in Arkansas. These included increasing the minimum commercial size limit, closure of critical border waters to commercial fishing, reduced creel limits for sport anglers, and the closure of spawning areas during the spawning season.

The second study was designed to gather data on: 1) behavioral responses of holdover rainbow (*Onchorynchus mykiss*) and brown trout (*Salmo trutta*) to discharges of poorly oxygenated hypo-limnetic water from Bull Shoals Dam, 2) the magnitude, duration and timing of brown trout spawning movements, and 3) the location of previously unknown spawning shoals. From mid-September to early October, 30 16-20 inch trout (24 brown, 6 rainbow) were implanted with transmitters. Following a 2 week surgical recovery period, trout have been tracked from early October to the present. Although behavioral responses to low dissolved oxygen is inconclusive at this time, important information on brown trout spawning has been obtained. Large scale spawning movement occurred during October 23-24. During the run brown trout traveled as much as 8-10 miles upstream per day for a total of 18 miles in 2 days. Early data dividends have been the location and/or confirmation of several suspected spawning shoals as well as information in the determination of the cause of a small fish kill.

## **Oklahoma's Crappie Management Program**

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Trap-netting sampling for white crappie, *Pomoxis annularis*, has been conducted annually in Oklahoma since 1983. Primary objectives of this sampling have been to collect population survey data and to develop a model useful in characterizing existing populations and to target management strategies. The model presently being used is patterned after one developed by the Missouri Department of Conservation. The model stipulates a range of point values for five Population parameters estimated from fall trap-net samples. These parameters are density, growth, age structure, size structure, and recruitment. To date, the model has been used to recommend length on three populations and develop a management strategy to increase growth rate in one population.

## **Distribution, Movements, and Habitat Preferences of Adult Striped Bass Habitat in Robert S. Kerr Reservoir, Oklahoma: A GIS-based Approach**

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We are assessing the distribution, movements, and habitat preferences of adult striped bass habitat in Robert S. Kerr Reservoir, Oklahoma, with ultrasonics telemetry and Geographic Information System (GIS) capabilities of spatial data analysis. Kerr Reservoir is a 16,996 ha mainstem reservoir, with two major tributaries, on the navigation portion of the Arkansas River. During the fall and winter of 1992, eighteen fish (1.1 to 15 kg) from the Illinois River, Eufaula Dam tailwater, and the mainstem reservoir were implanted with ultrasonic, temperature-sensing tags. The entire mainstem reservoir is being searched bimonthly for tagged fish. In addition to the mobile search, a stationary receiver has been placed at the outlet of the reservoir to document striped bass movements out of the system. Fish locations and concurrent measurements of utilized and available habitats are being stored in a GIS, which contains a digital map and spatial habitat information about the reservoir. This information was obtained from physicochemical measurements, including: depth, current velocity, substrate/cover, temperature, dissolved oxygen, conductivity, pH, and secchi depth, made throughout the system. The Kerr Reservoir GIS should improve our ability to identify and predict the seasonal distribution and habitat preferences of striped bass in the system.

### **Trout vs Hydropower at Bull Shoals Reservoir-White River; Problem or Symptom?**

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Four flood control/hydropower reservoirs have been constructed on the main stem White River-Arkansas and Missouri. Tailwater trout fisheries of great recreational and economic importance have been developed at each site. Tailwater fisheries also exist on the White River tributaries of North Fork and Little Red Rivers. Oxygen deficient hydropower releases after reservoir stratification frequently threaten the trout resource. Numerous fish kills have been documented, particularly below Bull Shoals reservoirs. Much attention is now focused on structural modifications to improve tailwater DO levels, an important symptom but not the problem. Flood control and hydropower purposes dominate in a system where fish, wildlife and recreation values greatly exceed original purpose values. Perhaps no other river/reservoir system in the region can yield such public benefits from reallocation of storage and system-wide operational change to benefit fish, wildlife and recreation.

## **A Review of the Introduction of the Inland Silverside, (*Mendia Beryllina*) in the Arkansas River in Oklahoma**

Jimmie Pigg Oklahoma State Department of Health Environment Services Laboratory

Since the first introduction in 1961 in Boomer Lake and the escape into Stillwater Creek and finally into the Cimarron River, this species has spread into mainstem of the river. Additional stocking by ODWC into the reservoirs has contributed to successful establishment of the Inland Silversides in the river.

The increase in abundance and distribution will be review for the period from 1961 to 1992. The fish collection data from the establishment of ten long term sampling stations on the mainstem of the Arkansas will be review for the years 1976 to 1992. A review of the impact of the Inland Silverside upon the populations of the native minnow. Also included is a review of the silverside populations in the mainstem reservoirs of the Arkansas River.

### **A Review of Barge Commerce and Hydropower Generation Value on the Arkansas River**

Robert Pfeiffer U.S. Army Corps of Engineers, Little Rock District P. O. Box 867, Little Rock, Arkansas 72203

The McClellan-Kerr Arkansas River Navigation System was opened for traffic in 1970. The waterway provides a low cost transportation alternative for bulk commodities, connecting Tulsa (via the Port of Catoosa) and other major commercial centers on the Arkansas River with the Mississippi River and Gulf Coast waterway systems.

Tonnage levels moving on the System grew rapidly during the 1970's and reached over 8.0 million tons by 1978. Principal commodities moving during that period were coal, residual fuel oil from Oklahoma refineries, and grain.

System tonnage declined during the early 1980s as a result of a changing energy market. Tonnage of both coal and fuel oil declined markedly. Beginning in the mid-1980s, tonnage levels have rebound, growing to over 9 million tons, with grain and agricultural fertilizers being the major growth commodities.

The Primary hydropower installations in Arkansas are located at Dardanelle and Ozark in Arkansas. The value of hydropower generated at these facilities is over \$30 million annually. Privately owned generating facilities are located at Little Rock (Murray Lock and Dam) and just below Fort Smith (Mayo Lock and Dam), and one is under construction near Morrilton (Ormand Lock and Dam).

## **River Use**

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A three year study of water quality in the Arkansas River was completed in 1989. Among the purposes of the study were an evaluation of the existing water quality data for the river in Arkansas and a two year sampling program at four sites in the river and a site on Lee Creek. The principal focus of the study was to evaluate the water quality data with respect to the use of Arkansas River water for agricultural, industrial and municipal water supply purposes. The purpose of this paper is to summarize the results of the study.

## **Status of the Exotic Zebra Mussel in the Arkansas River**

John L Harris Arkansas Highway and Transportation Department Little Rock, Arkansas 72219

The current distribution and population status of the introduced zebra mussel (*Dreissena polymorpha* Pallas) in the Arkansas River drainage will be discussed. A synopsis of aquatic system impacts resulting from zebra mussel introduction based on European, Great Lakes, and upper Mississippi River drainage experiences will be presented. Finally, predicted impacts to the Arkansas River aquatic system will be addressed.

## **The Commercial Fishing Survey on the Arkansas River in Arkansas**

James Ahlert Arkansas Game and Fish Commission Fisheries Division 2 Natural Resources Drive  
Little Rock, Arkansas 72205

The commercial fishing survey on the Arkansas River began in 1974 when the initial trips were made with commercial fishermen on the upper Arkansas River. A total of 873 interviews were made with commercial fishermen during the period of 1974 to 1991. On each of the trips the number of fish per species, the estimated weight of each species, the type of gear used, its location, and method of set was recorded. A total of 44,845 fish were observed being harvested that weighed an estimated 200,357.9 pounds. If the gill and trammel nets observed being raised were laid end to end they would reach 676 miles. A total of 9,492 hoop nets, 132 fiddler nets, 269 trotlines, 13 snaglines, and 7 slat-traps were also observed being raised.

Over the years regulations governing commercial fishermen has changed considerably. Conflict between commercial fishermen and sport fishermen has produced a number of regulation changes.

### **Water Quality of the Arkansas River**

Forrest Payne, Environmental Scientist, Aluminum Company of America, P. O. Box 300, Bauxite, Arkansas 7201 1, and Jim Peterson, United States Geological Survey, 2301 Federal Office Bldg., Little Rock, Arkansas 72201

Although the Arkansas River originates in the Rocky Mountains southwest of Denver, Colorado, approximately 80% of the total discharge at the mouth of the river originates downstream of Tulsa, Oklahoma. This presentation will concentrate on the water quality of the Arkansas River downstream of Tulsa.

Two general components of water quality will be evaluated: nutrients and metals. Nutrient concentrations and trends in nutrient concentrations will be discussed in terms of nutrient enrichment and implications for fishery production in the river. Trace metal concentrations and trends in trace metal concentrations will be explored in relation to U.S. Environmental Protection Agency toxicity criteria and the consumption of fish.

## **Decline of the Speckled Chub in the Arkansas River Drainage**

Geffery R. Luttrell, Anthony A. Echelle, and Alexander V. Zale Department of Zoology and Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University, Stillwater, Oklahoma 74078

The speckled chub (*Macrhybopsis aestivalis*) is a small cyprinid indigenous to the larger lowland rivers of the interior United States. In 1990 we began a survey of the status and distribution of the Arkansas River subspecies *M. a. tetranemus*, a taxon believed to be declining (category 2 status). We evaluated the historical distribution of *M. a. tetranemus* by obtaining collection records from regional museums. Historically, the species ranged throughout most of the Arkansas River drainage (i.e., portions of Colorado, New Mexico, Texas, Kansas, Oklahoma, and Arkansas). We assessed the present status and distribution of *M. a. tetranemus* by sampling historical collection localities with small-mesh seines. *M. a. tetranemus* has been extirpated from most of its former range in the past 30 years. Populations of the taxon persist in the lower Salt Fork of the Arkansas River in Oklahoma, and the upper Canadian River in Texas and New Mexico. The species is rare to absent across the remainder of its former range.

## **Ecological and Related Changes Induced by Dewatering of the Upper Arkansas River in Kansas to the High Plains, Chyenne Bottoms, and the McPherson Lowlands - A Glance Upstream**

William G. Layher Pine Bluff Cooperative Fisheries Research Project, U.S Fish and Wildlife Service Agricultural Experiment Station University of Arkansas at Pine Bluff Pine Bluff, Arkansas 71601

Early irrigation ditch projects on the high plains of Colorado and Kansas significantly reduced summer flood flows in the Arkansas River allowing a wooded riparian corridor to develop. Nearly a century later mining of the streams alluvial aquifer and deeper mining, of the vast Ogallala aquifer totally depleted river flows. Large federal reservoirs in Colorado prevented annual flushing flows. Without flushing and artificial development of new headwater points; downstream segments increased in salinity and now threaten freshwater alluvial aquifers in the McPherson lowlands used extensively for city water supplies. Potential surface runoff in the vast basin has been reduced to near zero by government funded land leveling and watershed dams. All combined, these dewatering activities have drained the life blood of Chyenne Bottoms, a state owned marsh of international importance. These ramifications of an altered environment will be felt far into the future.

### **Sporffish Populations on the Upper Arkansas River**

Bob Limbird Arkansas Game and Fish Commission Fisheries Division 2 Natural Resources Drive Little Rock, Arkansas 72205

The Arkansas River is one of the most productive bodies of water in the state of Arkansas for Sportfishing and commercial fishing activities. A study conducted in 1987 estimated conservatively 840,000 angler fishing trips per year with fishermen spending \$1.62 million on the Arkansas River. The Corps of Engineers estimates total fishing usage at 1,895,943 persons, with approximately 130 fishing tournaments annually and \$220,000.00 spent at a single state event. Larger tournaments bring approximately \$1.3 million annually.

Total fish biomass per hectare varies from 605 kg/ha in Pool 13 (Fort Smith) to an average of 1,146.5 kg/ha in Merrisach Lake, a 1,012 hectare impoundment located within Pool 2 in southeastern Arkansas. Black bass biomass varies from an average of 24.9 kg/ha on Pool 12 to 11.88 on Pool 13.

Sporffish species, including sunfish and excluding catfish which is a commercial species composes from 66.6 to 106.3 kg/ha on the Upper Arkansas River as derived from cove rotenone Sampling during the period 1988-92.

## **An Evaluation of Striped Bass and Hybrid Striped Bass Production Techniques used by the Byron State Fish Hatchery**

Steven Spade, Hatchery Manager Route 1, Box 67 Byron, Oklahoma 73723

In 1988 Byron hatchery personnel evaluated different phases of striped bass and hybrid striped fry production to set goals for 1992. This is a report on if the goals were reached, how they were reached and new problems that arose. The following goals were established: 1. Increase percentage of broodfish to ovulate from a three year average of 45.5 percent to 75 percent by 1992. 2. Increase percent of hatch from 25 percent in 1987 to 50 percent by 1992. 3. Increase number of fry produced from 8 to 15 million annually.

To meet these goals changes were made in broodstock transport and holding procedures, water quality manipulation, and spawning techniques. In 1990 and 1991 the percent of broodfish to ovulate exceeded 75 percent and in 1992 was 64.1 percent. Also in 1990 and 1991 percent hatch exceeded 50 percent while in 1992 only 35.9 percent hatched. In 1992 in excess of 16 million fry were produced in response to goal 1 and 2 being met.

### **Comparison of Growth of Smallmouth Bass, Florida Largemouth and Northern Largemouth Bass on a Pelleted Diet**

Julia K Matlock, Assistant Hatchery Manager Byron State Fish Hatchery Route 1, Box 67 Byron, Oklahoma 73723

During the fall of 1990 and into the winter of 1991, smallmouth bass, Florida largemouth bass and Northern largemouth bass fingerlings were trained to take pellets. Weight and growth measurements were taken during this period. The fish were held in 450 gallon circular tanks in well water (avg. 61 degrees F) and fed using automatic feeders. Growth was nearly identical for the smallmouth bass and Florida largemouth bass. However, the Northern largemouth bass grew at a faster rate than the other two species.

## **Utilization of Two Sportfish Hatcheries by Piscivorous Birds During the Summer**

Allen Weaver, Patrick Smith and William G. Layher Pine Bluff Cooperative Fisheries Research Project U.S. Fish and Wildlife Service Agricultural Experiment Station University of Arkansas at Pine Bluff Pine Bluff, Arkansas 71601

It is commonly believed that piscivorous birds have the potential to cause severe economic loss to sportfish hatcheries through the consumption of fish. Intense observations of piscivorous birds were conducted at two Arkansas sportfish hatcheries from June to September, 1992, in an attempt to determine the severity of these beliefs. The hatcheries are located near Hot Springs and Lonoke, Arkansas, and are both owned and operated by the Arkansas Game & Fish Commission. A list of 25 bird species of most concern to the hatchery officials was developed as birds to be focused upon in this study. The list includes herons, egrets, cormorants, and some waterfowl species. Funding for this study was provided by the U.S. Fish and Wildlife Service Fish Farmers Experimental Lab, located in Stuttgart, Arkansas. Procedures established in this study are being used in an ongoing study of piscivorous birds use of sportfish production facilities throughout the entire year.

## **Piscivorous Bird Use of Two Arkansas Sportfish Hatcheries During Fall**

Clinton Bailey, Chris Kennedy, Patrick Smith, and William G. Layher Pine Bluff Cooperative Fisheries Research Project, U.S. Fish and Wildlife Service Agricultural Experiment Station University of Arkansas at Pine Bluff Pine Bluff, Arkansas 71601

Observations of piscivorous birds on two Arkansas sportfish hatcheries were conducted from September to November, 1992. The hatcheries are located near Hot Springs and Lonoke, and are both owned and operated by the Arkansas Game & Fish Commission. This study was conducted to address the potential economic loss to these fish rearing facilities, through the consumption of fish. A list of 25 bird species comprised of both birds known to consume fish and birds believed to pose a potential threat to sportfish hatcheries was developed from birds that are frequent visitors to these hatcheries. The list includes herons, egrets, cormorants, and some waterfowl species. Herons and egrets had a higher rate of occurrence than did the other species. While waterfowl numbers did increase in the latter time period of the study, they were observed to have a minimal impact to the hatcheries.

## **Experimental Production of Proliferative Gill Disease In Channel Catfish**

Cheryl Hayes and Marguerfte Gravois Pine Bluff Cooperative Fisheries Research Project U. S. Fish and Wildlife Service Agricultural Experiment Station University of Arkansas at Pine Bluff Pine Bluff, Arkansas 71601

Proliferative gill disease (PGD) is an important disease of cultured channel catfish *Ictalurus punctatus* that has been produced experimentally only by exposing channel catfish to water or mud from ponds where channel catfish have had PGD. Pathogen free channel catfish raised in well water were exposed to mud samples collected from a pond diagnosed with PGD and a pond with a probable case of PGD. These catfish developed lesions and parasites characteristic of PGD. Worm samples were obtained from mud for species identification since triactinomyxid myxozoans were detected in ponds diagnosed with an outbreak of the disease. Gill samples were taken from the exposed channel catfish and preserved for histological preparation and microscopic examination.

## **Parasites Communities of Channel Catfish (*Ictalurus punctatus*) from a Hatchery and Two Lakes in Northwest Arkansas, U.S.A.**

Jeurel Singleton and Okechukwu C. Ekworomadu Arkansas Cooperative Fish and Wildlife Research Unit Department of Biological Sciences University of Arkansas Fayetteville, Arkansas 72701

A comparative survey was conducted to determine the prevalence, intensity and species diversity of parasites of the channel catfish, *Ictalurus punctatus* from three different aquatic habitats in northwest Arkansas. *Clinostomum marginatum* (yellow grub) was prevalent in all three aquatic habitats. The mean intensity of nematodes in hatchery fish was higher than in fish from the lakes. Parasite species diversity and relative abundance in the lake fish were greater than in the hatchery. Parasite community structure varied seasonally. Of the species recovered, none existed in numbers that were detrimental to the host.

## **Joe Hogan State Fish Hatchery 1992 Grass Carp (*Ctenopharygodon idella*) Spawning Project**

Donald H. Fiegel Arkansas Game and Fish Commission Fisheries Division 2 Natural Resources Drive Little Rock, Arkansas 72205

The Joe Hogan Hatchery produced 4,120,000 grass carp fry during 1992. A total of 10,300,000 eggs were taken from 72 brood grass carp that averaged 9 kilograms each. Brood stock were collected from the ponds starting June 3, 1992, and three pairs a week were induced to spawn through July 17, 1992.

## **Dual Purpose Reservoirs and Earthen Ponds: Assessment of Water Inflow on Channel Catfish (*Ictalurus punctatus*) Production**

Nathan Stone, and Jennifer L Gronefeld Fulbright College of Arts and Sciences Department of Zoology University of Arkansas Fayetteville, Arkansas 72701

Competition for water source has limited Aquaculture development in Arkansas. Utilization of existing reservoirs for both fish production and crop irrigation has been proposed as a solution to this conflict. The main objective of this study is to evaluate the potential of fish production in irrigated reservoirs. The study was conducted at the Agricultural Research Station, University of Arkansas, Pine Bluff from May to September 1992. Three ponds were randomly selected to receive 11.5 gallons of well water/minute and three did not receive an inflow of water. Stocking rates were 3,000 kg/ha. Selected water quality parameters were analyzed bi-weekly. A Student T-test illustrated significant differences in some water quality parameters as time progressed. Channel catfish production was not significantly different between the treatments.

## **Winter Feeding of Golden Shiners**

Lloyd Inmon, Martha Rowan, and Nathan Stone Pine Bluff Cooperative Fisheries Research Project  
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In 1990, the golden shiner industry in Arkansas was valued at 20 million dollars. Because of the golden shiner's economic importance a study was conducted to evaluate the effect of winter feeding on the growth of golden shiners. In the study, eight 0.1 acre ponds were stocked with 500 pounds per acre of golden shiners (average weight = 10.5 lb/100 fish). All ponds were fertilized regularly to maintain Secchi disk readings of less than 28 inches. Fish in four ponds were fed ff the p.m. water temperature at 3 feet of depth was 50 degrees fahrenheit or greater. Four ponds were left unfed. Fish were fed crumbled sinking pellets (32% protein) at 1% of body weight. Sampling was conducted to adjust the feeding rate. Current maximum and minimum air and water temperatures were recorded daily. Secchi disk readings and early morning oxygen were recorded once per week. Fish were harvested and graded after four months. Fish production averaged 370lb/acre for the fed treatment (net production = -1 30 lb/acre) and 322 lb/acre for the unfed (net = -1 78 lb/acre). Survival ranged from 53 - 64%. Winter feeding did result in more pounds of larger fish (no. 23 grader slot width and above).

## **Estimating Numbers of Golden Shiner Eggs**

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Annual sales of Arkansas farm-raised golden shiners exceed \$20 million. Research on improved hatchery management techniques for this species is hampered by a lack of standard techniques for estimating numbers of the small eggs and fry. This study evaluated two methods for estimating egg numbers and compared them to actual counts. Fourteen samples of the preserved eggs were counted by hand and counted with an electronic egg/fry counter (Jensorter Model FC-1). Five samples were estimated volumetrically. The volumetric method, where total egg volume is measured in a graduated cylinder and 2-3 subsamples of known volume counted, resulted in estimates that were generally lower than actual counts ( $y = 94.8 + 3.7\%$ ). The egg counter, which uses an infrared detection system, generally underestimated the actual number of eggs by about 7% ( $y = 93.3 + 5.9\%$ ).

## **Fishery Investigations at Prado Reservoir Colombia, South America**

Kenneth E. Shirley, Fisheries Division Arkansas Game and Fish Commission 2 Natural Resources Drive Little Rock, Arkansas 72205

Prado Reservoir is Colombia's largest (3,900 ha.) warm water reservoir. Built in 1969, a major artesanal fishery developed. By 1974 it had begun to collapse. In 1976-78, a fishery investigation was initiated to determine the causes of the collapse and to develop solutions. Studies included a creel survey, limnological investigation, gear selectivity, and food habits and fecundity of major species. The major findings were that the reservoir suffered the typical fishery decline following impoundment and that in addition, over-harvest with unselective gear and a failure of some important species to spawn successfully compounded the problem. Several species of river spawning fish trapped upon impoundment were unable to spawn in the short river reach above the lake.

Solutions included gear regulation changes, stocking wild caught catfish juveniles from the tailrace and stocking the lake, design of a lakeside hatchery for production of other species, and implementation of small farm aquaculture operations to increase local protein production and reduce pressure on the lake.

## **Effect of Feeding Frequency and Feeding Rate on Golden Shiner Yields**

Baker Holden, Martha Rowan, and Nathan Stone Pine Bluff Cooperative Fisheries Research Project U.S. Fish and Wildlife Service Agriculture Experiment Station University of Arkansas at Pine Bluff Pine Bluff, Arkansas 71601

Three related studies were conducted concurrently in ponds and pools to determine the effect of feeding frequency and feeding rate on the yield of golden shiners. In the first study, golden shiner fingerlings (1.5757 lb/thousand) were stocked in twelve aerated 9 foot diameter plastic pools at a rate of 219 fish/pool (1 50,000/acre) and were fed a crumbled 32% protein commercial catfish feed at a daily ration of 3% body weight in one, two and three feedings per day (3%, 1.5% or 1% per feeding). Fish harvested after 49 days. Net yield for the treatments (1, 2 or 3 portions/day) were 0.67, 0.69 and 0.74 lb/pool, respectively, while FCR was 1.00, 0.97 and 0.89, respectively. In the second study, golden shiner fingerlings were stocked out as in study 1, but fed 1.5% body weight per feeding, with one, two or three feedings/day (1.5%, 3% or 4.5% per day). Net yield for the treatments (1, 2, or 3 feedings/day) averaged 0.52, 0.66 and 0.99 lb/pool, with FCR of 0.56, 1.03 and 1.18 respectively. In the third study, golden shiner fingerlings (0.67 lb/thousand) were stocked in eight, 0.1 -acre ponds at a rate of 150,000/acre and were fed either 1.5% body weight, once/day, or 3% body weight, twice/day (1.5%/feeding). Net yield for the two treatments (1.5%, 3%) was 184.5 and 247.8 lb/acre, with FCR of 0.53 and 0.79. Feed conversion rates for fish in pools and ponds were lower than the expected 2:1 ratio, so actual feeding rates fell to approximately 60% of the nominal rates by the end of the studies. Results of the three studies indicate that increasing feeding frequency does not significantly increase yield or FCR. Increasing the feeding rate to 4.5% did significantly increase net yield.

## **Tri-Lakes Creel Survey**

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In 1988 a creel survey was started on Dierks, Gillham, and DeQueen (also known as the Tri-Lakes) to obtain information on fishing pressure, catch rates, angler preference, bass harvest and catch-release. The creel survey began a year before slot-limits were initiated on Dierks (12"-15") and DeQueen (13"-18"), and has continued for four years after the slot limits.

The number of largemouth bass harvested by fishermen on Dierks Lake in 1988 was 7,495 within the proposed slot-limit, and in 1989 fishermen released 9,764 bass within the slot range. On DeQueen Lake fishermen harvested 5,410 bass in 1988 within the proposed slot range, and in 1989 fishermen released 15,285 largemouth bass within the slot range.

Fishing pressure increased on Dierks Lake the year after the slot limit went into effect and fishing pressure decreased on DeQueen Lake. Fishing pressure on Gillham has remained about the same since 1988. Angler catch rates have increased on all three lakes since 1988.

## **Oklahoma Black Bass Management Plan**

Garland Wright Oklahoma Department Wildlife Conservation Holdenville Fish Hatchery Route 3, Box 45, Holdenville, Oklahoma 74848

A Black Bass Management Plan was developed in order to most effectively provide quality bass angling opportunities in Oklahoma waters. Goals of this plan are to enhance public awareness and understanding in Oklahoma and to sustain, improve and develop both largemouth and smallmouth bass populations to enhance recreational fishing opportunities. Objectives needed to achieve these goals are presented and strategies designed to correct identified problem issues are listed.

## **Preliminary Results of a Mufti-State Study Using Saugeye to Control Stunted Panfish in Small Impoundments**

Greg L Summers Oklahoma Fishery Research Laboratory University of Oklahoma Norman, OK 73019

Following the results of saugeye (walleye X sauger) introductions in Lake Thunderbird, Oklahoma, a task force of the Walleye Technical Committee, North Central Division, American Fishery Society, stocked fingerling saugeye into 21 small impoundments in seven Midwestern states. The objective of the study was to determine the utility of saugeye in improving fish community balance through increased predation of panfish species, particularly crappie (*Pomoxis* spp.) and bluegill (*Lepomis macrochirus*). Lakes were stocked at a rate of 20 saugeye per hectare in the spring of 1992 and sampled the following fall. Saugeye densities were determined using night-time electrofishing and panfish populations were assessed using trap net samples. Saugeye densities appeared to be influenced by predator density and presence of gizzard shad. The study is planned to continue for an additional five years.

## **Distribution and Abundance of Reintroduced Smallmouth Bass and Native Largemouth Bass and Spotted Bass in Relation to Water Quality in Beaver Reservoir**

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Water quality parameters known to affect smallmouth bass populations were measured longitudinally in Beaver Reservoir to assess suitable habitat. Electrofishing was used to find trends in black bass populations related to trends in water quality. Upper Beaver Reservoir was found to be turbid, productive, eutrophic, and poor smallmouth bass habitat. Lower Beaver Reservoir was found to be clear, oligotrophic, and excellent smallmouth bass habitat. Mid-Beaver Reservoir was found to be a mesotrophic transition zone that may be poor to good smallmouth bass habitat depending season and reservoir inflow. Largemouth bass and spotted bass electrofishing catch rates were positively correlated with reservoir productivity. Smallmouth bass population displayed a very restricted population centered around point of stocking (Beaver Nursery Pond) and showed a weak negative correlation with reservoir productivity.