

# Southern Division of the American Fisheries Society 2004 Spring Meeting Abstracts

## Warmwater Streams Symposium

### **Then and Now: Twenty-Four Years of Warmwater Streams Management**

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An old proverb says: "The more things change, the more they stay the same." Solomon, a king of Israel, wrote in Ecclesiastes chapter 1, verse 9: "What has been is what will be, and what has been done is what will be done, and there is nothing new under the sun". We all build on the body of knowledge that has been given to us by the previous generation of scientists. Each new generation answers questions using the technology we have at hand. We should never think that we have arrived or that we are smarter, faster, and brighter than the previous generation. We will give you a picture of what was covered in the last major warmwater streams symposium in the Southern Division, which was held in Knoxville, Tennessee in March 1980. That symposium was subsequently published as *The Warmwater Streams Symposium: A National Symposium on Fisheries Aspects of Warmwater Streams*. We will compare and contrast the progress in warmwater streams management over the 24 years since that symposium was held. In many ways, this talk will provide guidance to a new generation of warmwater streams managers, drawing on the visionaries of the last generation for guidance.

Keywords: warmwater streams

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### **Smallmouth Bass Recruitment Based on the Goldilocks Principle: Sometimes It's Too wet, Sometimes It's Too Dry, and Sometimes It's Just Right**

*Scott M. Smith, John S. Odenkirk, and Stephen J. Reeser, Virginia Department of Game and Inland Fisheries*

Recruitment of smallmouth bass *Micropterus dolomieu* in riverine systems typically displays a high degree of annual variation. We examined three rivers in Virginia with the objectives of identifying a functional index for measuring recruitment success, examining the relationship between stream discharge and recruitment success, and conceptually providing a management option for improving recruitment. The catch-per-unit-effort of age 0 smallmouth bass in October-November was an accurate measure of year-class strength. The recruitment success of smallmouth bass was significantly related to mean June stream flow, with the strongest year classes produced in years with moderate flows. In order to determine if supplemental

stocking could ameliorate poor recruitment, we modeled the population with and without supplemental stocking. The model indicated that supplementing weak or average year classes could increase the overall abundance of smallmouth bass. Augmenting weak year classes stabilized recruitment, and possibly maintained catch rates. Augmenting average year classes increased the frequency of years with high fish abundance, and possibly increased the numbers of trophy-sized fish. Finally, our data suggested that stream discharge during and immediately after spawning could be critical to smallmouth bass recruitment success.

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### **Estimating Smallmouth Bass Population Size and Biomass in Virginia Rivers Using Multiple-Pass Boat Electrofishing**

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A depletion study using nine electrofishing boats was conducted on two Virginia rivers to evaluate smallmouth bass population size and biomass. Population estimates generated by Mircofish 3.0 were compared to those derived by least squares linear regressions, and population size structures from depletion samples were compared to those from single-pass surveys. Adult smallmouth bass were successfully depleted in three to five runs at most sites. Population estimates ranged from 50/km – 740/km and 3/ha – 115/ha. Means for the Rappahannock and James Rivers were 386/km (SE=132); 47/ha (SE=17) and 265/km (SE=90); 38/ha (SE=20). Young-of-year (YOY) population estimates averaged 221/km (SE=60) and 28/ha (SE=14) on the Rappahannock River and 248/km (SE=88) and 31/ha (SE=14) on the James River. Capture probability was highest (mean=0.40) for adults on the Rappahannock River and lowest (mean=0.17) for YOY on the James River. Population estimates based on least squares linear regressions were greater than those generated by Microfish, but differences were consistent and usually less than 30%. Single-pass runs provided biased estimates of size structure at 50% of Rappahannock River sites based on comparisons of mean total length (stock-size fish) and structural indices (more large fish were captured with depletion sampling); however, little size selectivity bias existed between methods on the James River. This study suggests that smallmouth bass can be successfully depleted from sample reaches within large Virginia rivers. Although the upper tier of sampling effort included five passes with nine boats, desirable outcomes were achieved with less effort. This study provides cautious optimism that single-pass surveys can adequately describe population size structure of smallmouth bass populations in some Virginia rivers; however, further study is needed and should include mark-recapture and telemetry techniques.

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## **A Process-Driven Approach for Assessing Warmwater Streams in Wyoming**

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Fisheries research and management in North America have largely focused on sport fishes, and in the western United States the focus has been almost exclusively on salmonids. However, the declining status of native warmwater species has attracted increased attention to warmwater streams. We developed a process, termed the Warmwater Stream Assessment (WSA), for evaluating warmwater streams that includes three major components: (1) stream reach selection and accumulation of watershed-level information, (2) fish and habitat sampling, and (3) summarization and assessment of fish and habitat information. Fish are sampled using common techniques (i.e., electrofishing, seining), and habitat is measured using a data-matrix approach where combinations of habitat components are recorded. The entire process assesses both habitat and fish assemblage characteristics relative to those likely present prior to settlement by Europeans. Hierarchical decision trees reflect critical habitat requirements for each species and are used to evaluate the presence or absence of species. Combined measurements of available habitat and the ecology of individual species enable assessment of the observed fish assemblage. The WSA incorporates knowledge of habitat features and fish assemblages to allow managers to infer how both habitat and fish assemblages may have changed due to anthropogenic activities. Although the WSA was developed for warmwater streams in Wyoming, its philosophy, process, and conceptual basis can be applied to many forms of environmental assessment.

**KEYWORDS:** warmwater streams, environmental assessment, hierarchical faunal filters, fish and habitat

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## **Influence of Long-Term Streamflow Variation on Recruitment of Riverine Fish Populations**

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River regulation and water development are the foremost problems threatening stream fishes and other lotic biota in the southern United States. The influence of these factors, however, in systems with high natural variability over time must be assessed and quantified before relationships can be attributed to management actions. Thus, we used a long-term (13 year) dataset to assess the inter-annual variability in the recruitment of 19 warmwater fish species in a large Midwestern stream and related it to variation in river discharge. Our analysis included economically and recreationally important species, such as largemouth and smallmouth bass, as well as non-game catostomid, clupeid, and cyprinid species. Modeling results indicated that flow stability (characterized by percent mean daily change in discharge) was the best predictor of young-of-year fish recruitment. The

degree of influence however, varied among families. Flow stability had a greater influence on the recruitment of large-bodied fishes with relatively restricted spawning seasons, such as catostomids, whereas cyprinids and centrarchids were less affected. Results of this study are being used to develop predictive models to assess the impacts of river regulation on fish assemblages to aid in management of fisheries in regulated rivers.

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### **Sampling Considerations for Assessing Prairie River Fish Assemblages**

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Success at incorporating biotic integrity into water resource management depends on an appropriate cost-effective procedure for sampling aquatic organisms, including fish. Our objective was to develop a protocol for sampling fish assemblages in the large prairie rivers in Oklahoma. Development of the protocol has proceeded through four phases: 1.) site reach delineation, 2.) classification of in-stream habitat, 3.) gear efficiency evaluation, and 4.) sampling effort determination. Three habitat types; shallow water (less than 0.75 m deep), deep water (greater than 0.75 m deep), and backwater (current velocity of 0.0 m/s) were visually identified on digital orthophoto-quads over a 42 km reach of the Cimarron River, and they covered 59%, 37%, and 4% of the reach, respectively. On average, these proportions occurred within a 1500 m stretch of river. We sub-divided each habitat type into six sub-types based on water depth and flow measured in the field, and sampled fish in randomly selected sub-types. Cluster analysis and analysis of similarities (ANOSIM) of the fish collections subsequently grouped the six habitat sub-types into the original three types. Preliminary analysis of the gear efficiency evaluations indicate sampling effort should be disproportionately allocated to rarer (backwater, deepwater) habitat types. Our results suggest that a representative sample of the fish assemblage can be attained in a two-day period with the use of seines and hoop nets.

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### **Random selection of stream sites: an important step in fluvial geomorphic and fishery surveys**

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Stream surveys are conducted to assess the status and trends of their physical and biological components. However, the selection of sampling locations has rarely incorporated a random element. Several researchers have reported that sampling at handpicked sites or sites with easy access can lead to erroneous results regarding

stream resources. Employing a probability sampling design allows statistically valid inferences to be made about unsampled stream locations. Several probability sampling designs have been developed and implemented that allowed assessment of the status and trends of unsampled stream resources. We developed a stratified random sampling design used for sampling fluvial geomorphic and black bass populations in eastern Oklahoma streams. We stratified the region by stream order (Strahler orders 1-4) and ecoregion (Boston Mountains, Central Irregular Plains, Ouachita Mountains, and Ozark Highlands), and randomly selected 10 stream sites per strata combination. Measurement of geomorphic and fish variables at the selected stream sites will facilitate statistical comparisons at multiple spatial scales and across different ecoregions. Many state wildlife and fisheries agencies participate in stream management. However, it is unknown how many incorporate random sampling designs to avoid the potential mismanagement of stream resources.

Key Words: Assessment, inference, probability sampling, bias

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### **How much water can we squeeze from a smallmouth bass? Identifying aquatic conservation thresholds for a warmwater system**

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Many rivers and streams are feeling the pressure of instream and offstream use conflicts. The North Fork Shenandoah River, Virginia, is one such river facing a water allocation crisis. Plagued by low flow conditions and increasing growth from the Washington D.C. metro area, water demand is projected to exceed supply in 2025. As a result, the warmwater fish assemblage of the North Fork is threatened by reduced water quantity and quality. A four-year instream flow study was initiated in 1999 to examine the relationship of macro- and microhabitat response to changes in stream flow. Using several analytical tools, PHABSIM, SNTMP, and QUAL2E, we modeled the physical stream and its habitat components. Model results indicate severely limited habitat for riffle, fast generalist, and pool run guilds during drought conditions. In addition, ammonia and phosphorus levels exceeded EPA standards for aquatic life. However, water temperatures were moderated by groundwater inputs. Model results were incorporated into a stepwise process to outline aquatic conservation thresholds and implement an aquatic threat response system. This process provides managers and stakeholders with a novel, community-based, water allocation management strategy to protect the natural commodity of the North Fork Shenandoah, and serve as a model for other watersheds.

Keywords: warmwater system, instream flow, water allocation, aquatic conservation flows

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## **Stream Fisheries Management in the Southeastern United States: Trends from a Survey of State Agencies**

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We surveyed 15 state fish and wildlife agencies in the southeastern United States in 2000 to evaluate characteristics of their stream fisheries management programs. Sixty-two percent of the respondents listed maintaining and improving ecosystem integrity, and increasing angling quality and opportunities as their primary goals for managing streams fisheries. The mean number (percent) of full-and part-time employees managing streams fisheries in the Southeast was 31 (57%). Agencies expended most of their money on hatchery, management and law enforcement activities. Employees allocated nearly a third of their time on management activities and another third on research and hatchery activities combined. Most agencies annually used electrofishing to estimate the abundance of sportfish populations. The majority of agencies surveyed instream channel habitat units as needed for stream bank stabilization and riparian restoration projects. Agencies conducted creel surveys as needed using fact-to-face interviews to identify fishing trends, establish regulations, and measure satisfaction of anglers. Water quality and contaminants, watershed management, habitat restoration and hydropower relicensing were among the issues most respondents rated as moderately or very important. Results from this survey indicate that southeastern fish and wildlife agencies have increased their stream fisheries management activities compared with a similar survey conducted in the mid-1990s.

Keywords: fisheries streams rivers management survey southeastern United States

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## **Physical evaluation of stream crossings using applied fluvial geomorphology techniques**

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Land usage in the Ouachita uplift of Oklahoma is dominated by silviculture activities. Thousands of road crossings have been constructed to facilitate timber resource access. Many of these structures now act as fish movement barriers either directly by construction design or indirectly by subsequent changes in streambed morphology. The objectives of this study were to: (1) develop regional curves for the bankfull metrics of cross-sectional width, depth and area; (2) assess changes in streambed morphology associated with road crossings and (3) correlate these changes with life cycles of stream fish. Regional curves for a southeast Oklahoma hydrophysiographic province were created using cross-sectional surveys. Level II assessment techniques described by D.L. Rosgen were implemented to evaluate morphological changes at road crossings. Reference reaches were established for each stream order and class. Regional curves were successfully developed and used

for identification of bankfull elevations at study reaches. Level II assessments quantified significant changes in sediment distribution, stream slope and sediment routing ability, cross-sectional dimensions, mesohabitat composition and velocity distribution. Decreases in fishes' movement potential, genetic integrity, spawning success and community diversity were correlated with these morphological changes through a search of literature. Study results will be used to streamline road crossing removal, improvement and future design protocols.

Keywords: fish movement barriers stream morphology regional curves sediment capacity competency road crossing design

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### **The Influence of Road Crossings on Fish Movement and Fish Communities in Ouachita Mountain Streams, Ouachita National Forest**

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Studies have been and are being conducted to measure the influence of road crossings on fish movement and on fish communities within the Ouachita National Forest. Nine weeks of monitoring showed over a hundred darters moved through a baffled pipe and grouted rip rap ramp. Fish movements through nine different crossings ranging from natural-bottomed fords to piped crossings showed the natural ford and box culverts to have fish movements and the others had reduced to no movements through the crossings. Six crossings were examined with three crossings modified in an attempt to improve fish passage. Fish were less likely to move across reaches with low-water bridges compared to reaches without low-water bridges. Average species richness was higher for fish communities downstream of the crossing compared to upstream (12.5 versus 6.3). Two rip-rapped low-water crossings were the only ones allowing upstream fish passage. In a leopard darter study, only one moved downstream through the low-water crossing and none upstream. Twenty-one low-water crossings had a species richness of 9.38 downstream versus 7.13 upstream. Total abundance (total number of all individuals of all species) was significantly lower in the combined upstream reaches versus the combined downstream reaches.

Keywords: fish-passage road-crossings low-water-crossings

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## **Design and installation of two streambank stabilization projects in northeast Oklahoma**

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Sedimentation from streambank erosion is a chief pollutant of streams. Eroding streambanks increase the amount of sediment entering streams which impacts sport fisheries by reducing fish habitat diversity, macroinvertebrate production and subsequent sport fish growth rates. Many technologies using applied fluvial geomorphology concepts are available to streams managers to locally minimize this problem. The Oklahoma Department of Wildlife Conservation has successfully completed two projects that demonstrate the application, design and effectiveness of these structures. In 2002, a cedar tree revetment was completed at Spring Creek at a cost of \$7,354. Unfortunately, three flood events occurred before the vegetation could become well established. During the first two events the structure experienced flows equal to a bankfull discharge and the structure performed excellent. During the third event, however, discharges were commensurate with a five-year flood event and 75-percent of the structure failed. The structure has since been repaired and is operating successfully. In the same year we installed five J-hook rock vanes at a second location at a cost of \$12,400. To date no visible streambank erosion has occurred. Combined, these projects stabilized approximately 900-ft of stream bank and decreased subsequent sediment inputs.

Keywords: Geomorphology Cedar tree revetment J-hook rock vane Streambank Stabilization

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## **Responses of Fish Populations to the Installation of Rock Vanes in Spring Creek, Oklahoma**

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A before-after, control-impacted design suggested that the installation of rock vanes in Spring Creek, Oklahoma affected fish habitat and fish populations. Dominate substrate distributions did not change at the control site, but included bedrock, boulders, and more silts at the project site after project completion. Abundance of submergent vegetation increased more at the project site than the control. Water depth and velocity heterogeneity did not change at either site among sampling periods. Smallmouth bass *Micropterus dolomieu* catch per effort (CPE) at the project site mimicked that of the control, whereas shadow bass *Ambloplites ariommus* CPE responded differently between sites. Smallmouth bass relative weights did not change at the control site, but decreased during the last sampling period at the project site. Shadow bass relative weights initially decreased at the both sites after

rock vanes were installed, but recovered only at the control site. Fish assemblage stability was not different between the control and project sites. Additional species whose CPE responded differently at the project site when compared to the control were banded sculpins *Cottus carolinae*, cardinal shiners *Luxilus cardinalis*, northern hogsuckers *Hypentelium nigricans*, Ozark minnows *Notropis nubilus*, and redspot chubs *Nocomis asper*, suggesting unnatural changes in abundance.

Keywords: BACI, stream habitat, erosion, population response

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### **Restoring biodiversity in an east Tennessee tailwater**

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Historically, the fauna of lower French Broad River included about 98 species of fish and 54 species of mussels. After 35 years of operating Douglas Dam, only 48 fish species and 12 mussel species remained. To improve tailwater conditions, the Tennessee Valley Authority initiated a minimum flow release in 1987, and by 1993 developed a combination of aeration methods to maintain dissolved oxygen concentrations > 4 mg/L. Dramatic improvements in the biota followed. In 1997, federal and state agencies, and NGOs teamed up to restore the lost biological diversity. To date, 20,000 adult mussels (18 species), and 20,000 lake sturgeon *Acipenser fulvescens*, were translocated to the tailwater. Following improvements in discharge, 80 % of the historic fish fauna has been collected. Recolonization by mid-water column species is likely due to the lack of low-velocity habitat during full generation. High survival of translocated mussels indicates that many extirpated species can be reestablished. Of the 54 mussel species historically occurring in the lower French Broad River, 5 are now extinct, but at least 31 species can be reestablished. It is unlikely that 16 species can be reestablished because of the unavailability of donor population, or absence of their hosts (mid-water column species).

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### **A Survey of Pigeon River Re-introduction Efforts**

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Since 2001, eight fish species totaling 3,975 individuals have been re-introduced into the Pigeon River, an Appalachian stream that once was so polluted North Carolina classified the best use of her waters to be for waste disposal. The river has historically suffered from the cumulative effects of years of pollution and hydrological alteration. In recent years, water quality improvements in the river have led state, federal, and private agencies to re-introduce several species into the river. To assess survival of relocated species, visible implant fluorescent elastomer (VIE) tags were employed. The first re-introductions, which were collected from area streams and

tagged before release were blueside darters (*E. jessiae*), bluebreast darters (*E. camurum*), and gilt darters (*Percina evides*). Snorkeling surveys during the summer of 2002 revealed healthy gilt and bluebreast darters, but no blueside darters; observation of untagged gilts suggest reproduction. Subsequent re-introductions have included stargazing minnows (*Phenacobius uranops*), mountain madtoms (*Noturus eleutherus*), stripetail darters (*E. kennicottii*), American brook lampreys (*Lampetra appendix*), and mountain brook lampreys (*Ichthyomyzon greelyi*). Selected mollusks have also been re-introduced, including six genera of common snails beginning in 1996 and eight genera of common mussels in 2000. Significant reproduction in snails of the genera *Leptoxis* and *Pleurocera* have been documented.

Keywords: Re-introduction Pigeon River darters madtoms lampreys mussels snails snorkeling Visible Implant Fluorescent Elastomer (VIE)

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### **Propagation and culture of endangered juvenile mussels (Unionidae) at the Freshwater Mollusk Conservation Center, Virginia Tech**

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North America contains the greatest diversity of freshwater mussels in the world, roughly 300 species; however, this family of mollusks is the most imperiled taxon in the United States. Already, 35 species are presumed extinct and 70 species are listed as endangered or threatened. Without immediate efforts to recover federally protected species in watersheds throughout the country, the extinction of additional species is likely. Biologists at the Freshwater Mollusk Conservation Center at Virginia Tech have developed methods to produce and culture endangered juvenile mussels. The goal of this project is to augment natural reproduction at sites with these species and to release juvenile mussels at historic sites within rivers to expand population ranges. Between 1998 and 2003, nearly 400,000 juvenile mussels of 9 endangered mussel species were released into the Big South Fork Cumberland, Clinch, Powell and Hiwassee rivers. These rivers contain sufficient brood-stock and suitable habitat to augment and re-establish populations of rare mussels. Juvenile mussels are typically between 700-1200 mm long and 60 days old at the time of their release into the rivers. Propagation is now a viable tool to implement recovery of federally listed mussel species.

Keywords: Unionidae freshwater mussels endangered propagation recovery

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## **Candidate Conservation Agreement with Assurances for the Robust Redhorse, *Moxostoma robustum*, Ocmulgee River, Georgia**

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Georgia Power entered into the first Conservation Agreement with Assurances between the US Fish and Wildlife Service and a non-governmental organization in January 2002. This agreement is based on a policy from the US FWS that recognizes the benefit of protecting rare and potentially declining species before they are threatened with extinction. This is a cooperative effort among the USFWS, Georgia Department of Natural Resources, and Georgia Power to introduce the robust redhorse, *Moxostoma robustum*, into the Ocmulgee River, Georgia. The robust redhorse is a large North American sucker first described by Edward Cope in 1870, but largely unknown until it was rediscovered in 1991.

The agreement proposes four conservation actions beginning with the introduction of juvenile robust redhorse into the Ocmulgee River. The purpose of the reintroduction is to expand the known range by creating an additional population from fish collected in the Oconee River, Georgia. Georgia Power will support monitoring and population estimates to document the progress toward this goal. In return, the company receives assurances that licensed flows from Lloyd Shoals Dam will remain unchanged and is provided an incidental take permit in the event the species requires listing under the Endangered Species Act in the future.

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## **Ohio River Paddlefish: Management Strategies for a Multi-jurisdictional Species**

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Paddlefish are native to the Ohio River sub-basin of the Mississippi River drainage comprising a linear distance of 20,856 km or 22% of endemic paddlefish range. Historically, habitat degradation, exploitation by sport and commercial fishers, and illegal harvest has significantly impacted paddlefish population throughout their range. Recently, increased commercial exploitation of paddlefish because eggs are a high-grade substitute for sturgeon caviar has placed an additional stressor on paddlefish populations.

Paddlefish within the Ohio River sub-basin migrate among multi-jurisdictional boundaries consequently to effectively manage this great river species; a coordinated strategy must be employed. The Ohio River Fisheries Management Team (ORFMT) provided a framework for such an approach. Five state agencies actively participate in ORFMT tasks with two additional states contributing when appropriate. In 2001, the ORFMT Technical Group developed an Ohio River Sub-basin Paddlefish Strategic Plan that clearly outlined both policies and tasks. The plan recognized the multi-jurisdictional framework of managing great river species, as well as considered individual states management strategies. Policies on genetic concerns, commercial and sport harvest regulations, and data-sharing were addressed and implemented. Coordinated field tasks related to tagging and movement, standardized population characterizations, and stocking were also addressed and are currently on-going. Through this approach, the management of paddlefish within the Ohio River sub-basin is truly multi-jurisdictional providing for a more realistic strategy for this great river species.

## Ecology and Management of Catfishes Symposium

### Catfish Angling Today

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For over 100 years, recreational angling for catfish has been a popular form of outdoor recreation in the United States. Though national surveys indicate slightly declining participation in catfish fishing, this species group still represents the fourth most popular fish category and the second largest in participation (exceeded only by black bass). An estimated 7.5 million catfish anglers over age 16 spent more 103 million days fishing for catfish species in 2001. Three states list catfish as the most preferred species group, and they rank among the top three in 16 states. In the last decade, human dimensions investigations have begun to portray the characteristics, attitudes, and preferences of catfish anglers. Beyond statistics and profiles, however, catfish anglers represent a conglomerate of individuals who consider the pursuit of ictalurids a central part of their existence. Species preferences vary regionally, along with preferred techniques. Unifying elements include the pursuit of a large and highly palatable fish, time spent outdoors along rural waterways, and doing so in the company of like-minded individuals. As with other types of fishing, catfish fishing is changing, with increased industry involvement and growing participation in clubs and tournaments.

Keywords: Catfish Angling

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### Why catfish are better than bass: a research perspective

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Catfishes have long been recognized as important species, yet information regarding biology and management has lagged behind other sportfishes. Although catfishes are not considered "gamefish" in most of the Southeast, the recent surge in popularity by anglers has piqued the interest of fish chiefs, biologists and researchers. In 1999 *Catfish 2000* was published; it comprised 47 papers regarding North American species and also highlighted missing information on catfishes. During the many years that my research team has studied catfishes, we have: developed age and growth techniques, compared introduced and native population parameters, quantified diel movements of riffle dependent juveniles, assessed differences in reservoir and riverine populations, and identified important hydrologic features for growth and recruitment. However, we still do not know basic life history characters and other population parameters to assist in management. For example, fecundity, age-at-maturity, and survival estimates are all either sparse or lacking and impede our

ability to assess and compare populations. In addition, data regarding exploitation rates are limited; therefore, ability to conserve stocks (if needed) is impaired. So, why are catfish better than bass? Because, we still have so much to learn. A comprehensive and collaborative research program on biological and social issues surrounding catfish ecology and management is needed.

Keywords: catfish research and management

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### **Angler attitudes and opinions regarding catfish and their management in Mississippi River Basin states**

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We surveyed catfish angler opinions and attitudes about catfishing, particularly trophy catfishing. The Mississippi Interstate Cooperative Resource Association funded the study. Catfish anglers were selected from the mailing list of Catfish-Insider Magazine. Some results have been published in In-Fisherman Magazine (February 2002). Channel catfish are more sought after than flathead and blue catfish, but the latter species have more trophy potential than channel catfish. Most catfish anglers prefer fishing rivers with rod and reel but some use set lines. Anglers fish for fun but many indicated that catching large fish was important. Most catfish anglers (71%) take at least one trip annually to fish for a trophy catfish. About 70% of the anglers thought a trophy channel catfish was > 737-mm long; a trophy flathead was > 864-mm long, and a trophy blue catfish was > 914-mm long. About 66% of those surveyed thought that managers need to direct more attention to catfish fisheries. Many support more stringent regulations to protect catfish populations and improve trophy fishing.

Keywords: catfishing, angler opinion, Mississippi River Basin, trophy catfish

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### **Introduced Flathead Catfish: Prize or Plague?**

*Kwak\*, T.J., W.E. Pine III, and D.S. Waters, U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Raleigh, NC*

In its native distribution in the Mississippi, Rio Grande, and several Gulf Slope drainages, the flathead catfish, *Pylodictis olivaris*, is regarded as a prized sport fish for its potential to attain large sizes, fighting ability when hooked, and meat quality. Since the 1950s, it has been introduced into Atlantic Slope rivers from Florida to Pennsylvania, and populations can be established by releases of few individuals. Its rapid dispersal, high population and individual growth rates, and obligate carnivorous food habits have been problematic for native fish assemblages, fisheries, and imperiled fishes where it has been introduced. The flathead catfish has been considered easily collected by electrofishing, of low densities, with sedentary behavior, restricted to freshwater, and feasible to manage in restricted river units,

but recent research suggests that electrofishing is an inefficient flathead catfish gear, it may occur in dense populations, individuals migrate throughout a drainage, it tolerates brackish waters, and populations must be managed at the watershed scale. We suggest that management of introduced flathead catfish populations focus on limiting dispersal among watersheds, public education, and encouraging harvest. Additional research is needed to elucidate the effects on native fishes and develop and assess the potential for alternative population control measures.

Keywords: catfish, flathead catfish, introduced species, exotic species, nuisance species, invasive species, native fish conservation

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### **Modeling management scenarios and the impact of introduced flathead catfish on native fishes**

*Pine, William E., III\*, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University*

*Kwak, T. J., U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Raleigh, NC*

*Rice, J. R., Department of Zoology, North Carolina State University, Raleigh, NC*

*Waters, D. S. Department of Zoology, North Carolina State University, Raleigh, NC*

The flathead catfish, a carnivorous fish species native to most of the central interior basin of North America has been introduced widely across the United States, primarily along the Atlantic slope. Concurrent declines in abundance of native fishes have been reported in areas where flathead catfish have been introduced. To evaluate the impact of this invasive species on the native fish community and potential management scenarios, we developed an Ecopath ecosystem simulation model (including flathead catfish) based on empirical data collected for a North Carolina coastal river. Model results suggest that flathead catfish suppress native fish community biomass by 5-50% through both predatory and competitive interactions. However, these reductions could be mitigated through sustained exploitation of flathead catfish by recreational or commercial fishers at levels equivalent to those for native flathead catfish populations (annual exploitation = 6-25%). These findings demonstrate the potential for using directed harvest of an invasive species to assist in restoring native ecosystems and contribute to the growing global demand for fish products as a human food source.

Key Words: catfish, flathead catfish, ecosystem modeling, Ecopath, introduced species, exotic species, invasive species, native fish conservation

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## **Changes in Population Structure Following Removal of Introduced Flathead Catfish**

*Harrison\*, D.R. Georgia Department of Natural Resources (GADNR), Waycross, GA*

The presence of non-native flathead catfish (*Pylodictis olivaris*) in the Satilla River, GA was confirmed in 1996. The presence of this exotic species in the Satilla River is of grave concern, given that the Satilla River has long been famous for its excellent redbreast fishery. Studies have shown that when flathead catfish are introduced into rivers where redbreast sunfish are native, redbreast abundance can be reduced by up to 80%. In 1997, Georgia Department of Natural Resources personnel initiated flathead catfish removal efforts through electrofishing in an attempt to control population expansion and reduce predation on native fishes. Electrofishing data collected from 1997 through 2003 reveals that, despite annual removal efforts, the CPUE of flathead catfish has increased from 4.4 fish/hr to 28.1 fish/hr. However, during this same time period there was a shift in the size distribution, with the average weight of flathead catfish decreasing by 35%. Due to the continued expansion of the flathead catfish population, new strategies are being implemented, such as initiating removal efforts in the pre-spawn period, in an effort to reduce the abundance of flathead catfish in the Satilla River.

Keywords: Flathead Catfish

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## **Blue catfish (*Ictalurus furcatus*) in Virginia's tidal rivers**

*Greenlee, R.S., Virginia Department of Game and Inland Fisheries (VDGIF), Williamsburg, VA*

Blue catfish (*Ictalurus furcatus*) are widely established in Virginia's tributaries to the Chesapeake Bay, with successful introductions to the Rappahannock and James River systems in the mid-1970s, and the York River system in 1985. Following introduction, blue catfish quickly became widely distributed and extremely abundant in the larger tidal tributaries and mainstem reaches of these rivers. In 2002, an intensive electrofishing survey was conducted in the tidal James, Mattaponi, Pamunkey, and Rappahannock River systems providing a synoptic snapshot of blue catfish growth, population age and size structure, food habits, and distribution in these systems. Interesting differences in growth, diet, and age structure existed between rivers, likely related to differences in time since introduction and differences in productivity among rivers. Low frequency electrofishing (LF) has been the primary survey method employed during fisheries management work on this species in Virginia's tidal rivers. However, use of data derived from LF is problematic, with unexplained river-to-river and to some extent year-to-year variability in gear effectiveness rendering catch per effort results next-to-useless, and biasing other analyses. Comparisons of the results obtained using high frequency and LF sampling techniques have helped to elucidate the drawbacks LF and the relative biases of the two gear types.

Keywords: blue catfish introduced distribution growth diet low frequency electrofishing high frequency

## **The Introduced Flathead Catfish in the Delaware and Susquehanna River drainages**

*Richard J. Horwitz, T. Kevin O'Donnell, Paul F. Overbeck, and Amanda Kindt, Patrick Center for Environmental Research, Academy of Natural Sciences of Philadelphia, Philadelphia, PA*

*Joseph Perillo and Lance Butler, Philadelphia Water Department, Philadelphia, PA  
John Teeter, Monell Chemical Senses Center, Philadelphia, PA  
Ann Faulds, Pennsylvania Sea Grant, Philadelphia, PA*

The flathead catfish now occurs in the Delaware and Susquehanna River drainages in Pennsylvania, probably from unintentional reservoir introductions with channel catfish. A task force has been developed to assess its status and seek management options. Targeted sampling and other sampling in 2000-2003 indicate that it is widespread in the Schuylkill River, with two identified areas of concentration, both near dams. It now has access to much of the Delaware River drainage and probably the Susquehanna River basin via the Chesapeake and Delaware Canal. It has been reported in the Delaware and Susquehanna Rivers, although there are very few documented records outside the Schuylkill River and two reservoirs. Size ranges of fish from the Schuylkill River indicate that reproduction is occurring and suggest that abundance is increasing, although removal during sampling may be locally decreasing the abundance of large individuals. Stomach analyses indicate feeding on fish and crayfish. Preliminary results of laboratory studies on response to electrical fields will be presented. Studies in 2004 will focus on feeding and impacts on resident and anadromous fishes by stable isotope analysis, food habit studies and analysis of prey fish abundance.

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## **Characterization of the Santee Cooper Recreational Catfish Fishery, Results of Four Years of Creel Survey**

*Lamprecht\*, S.D., White, M.G., and Glenn, J.S. South Carolina Department of Natural Resources*

A roving creel survey was conducted on Santee Cooper Reservoir from March 1988 to February 2002 to determine angler effort, harvest, trip expenditures, and opinions. Anglers targeted catfish, as a group, more than any other fish species. Annual catfish harvest per hectare was 3.6 kg for Lake Marion, 5.8 for L. Moultrie, and 507 for the Diversion Canal. Estimates of system wide catfish angler trip expenditures ranged from a high of \$ 9.2 million to a minimum of \$ 4.9 million. Species composition of the catfish harvest was predominantly blue catfish, followed by channel catfish, and flathead cats. No species preference was indicated by 43% of catfish anglers, 41% preferred blue catfish, 11% flathead, 4% channel, and 1% white catfish. A size preference question showed 72% of catfish anglers preferred catching one 20 pound fish over four 5 pound catfish. The mean response to what size was considered a trophy was 44 pounds, with a range of 10 to 130 pounds. Quality size responses ranged from 5 to 50 pounds, with a mean of 15.4 pounds. The majority of all angler concerns were categorized as dealing with catfish and submersed aquatic plant management.

Keywords: Catfish Harvest Angler Expenditures Preference

## **Culturing imperiled madtoms for conservation**

*Bryan\*, J.L., U.S.G.S. Columbia Environmental Research Center*

*Shute, J.R., Conservation Fisheries Inc.*

*Wildhaber, M.L., U.S.G.S. Columbia Environmental Research Center*

*Rakes, P.L., Conservation Fisheries Inc.*

*Noltie, D.B., University of Missouri - Columbia*

Because madtom populations are increasingly threatened and endangered, researchers at Conservation Fisheries Inc. and the USGS Columbia Environmental Research Center are using captive propagation to gain information concerning the environmental cues for madtom reproduction, establish techniques of spawning madtoms and rearing their fry, and to reintroduce fish to previously occupied streams. Work with seven madtom species has yielded nearly 50 spawns, using either hormonal injections and/or changes in photoperiod and temperature. Overall, changes in photoperiod and temperature appear to be the most promising technique for prompting madtoms to spawn. Obtaining successful egg hatches has also been a challenge, with the greatest success coming from the use of hanging baskets. Additional innovations include overwintering fish in the lab for use of older and more fecund fish than would occur in the wild and the possibility of repeated spawnings from individual females during the same spawning season. Even with these successes, unresolved problems include high levels of infertility, unprovoked parental egg consumption, and high losses of eggs gathered early in development. Nonetheless, these advances in madtom culture provide promising tools for the conservation of many imperiled madtom species.

Keywords: madtom *Noturus* culture

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## **Genetic structure of the channel catfish complex (Genus *Ictalurus*) in New Mexico and Texas**

*McClure\*, S.A., Echelle, A.A., and R.A. Van Den Bussche, Department of Zoology, Oklahoma State University, Stillwater, OK*

The headwater catfish (*Ictalurus lupus*) has been reported from the Pecos River Basin in New Mexico and Texas, tributaries of the Rio Grande, several streams draining eastward from the Edwards Plateau of southern Texas, and Gulf Coast streams in Tamaulipas, Mexico. Historical records have shown declines in distribution and density of *I. lupus* since the 1980s. Possible reasons include competition and/or hybridization with the channel catfish (*Ictalurus punctatus*). The purpose of this study was to assess current status and geographic genetic pattern of *I. lupus* in New Mexico and Texas. 228 animals were collected, field identified and preserved for genetic analysis. Due to external morphologic similarities between the two species, a portion of the cytochrome b (Cyt b) gene was cloned and sequenced. 14 distinct haplotypes and two divergent clades (roughly 5%) were found. From GenBank

reference sequences and field identification, Clade 1 was labeled *Ictalurus punctatus* haplotypes and Clade 2, *Ictalurus lupus*. Based on Clade 2 haplotype distribution, *I. lupus* numbers seem to be declining in New Mexico and are restricted to isolated basins in Texas. Further work needs to be done on the morphometrics of the collected catfish samples to ensure congruence between field identification and genetic analysis.

Keywords: catfish distribution genetics Cytb

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## **The Catfishes of the Neotropics and How We Plan to Describe Them All**

*Armbruster\*, J.W.*

Catfishes are an incredibly diverse group of fishes found on all continents (except Antarctica) and in all oceans. To most North Americans, the diversity of catfishes is not apparent. In North America, there is only one family of catfishes (Ictaluridae) with 44 species. In contrast, the Neotropics has 15 families of catfishes with approximately 1600 described species and many left to be described. Worldwide, there are 34 catfish families and 2734 species. Neotropical catfishes range from tiny, eyeless trichomycterids no longer than 20 mm SL to giant pimelodids 2 m SL. Habitats range from lowland, hypoxic swamps to torrential streams at the tops of the highest mountains. Neotropical catfishes feed on a variety of things ranging from the rather standard fishes and invertebrates to seeds and wood. Right now, there is an NSF funded project underway to describe all species of catfishes in the next five years called the All Catfish Species Inventory (ACSI). This talk will be an overview of the diversity of catfishes in the Neotropics and how ACSI plans to describe all of the remaining species of catfishes.

Keywords: Catfishes Siluriformes Neotropics Biodiversity

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## **Environmental Characteristics Related to Channel Catfish Growth and Age and Length at Maturity in Mississippi Streams**

*Donald C. Jackson and Samuel Shephard*

Channel catfish form the basis for important public fisheries in Mississippi streams. We examined 20-50 channel catfish/season from 10 rivers representing every physiographic region of the state during Spring/Summer 2001, Fall 2001, and Spring/Summer 2002 (N = 1,299 fish). Samples were intended to be representative of the stock-specific size range of channel catfish in each stream. Sampling locations covered various sections of each waterway in order to mitigate against age- or length-based habitat preference, and helped ensure an unbiased sample for the respective channel catfish population. Through examination of pectoral spine cross sections, lengths at age for channel catfish from each stream were back-calculated, compared with observed lengths at age for the respective system, and fitted to age and growth models (Von Bertalanffy and Gompertz). Gonad samples were removed from 15-20 channel catfish per stream and state of maturity determined. Biological

characteristics of channel catfish from each stream were related to stream-specific water quality and watershed characteristics. Channel catfish growth was best described by a Gompertz curve. Statewide (all rivers combined) 50% of channel catfish were mature by total length 384 mm and age 4.3 years. There were no significant differences in age and length at maturity among rivers except for the Sunflower River ("Delta" region, western Mississippi), where 50% were mature at age 2.7 years. The Sunflower River was also the only river with channel catfish exhibiting both rapid growth and large asymptotic size. Mean length for channel catfish at age 1 was negatively related to Secchi transparency. Age-specific mean lengths for channel catfish ages 2-6 were all negatively related to altitude (proxy for latitude) and positively related to soil fertility. Mean length for channel catfish at age 7 was positively related to the number of days of high flow (greater than double annual mean flow) as well as negatively related to altitude. Relative abundance of channel catfish was positively related to the proportion of the watershed comprised of bottomland hardwood forest.

Keywords: channel catfish, streams, growth, maturation

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### **Relationships between catfishes and flooding in the lower Mississippi River**

*Michael A. Eggleton, Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, Pine Bluff, AR*

*Harold L. Schramm, Jr., Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi State University, Mississippi State, MS*

Current and previous research in the lower Mississippi River (LMR) has indicated weak relationships between catfish growth and flood-pulse measures. To assess this phenomenon further, we conducted a comprehensive bioenergetic assessment of blue catfish *Ictalurus furcatus* and flathead catfish *Pylodictis olivaris* populations in the LMR. Our objectives were to compare energy intake by catfishes in different river habitats through time. Diet composition of both species varied among habitats and generally differed in the energy levels of the foods being consumed. Caloric (energy) densities of foods consumed by catfishes were generally greatest in floodplain lakes, least in the main river channel, and intermediate in secondary river channels. Daily caloric intake for both species did not vary among habitats either year, but between-year variation was significant in all habitats for both species. Between-year increases in caloric intake during one of two years coincided with warmer thermal conditions associated with a protracted annual flood pulse. Results suggested that although different LMR habitats afforded catfishes different energetic returns in terms of foods consumed, realization of these benefits may not be accrued by catfishes every year. Year-specific physical characteristics such as water temperature and flooding regime likely affect catfish energetics in the LMR.

Keywords: catfishes rivers flood-pulse floodplains energetics

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## **Variation in Annual Movement Patterns within and between two Missouri Watersheds**

*Vokoun\*, J. C. and Rabeni, C. F. Missouri Cooperative Fish and Wildlife Research Unit*

Flathead catfish were collected in late June and early July in the Grand River and Cuivre River mainstems and implanted with 400-day radiotransmitters to determine annual movement patterns. Substantial variation was observed within and between watersheds. Flathead catfish displayed annual movement that consisted of three main periods punctuated by brief periods of movement/migration; a postspawn summer/fall restricted movement period, followed by fall migration/movement en route to wintering areas, a period of overwintering, followed by initial movement/migration from wintering areas in early spring, followed by the prespawn/spawning period of increased activity including longer movements (up to 187.6 km) during the rains of late spring-early summer. Within this framework, individual fish displayed at least three variations of the annual pattern. Some individuals entered tributary watersheds during the prespawn/spawning period only, returning to the Missouri or Mississippi River during summer/fall, overwintering there and re-entering the tributary the following spring. Other individuals entered tributary watersheds for the prespawn/spawning period and remained for the summer/fall period, returning to the big rivers to overwinter. In Grand River, all individuals moved downstream (6-48km) to Missouri River and overwintered. However, some individuals in Cuivre River aggregated in specific overwintering pools, while others migrated to the Mississippi River and overwintered. It is hypothesized that mid-latitude climate and variability of habitats in Missouri allowed investigators to record interindividual variation of migratory behavior in flathead catfish populations. Documented fish harvested at locations tens of kilometers from areas they spent considerable time suggests a larger scale for management than has been proposed.

Keywords: flathead catfish Missouri movement radio-tracking

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## **Modeling and Management for Memorable Mudcats in Missouri**

*Travnichek\*, V.H. Missouri Department of Conservation (MDC), Columbia, MO*

Large flathead catfish (>34 inches) are highly sought by anglers in the lower Missouri River. However, there has been no directed management activity towards producing this type of fishery. Thus, the Missouri Department of Conservation initiated a study in 1999 on the lower Missouri River to gather information from this population to assist in developing management strategies for producing larger individuals in large riverine systems in Missouri. A Beverton-Holt dynamic pool model was used within Fishery Analysis and Simulation Tools software to evaluate and compare several size and creel limits for flathead catfish in the Missouri River. Minimum length limits, slot length limits, and reduced bag limits for flathead catfish over a certain size were modeled. Results from modeling indicated that growth overfishing was occurring for flathead catfish in the Missouri River (i.e., most fish were harvested before reaching their growth potential). Modeling also indicated that a 30-inch minimum length limit would produce a five-fold increase in the number of memorable-sized fish (>34 inches) compared with no size limit. Most of the slot

length limits and reduced bag limits that were modeled did not predict as many memorable-sized fish as did the 30-inch minimum length limit. Public input is currently being sought to assess the possibility of creating a special management area along a portion of the Missouri River with a 30-inch minimum length limit on flathead catfish that would hopefully provide opportunities for catching larger sized fish in this area.

Keywords: flathead catfish Missouri River movement modeling trophy fishery

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### **Evaluating a Reservoir Catfish Fishery Using Volunteer Angler Data, Low Frequency Electrofishing, Hoop Nets and Jug Lines**

*Sullivan\*, K.P., Missouri Department of Conservation (MDC), Clinton, MO*

Even though catfish represent one of the most important recreational fish groups, managers have only recently become active in reservoir catfish management. The biggest challenge facing managers is how to collect a representative sample of the various catfish species. Sampling techniques have been identified to assess channel catfish in Missouri's small impoundments, and flathead catfish in large rivers, but little work has been done to identify effective sampling methods for catfish in large reservoirs. Prior attempts to document catfish angler data at 55,600-acre Truman Reservoir using standard creel methods were unsuccessful. In 2003, we initiated a multi-year volunteer catfish angler creel at Truman to fill this data gap. We recruited 97 anglers who fished for catfish at Truman. The anglers filled out daily diary sheets after each catfishing trip to Truman, and recorded effort and catch data for themselves and all licensed anglers that fished with them. Forty one anglers reported 2,016 catfish caught during 765 catfish angler trips. We will collect catfish using various sampling methods beginning in 2004. The population length frequencies gathered during field sampling will be analyzed alongside volunteer creel data to gain an overall assessment of catfish population structure.

Keywords: Hoopnets Catfish Electrofishing Volunteers

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### **Age and growth of flathead catfish (*Pylodictis olivaris*) in relation to exploitation in Oklahoma reservoirs**

*Winkelman\*, D.L., Colorado Cooperative Fish and Wildlife Research Unit, Fort Collins, CO*

We studied flathead catfish populations in Lake Carl Blackwell and Lake McMurtry, Oklahoma from 1998-2001. One of our objectives was to compare age and growth of flathead catfish from these two populations. Lake Carl Blackwell receives relatively high fishing pressure compared to Lake McMurtry, in which typical fishing methods used to catch flathead catfish are banned. Assuming that Lake Carl Blackwell had higher fishing pressure, we hypothesized that Lake Carl Blackwell would have fewer flathead catfish, a smaller size distribution, younger age distribution, and greater growth rates compared to flathead catfish in Lake McMurtry. As predicted, catch-per-

unit-effort was lower in Lake Carl Blackwell than in Lake McMurtry. The overall size distribution of fish captured in Lake Carl Blackwell differed from that in Lake McMurtry; however, the size distribution of fish greater than 510 mm (the current minimum size limit) did not differ between the populations, contrary to our predictions. The age distribution between populations significantly differed but not as predicted and growth does not appear to differ between the populations.

Keywords: catfish flathead ictalurid growth age size

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### **Abundance, growth, and mortality of the Lake Texoma Blue Catfish Population: Implications for Management**

*Mauck, P., Oklahoma Department of Wildlife Conservation, Caddo, OK*

The blue catfish *Ictalurus furcatus* fishery at Lake Texoma has been increasing in popularity. Guides that typically seek striped bass *Morone saxatilis* switch to blue catfish, particularly during the winter months when the largest individuals are most vulnerable. The Oklahoma Department of Wildlife Conservation has been collecting low frequency electrofishing samples since the early 1990's. Population abundance appears stable but concerns have been raised over the long term viability of the fishery in the face of increased angling pressure on the largest individuals. Baseline age and growth data, using otoliths, were collected from both the Red River arm and Washita River arm in 2003 (333 individual fish aged). Mortality estimates were made using the FAST model. Growth rates, particularly of fish > age 6, were highly variable. The oldest fish collected was age 16 and weighed 20.43 kg. Growth rates of the smaller individuals (ages 1, 3, 4, 5) were higher in the Red River arm than in the Washita River arm. No differences were found in growth rates of older fish, likely due to the high variation in mean length at age. It takes more than 12 years for blue catfish from Lake Texoma to reach 760 mm (preferred size). Fish of this length weigh approximately 4.5 kg. Total annual mortality estimates (A) from the Red River arm and Washita River arm were 13.5% and 17.0%, respectively (A = 18.8% for both arms combined). Even though these mortality estimates are low relative to that of other freshwater sport fishes, given the length of time it takes to reach a size being targeted by guides and their clients, options to limit harvest of large blue catfish may need to be considered in the future.

Key words: blue catfish, age and growth, mortality

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## Quality control in age estimation of catfish in Texas

*Buckmeier\**, D. L. Texas Parks and Wildlife Department

In a recent statewide survey of Texas anglers, catfish (i.e., channel catfish *Ictalurus punctatus*, blue catfish *I. furcatus*, and flathead catfish *Pylodictis olivaris*) ranked second only to black bass *Micropterus sp.* in terms of angler preference. Although popular among anglers, intensive management of catfish species in Texas is in its infancy. Existing data will need to be augmented in order to manage populations effectively. Age data provide perhaps the most valuable information to fisheries managers because they allow the estimation of growth, mortality, and recruitment. Unfortunately, the accuracy of past age estimates of Texas catfish is unknown because there was no quality control mechanism in place. Use of valid age estimation techniques alone does not guarantee accuracy; subjectivity associated with reader interpretation must also be assessed. To ensure accuracy of future age estimates, the Texas Parks and Wildlife Department uses an instructional DVD to train readers to correctly apply validated age estimation techniques and a digital video database of known-age reference otoliths to monitor accuracy. Digital video technology allows reference otoliths to be easily shared for training and testing purposes.

Keywords: catfish age

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## Analysis of flathead catfish population parameters using spine versus otolith age data

*Jolley\**, J.C. and P.C. Sakaris, Alabama Cooperative Fish and Wildlife Research Unit, Auburn University, Auburn, AL  
*E.R. Irwin*, USGS, Alabama Cooperative Fish and Wildlife Research Unit.

Modeling of fish populations requires knowledge of age-dependent population characteristics such as growth, mortality, and recruitment. Age data for catfishes are usually derived from pectoral spines or sagittal otoliths; however, spines have been shown to underestimate ages of older fish. We used otoliths and spine age flathead catfish *Pylodictis olivaris* from Alabama (native population) and Georgia (introduced population). We modeled various management regimes using otolith and spine derived age data to examine if aging techniques affected population assessment. Although simulation models did not indicate dramatic differences between techniques, population parameters derived from otolith-aged fish consistently indicated slower growth and higher longevity. In addition, both techniques illustrated potential for growth and recruitment overfishing at moderate levels of exploitation.

Age estimation error was greater in larger fish; several-fold estimate differences were apparent in number of preferred-size fish using spines versus otoliths. For the introduced population (faster growing fish), simulation models potentially overestimated numbers of large fish because age estimation error was related to length-at-age. Because aging bias appears to be related to growth rates, we recommend selection of an aging structure based on otolith-derived length-at-age data. In addition, we advise caution when comparing populations aged with different methods.

Keywords: flathead catfish growth age estimation population model management length-at-age

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### **Procedures for Back-calculating Length and Estimating Growth of Catfishes**

*Schramm\*, H.L., Jr. U.S. Geological Survey, Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi State, MS*

Measures of growth are pivotal to management of all fish species. This population variable can be measured with precision and accuracy, but incorrect procedures can result in invalid data for analysis. I evaluated several procedures for back-calculating length from spines for blue catfish *Ictalurus furcatus* and flathead catfish *Pylodictus olivaris* collected from the lower Mississippi River. Total length (TL) was linearly related to spine radius (SR) measured near the base of the spine in the basal recess region; SR measured in the anterior field provided a better fit (higher  $R^2$ ) with TL than SR measured in the posterior field. Slopes of the TL-SR relationship differed among years, and intercepts varied by 23 units for blue catfish and 46 units for flathead catfish. Back-calculating length by direct proportion is recommended. However, a Lee effect (back-calculated lengths smaller than actual) was apparent and increased as the time interval between capture and the growth year of length estimation increased. Estimating annual growth increment (interannuli distances) directly from spine measurements (i.e., without back-calculating fish length) appears to reduce the Lee effect.

Keywords: catfishes, back calculation, growth analysis

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## Angler-Related Issues

### Improving Survival of Tournament-Caught Largemouth Bass

Walters\*, A.R. and Schramm, H.L., Jr. Mississippi State University Department of Wildlife and Fisheries and Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi State, MS

Mortality of largemouth bass *Micropterus salmoides* was measured in six fishing tournaments on Mississippi and Alabama reservoirs during July--September 2004 to evaluate the effect of livewell conditions. We compared recommended livewell conditions (treatment), which required the regulation of water temperature, continuous aeration, and use of 0.5% salt in boat livewells, to customary livewell procedures (control) that employed the use of aeration, but did not include temperature regulation or the addition of salt. Initial, pre-release, and 5-day post-release mortality averaged 2.2%, 3.8%, and 62.8% for treatment livewells and 6.9%, 4.2%, and 75.9% for control livewells. No significant difference was detected in initial, pre-release or post-release mortality ( $\alpha=0.10$ ) between fish held in treatment livewells and those held in control livewells. In contrast to previous post-release tournament mortality studies, severe bacterial infections began on day three and contributed to the 5-day post-release mortality.

Keywords: largemouth bass *Micropterus salmoides* mortality fishing tournament livewell bacteria salt aeration temperature

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### Development of a Largemouth Bass Hooking Mortality Model

Wilde\*, G. R., and Pope, K. L. Wildlife & Fisheries Management Institute, Texas Tech University, Lubbock, TX

Hooking mortality of largemouth bass *Micropterus salmoides* is most affected by the location of hooking wounds and water temperature. We used results from hooking mortality trials conducted at six temperatures, ranging from 7 to 32°C, to develop a model for hooking mortality in largemouth bass. Largemouth bass were acclimated to the experimental temperatures and were hooked, by hand, in randomly chosen sites within the oral cavity. We used logistic regression to model effects of hooking location and temperature. Model results were validated by angling fish in small, outdoor pools, recording hooking location and water temperature, and then holding captured fish for 6 days to assess total hooking mortality.

Keywords: largemouth bass hooking mortality temperature model

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## **Angler Perceptions of Trophy Largemouth Bass at Sam Rayburn Reservoir, Texas**

*Anderson\*, D.K., Kleinschmidt Associates, West Columbia, SC  
Ditton, R.B., Texas A&M University, College Station, TX*

Historically, fisheries managers have viewed their angling clientele as a homogenous group and concentrated on producing outcomes based on this perception, i.e., a "one size fits all approach." Over the past twenty years, managers have come to realize that the angling population is not homogenous and have attempted to vary management strategies to cater to various segments of anglers. One method of segmenting anglers is based on specialization, or the commitment and avidity an angler feels toward fishing. This research focuses on how an angler's specialization level affects their perception of "trophy" largemouth bass at Sam Rayburn Reservoir, Texas. Specialization groups were formed and differences between groups were examined for their perception of trophy bass. Furthermore, perceptions of trophy bass were used to examine managerial preferences for the reservoir (e.g., implementation of a slot limit). The majority (67%) of anglers indicated that a trophy bass was over 10 lbs, and most (39%) ranked the current 14-inch minimum length limit as their first choice, with the slot limit being third (out of three choices). Managers can use the results of this research to better understand their clientele and their expectations of trophy bass.

Keywords: trophy largemouth bass, fisheries management, Sam Rayburn Reservoir, recreation specialization, human dimensions

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## **Discharge as a predictor of paddlefish harvest in Kentucky Lake on the Tennessee River**

*Scholten\*, G.S., Bettoli, P.B., and Sandrene, M.E., Tennessee Cooperative Fishery Research Unit, Cookeville, TN*

Paddlefish *Polyodon spathula* in Kentucky Lake, TN-KY are targeted by commercial fishers for their roe which is sold for caviar. Based on export permits and Tennessee harvest reports, Kentucky Lake is the largest paddlefish caviar fishery in the world. The collapse of Eurasian stocks of sturgeon and increased national and international demand for caviar has increased pressure on US paddlefish stocks. The amount of effort that commercial fishers expended targeting paddlefish in Kentucky Lake appeared to be dictated by the magnitude and patterns of discharge from Pickwick Dam, which forms the upstream boundary of Kentucky Lake. The objective of this study was to determine if river discharge could be used to predict paddlefish harvest. There was a significant inverse linear relationship between mean discharge and mean catch each week in the 1999, 2000, and 2001 commercial fishing season.

Discharge was high during the 2002 commercial season and the catch predicted by the model (4024 fish) was similar to the actual catch (4511 fish). If this model predicts harvest with similar accuracy during dry seasons it would provide timely information that could justify extending or shortening the commercial season in response to seasonal rainfall patterns and river discharge.

Keywords: paddlefish predict discharge effort validate

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### **Participation Patterns of Louisiana Resident Recreational Anglers: Habit or Logical Choice?**

*Holloway\*, H.A. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA*

It is sometimes assumed that the pool of licensed resident anglers in a state is a fairly constant body across time, with inflow of anglers who attain the minimum license age, and outflow of individuals who exceed the maximum license age, experience health problems, or die. The total number of Louisiana resident licensed anglers for license years 2001, 2002, and 2003 was fairly consistent at approximately 516,000, 497,000, and 499,000, respectively, seemingly supporting the above assumption. However, analysis of license data reveals that less than half of the licensed anglers in 2001 also purchased licenses in both 2002 and 2003, and 22% of the licensed anglers in 2003 had not held a license the prior year. These results indicate a much greater degree of turnover in the pool of licensed resident anglers than that suggested by the above assumption. This presentation analyzes the participation patterns of Louisiana resident anglers in 2001-2003, reveals significant differences between age groups, and explores possible factors influencing angling participation decisions.

Keywords: recreational anglers participation fishing license

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## Morone Ecology and Management

### **Estimation of relative striped bass *Morone saxatilis* egg production in the Red and Washita Rivers, Oklahoma**

*Robert G. Ryan and Jeff Boxrucker*

Lake Texoma, an impoundment of the Red and Washita Rivers on the Oklahoma-Texas border, supports one of only a few self-sustaining inland populations of striped bass *Morone saxatilis* in the country. Striped bass reproduce in both the Red and Washita Rivers. However, recruitment dynamics of the two rivers are poorly understood. Desalinization projects proposed for the upper Red River basin potentially threaten striped bass recruitment. The objective of this research was to estimate relative egg production in the Red and Washita Rivers in order to assess the contribution of each tributary to Lake Texoma striped bass recruitment. Gelatin flavor beads, used as striped bass egg surrogates, were released in known amounts and recaptured downstream to determine sampling efficiency at standardized sample sites. Gelatin flavor bead releases were conducted at variable flows. Measured efficiencies were applied to striped bass egg collections to make estimates of relative egg production. Capture efficiencies measured from gelatin bead recaptures in the Washita River averaged .131%. Red River capture efficiencies for discharge levels below 31 m<sup>3</sup>/s averaged .176% and efficiencies for discharge levels above 93.5 m<sup>3</sup>/s averaged .037%. Adjusted striped bass egg counts indicate greater egg production in the Washita River in 2001, 2002, and 2003.

Keywords: striped bass, Red River, Washita River, egg production, Gelatin Flavor Beads

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### **Larval striped bass distribution and abundance in Lake Texoma, Oklahoma-Texas**

*Schaffler, J. J.\* and Winkelman, D. L., Oklahoma State University, Oklahoma Cooperative Fish and Wildlife Research Unit, Stillwater, OK*

We sampled larval striped bass in the Red and Washita River arms of Lake Texoma during 2002 and 2003 using a conical plankton net 0.5 m X 2.0 m X 500  $\mu$ m mesh. All samples were preserved in 95% ethanol and returned to our lab for positive identification. During 2002, we collected 589 larval striped bass. Two hundred and fifty-two of these came from one sample on the Washita River arm. Overall, striped bass abundance appeared to be greater on the Red River arm during 2002. During 2003, we collected 25 larval striped bass. Most of these were collected on the Washita River. During both years, abundance appeared to increase with increasing discharge.

Keywords: striped bass larval abundance reservoir fish ecology

## **Fundamental thermal niche of adult landlocked striped bass**

*Bettoli\*, P.W. U.S. Geological Survey, Tennessee Tech University, Cookeville, TN*

Low hypolimnetic concentrations of dissolved oxygen (DO) in many reservoirs prevent striped bass *Morone saxatilis* from using cool waters they might prefer. In Melton Hill Reservoir in east Tennessee, fifteen adult striped bass were tagged with temperature-sensing radio tags and tracked for an average of 418 d in 1999-2000. Cold discharges from an upstream dam and heated discharge from a steam-generating electric facility near the midpoint of this mainstem reservoir provided a broad range of temperatures in most seasons and low DO habitats were uncommon. Thus, the influence of DO on habitat selection was reduced or eliminated in the current study. Mean temperatures occupied by striped bass varied seasonally and were highest in summer (17.3°C), intermediate in spring and fall (15.3 - 16.4 °C) and lowest in winter (12.4 °C). Between May and October 1999, the mean temperature occupied was 17.5 °C and 30% of the observations were between 9 °C and 15 °C. These data indicate that the fundamental thermal niche of landlocked striped bass is lower than literature estimates of ~20 °C. These results also represent the first unbiased field estimates of the influence of season on the thermal ecology of adult striped bass.

Keywords: striped bass temperature selection thermal niche

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## **Monitoring an Introduced Population of White Perch and its Effects on Native Sportfishes in Kaw Reservoir, Oklahoma**

*Kurt E. Kuklinski\*, Oklahoma Department of Wildlife Conservation (ODWC), Norman, OK*

White perch (*Morone americana*) entered Oklahoma via the Arkansas River system and were first discovered in Kaw Reservoir in 2000. Since then, the white perch population has been sampled at least three times annually with a variety of sampling gear. Summer and fall trap-netting and gill-netting have been effective for sampling white perch, while electrofishing has proven to be mostly ineffective. Catch rates of white perch have remained low since their introduction. Catch rates of white crappie (*Pomoxis annularis*) and white bass (*Morone chrysops*) have not changed significantly since the introduction of white perch. Analysis of stomach samples showed little similarity between white perch and either white crappie or white bass. Zooplankton accounted for 64% (by weight) of white perch stomach contents. This could result in competition with sub-adult white crappie and white bass. However, competition with white crappie and white bass adults is likely limited since white perch diets consisted of only 35% insects and 1% fish. No evidence of egg predation by white perch was observed.

Keywords: white perch, white crappie, white bass, non-native species, diet analysis.

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## **Factors influencing first year recruitment of striped bass in Lake Texoma**

*Mauck\*, M.D., and Winkelman, D.L. Oklahoma State University, Oklahoma  
Cooperative Fish and Wildlife Research Unit, Stillwater, OK*

Young-of-the-year striped bass were collected to determine whether size-selective winter mortality limits first year recruitment in Lake Texoma. We examined the relationship between length dependant patterns in growth, food habits, and lipid energy reserves. Rapid growth and increased lipid reserves were attributed to the early diet shift to piscivory. Preliminary analyses provide no evidence of asymmetric winter mortality of smaller individuals. The lack of prolonged exposure to suboptimal winter temperatures and the abundance of adequate prey items, support increased lipid content found throughout the winter. Mechanisms commonly shown to cause size-dependant winter mortality seem insignificant at this southern impoundment.

Keywords: striped bass recruitment lipid reserves mortality

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## Water Quality: Affects on Fish and Fisheries

### **The Occurrence and Impact of Largemouth Bass Virus on Largemouth Bass Populations and Fisheries in Alabama**

*Michael J. Maceina, and John M. Grizzle, Department of Fisheries, Auburn University, Alabama*

Throughout many impoundments in Alabama in the late 1990s, the abundance of memorable-size (> 2.27 kg) largemouth bass declined. The objectives of this project was to determine factors related to the reduction in memorable size fish in 6 reservoirs including the potential influence of largemouth bass virus (LMBV) on population characteristics. In these reservoirs, growth and survival rates of older fish (> 3 years old) declined in the late 1990s compared to the early to mid 1990s. Using these metrics, simulation modeling predicted a 3 to 16 fold decline in the production of memorable size fish between the early and late 1990s consonant with the amount of angler effort to catch these fish. In 2001-2002, fish infected with LMBV grew slower after age 3 and had lower relative weights. Highest prevalence of LMBV occurred in fish 250-400 mm TL, with much lower frequencies of LMBV observed in larger and older fish. However, because we sampled only fish left in the population (survivors), LMBV may have killed larger fish, which we could not sample. This evidence strongly suggested that LMBV was the primary cause for the reduction of memorable size fish in the late 1990s via lower growth, relative weight, and possibly survival. Since 2001, the prevalence of LMBV has declined, growth and survival rates have improved, and the abundance of memorable size fish has increased.

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### **Influence of angling and fish confinement on prevalence of largemouth bass virus**

*Beck\*, B.H., Grizzle, J.M., McClenahan, S.D., Department of Fisheries and Allied Aquacultures, Auburn University, Alabama*  
*Schramm, H.L. Jr., U.S. Geological Survey, Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi State, Mississippi*

Largemouth bass virus (LMBV) has been found in many populations of largemouth bass in the southeastern United States, but the effect of this virus on angling success and the effect of catch-and-release angling on LMBV infections are unknown. Largemouth bass were captured from three Alabama reservoirs by electrofishing and angling and then divided into two groups. One group was euthanized after capture and assayed for LMBV, and the remaining fish were transported to a fish hatchery and were held in raceways for up to 6 days. During this period, fish were collected periodically and tested for LMBV. The probability that a fish was infected with LMBV was not related to the method of capture. However, of the 170 fish tested after being held in the hatchery, 80.6% were LMBV positive, which is significantly greater ( $P < 0.05$ ) than the 12.5% that were positive ( $N=208$ ) on the day of capture. The

increased prevalence of LMBV infection could result from the virus spreading

between fish during confinement or from the virus increasing from an undetectable to detectable level. Further studies are needed to examine the transmission of LMBV, and the effects of confinement and handling and their role in initiating an LMBV epizootic

Keywords: tournaments iridovirus disease

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### **Electroshock-induced mortality of fish in waters of different conductivity**

*Henry\*, T.B., and Grizzle, J.M., Department of Fisheries Auburn University, Auburn, Alabama*

Water conductivity affects electric field characteristics and the ability to sample fish by electrofishing. In two experiments, each with three species of juvenile fish, the immediate mortality was determined after electroshock with 60-Hz pulsed DC (3 ms pulse width) in waters of different conductivity. For experiment 1, the peak applied power density was maintained constant (1.03-4.92 mW/cm<sup>3</sup> depending on species) over a range of water conductivities (10-1020  $\mu$ S/cm); and in experiment 2, the peak voltage gradient was maintained constant (2.5-8 V/cm depending on species) over the same range of conductivities. In each experiment, two statistical models were developed and compared to determine which better described the probability of fish mortality. The independent variables voltage gradient and current density were used in the first model, and transferred power density (based on the power transfer theory for electrofishing) was used in the second model. At constant applied power (experiment 1), models of fish mortality predicted that the highest fish mortality would occur at water conductivities of 65  $\mu$ S/cm for bluegill *Lepomis macrochirus*, 74  $\mu$ S/cm for largemouth bass *Micropterus salmoides*, and at 140-175  $\mu$ S/cm for channel catfish *Ictalurus punctatus*. At constant voltage (experiment 2), fish mortality increased with current density, which is directly related to water conductivity. Results indicate that electroshock-induced mortality of juvenile fish in waters of different conductivity can be predicted by the power transfer theory for electrofishing; however, fish mortality can be predicted as effectively with simpler models that include only voltage gradient and current density.

Keywords: electroshock electrofishing power-transfer conductivity mortality bluegill largemouth bass channel catfish

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### **Evaluation of fish assemblages in floodplain habitats of the Apalachicola River, Florida, relative to altered hydrology and restoration strategies**

*Walsh\*, S.J., W.B. Tate, and M.A. Burgess, U.S. Geological Survey, Gainesville, FL*

The Apalachicola River, Florida's largest river by discharge, represents the lowermost segment of the 50,777-km<sup>2</sup> Apalachicola-Chattahoochee-Flint (ACF) drainage, one of the major watersheds of the eastern Gulf of Mexico. Historically, the ACF drainage has been highly modified by reservoirs, sedimentation, altered flows, navigational dredging, and other land-use changes. The Apalachicola River also has one of the

most extensive forested floodplains of the eastern Gulf Slope, yet landscape-scale physical changes have elicited concern over the fate of aquatic habitats and communities associated with the floodplain. In an effort to assess relationships between hydrology, biological impacts, and prospects for restoration, we are examining fish communities and habitats of the forested floodplain. We report results of the first phase of this study, to characterize the fish fauna and habitat utilization in a central portion of the drainage within Florida. Using a variety of qualitative and quantitative sampling methods, we surveyed fishes in isolated and connected backwater habitats of the floodplain. Excluding light trap samples designed to target larval fishes, we collected a total of 53 fish species representing 38 genera and 19 families. Nearly 75% of all specimens were centrarchids, cyprinids, and clupeids, with numerical dominance limited to relatively few species. Among backwater habitats, large oxbow lakes and connected (continuously flowing) systems had the greatest diversity and abundance of fishes; small, disconnected sloughs had fewer species, yet these habitats were nevertheless important refugia where physicochemical conditions permitted. This project is supported by the Florida Fish and Wildlife Conservation Commission.

Keywords: Apalachicola River floodplain diversity assemblage hydrology restoration sedimentation dredging

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### **Relations between larval fish assemblages, hydrologic characteristics and water quality in floodplain sloughs of the Apalachicola River, Florida**

*Tate\*, W.B., Walsh, S.J., Gerwig, R.M., and Burgess, M.A. U.S. Geological Survey (USGS), Gainesville, FL*

We used light traps to collect larval fish in floodplain sloughs of the Apalachicola River, Florida. We collected more than 25,000 fishes from five slough regions, representing 15 families, 30 genera, and 45 species. Collection data were grouped by slough system and replicates within each system were clustered according to proximity to other traps. Diversity, number of fish, number of fish by family, and relative frequency of centrarchids was calculated for each system and cluster. Correlation analysis was used to determine associations with hydrologic condition, water quality, and distance from the Apalachicola River. Diversity was significantly related to temperature, pH, dissolved oxygen, and turbidity. The number of fish per trap was related to conductivity and dissolved oxygen. The numbers of fish representing some families were related to temperature, conductivity, dissolved oxygen, and turbidity. Additional exploratory tools (i.e. multivariate techniques) are planned to further evaluate associations between the biological and physicochemical parameters. Comparisons will also be made among slough systems to determine potential effects of restoration efforts on Apalachicola floodplain sloughs.

Keywords: larval fish, floodplain, restoration

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## **Long-term Changes in Fish and Macroinvertebrate Communities in the Conecuh River (Escambia County, AL)**

*Popp\*, K.J. and Bayne, D.R., Auburn University*

We examined long-term trends in water quality and lotic communities in the Conecuh-Escambia River near Brewton, Alabama. Our objective was to determine if point source pollution influenced lotic communities downstream from an urban area. Water quality, fishes, and macroinvertebrates were sampled at stations upstream and downstream of an urban area annually over 22 years during low-flow periods in late summer and early fall. We found significant differences in water quality variables between sites. The downstream site had higher biochemical oxygen demand (5-day), lower dissolved oxygen, higher ortho-phosphorus, higher nitrite-nitrogen, and higher total alkalinity. Macroinvertebrates were significantly more abundant at the downstream site. Significant differences were also found in fish communities between sites. The downstream site had higher total biomass of fishes along with higher abundance of lepisosteids and greater biomass of lepisosteids and centrarchids. By trophic composition, the affected site had significantly higher insectivore biomass followed by greater predator abundance and biomass. Higher insectivore biomass may result from greater abundance of invertebrate food items. Further, effects of increased macroinvertebrate abundance may travel up the food chain, resulting in higher predator abundance. Alterations in lotic community structure were attributed to nutrient enrichment resulting from point source pollution.

Keywords: river community fish macroinvertebrate long-term water quality

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## **Urbanization effects on Maryland Stream Communities**

*Morgan II\*, R. P., and S. F. Cushman, University of Maryland Center for Environmental Science - Appalachian Laboratory, Frostburg, MD*

Using 1995-1997 and 2000-2002 data from the Maryland Biological Stream Survey (MBSS), we examined changes in fish communities associated with urbanization, specifically in the Piedmont and Coastal Plain Provinces of Maryland. Each MBSS unit (~1,600 sites) was assigned to a class based on the degree of urbanization (0-10, 10-25, 25-50, 50-75, and over 75%) within its upstream watershed. Once classified, each site was examined for non-urbanization stresses, and the site was eliminated if other factors predominated (e.g. acid deposition, agriculture, etc.). Each fish community was then compared to the expected fish community within that physiographic province for that MBSS site. This set of analyses indicated that there are significant changes in fish communities in Maryland associated with urbanization

effects. The amount of impervious area and road density within a watershed appeared to be key factors for brook trout populations, as well as for other species. Overall, urbanization tends to eliminate intolerant fishes, resulting in fish communities heavily dominated by tolerant fishes. Conservation practices to minimize the impact of urbanization on fish communities may be inadequate to protect non-tolerant fishes, due primarily to the invasive nature of urbanization and loss of fish refugia within a watershed.

Keywords: MBSS Urbanization Fish Communities

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### **Delayed sexual development of western mosquitofish exposed to fluoxetine**

*Henry, T.B., and Black, M.C. Aquatic Toxicology Laboratory Department of Environmental Health Science University of Georgia, Athens, GA*

Pharmaceutical products can contaminate surface waters after their prescribed medical use and have the potential to negatively affect aquatic organisms. Fluoxetine (active ingredient in Prozac®) is a selective serotonin reuptake inhibitor (SSRI) used to treat clinical depression in human medicine and has been detected in surface waters at sub parts per billion concentrations. Disruption of serotonin dependent processes, including regulation of the thyroid axis, is possible in aquatic organisms following environmental exposure to fluoxetine. In several experiments, neonate western mosquitofish *Gambusia affinis* were exposed to aqueous fluoxetine (0.06-6000 ppb) and effects on survival (acute, 7 d; chronic 91-100 d), sex ratio, and time to sexual maturity were evaluated. Fish were exposed in 7-L glass aquaria or in 100-L plastic tanks. Fluoxetine HCl was acutely toxic, and the concentration estimated to kill 50% of exposed neonates within 7 d was 614 ppb. Chronic exposure to concentrations less than or equal to 60 ppb did not significantly affect survival or sex ratio; however, development of adult sexual morphology was significantly delayed (by 2-3 weeks) relative to control fish. Our results indicate that fluoxetine delays development of adult sexual morphology in western mosquitofish but not at concentrations that have been found in the environment. Mixtures of fluoxetine, other SSRIs, and their metabolites present in surface waters could lead to negative effects in aquatic organisms in the environment.

Keywords: SSRI selective serotonin reuptake inhibitors endocrine disruption toxicology development chronic exposure sexual morphology fluoxetine

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**Impacts of altered riverine thermal regimes on warmwater fish assemblages – the establishment of productive tailwater trout fisheries, but at what cost?**

*Julian D. Olden\**, and *N. LeRoy Poff*, and *Department of Biology, Graduate Degree Program in Ecology, Colorado State University, Fort Collins, CO*  
*Paul L. Angermeier*. *Virginia Cooperative Fish & Wildlife Research Unit, Virginia Tech, Blacksburg, VA*

Dams threaten the persistence of warmwater riverine fish populations by selectively releasing cold water aimed at establishing productive tailwater trout fisheries. Here, I present the results of a study conducted on the rivers Jackson and Cowpasture in the mid-Altantic highlands of Virginia where we examined the downstream recovery of fish assemblages to an altered thermal gradient below Gathright Dam, Jackson River, VA. The most apparent finding from this research is that the conversion from warmwater to coldwater tailwater habitats below Gathright Dam has resulted in significant losses to warmwater fish populations. Across all species, fish densities were 3 times lower in tailwaters of the Jackson River compared to the main channels of the Cowpasture River and individual species were found to exhibit differential responses to the altered thermal regime, largely reflecting species' thermal preferences. Biological characteristics at the level of individuals (length-mass relationships), species (presence, density) and assemblage (taxonomic, functional composition) also showed differential patterns of spatial recovery to increasing downstream water temperatures in the tailwaters. Results from this research will help focus future management and conservation efforts aimed at improving the thermal conditions in tailwater environments in order to ensure the long-term persistence of warmwater fish assemblages.

Keywords: warmwater fishes, dams, thermal regulation, fragmentation, tailwaters, Upper James River, Virginia

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## Fisheries Management

### **Diet and performance of stocked brown trout in five Tennessee tailwaters**

*Meerbeek\*, J. R., and Bettoli, P. W. Tennessee Cooperative Fishery Research Unit  
Tennessee Technological University, Cookeville, TN*

The performance of brown trout stocked into five Tennessee tailwaters was investigated from November 2002 to October 2003. Adult and fingerling brown trout stocked into these tailwaters received an adipose fin clip or a wire microtag. Fish in four tailwaters grew faster (7-23 mm and 7-36 g/month) and were more robust ( $W_r = 94-113$ ) in spring than in summer and fall (0.4-19 mm and 0-23 g/month;  $W_r = 86-97$ ); in a fifth tailwater the fish grew fastest in the fall. Growth and condition were unrelated to temperature and dissolved oxygen; however, stomach biomass and number of organisms per trout separately explained up to 54% of the variation in growth and condition. Instantaneous growth in weight ( $0.77-1.51 \% \cdot d^{-1}$ ) was greatest when brown trout consumed high proportions (70-99% by number) of cladocerans, ephemeropterans, and diptera pupae. In one tailwater, brown trout fingerlings stocked in the fall of 2002 were significantly larger on four dates in 2003 than adults stocked in the spring of 2003; instantaneous mortality rates were similar for both stocked cohorts. In that tailwater, stocking 75,000 fingerlings in the fall or 22,000 adults in the spring would yield 10,000 similar-sized fish by July 1 each year.

Keywords: brown trout, Tennessee, condition, instantaneous growth, diet

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### **Redeye bass movement and habitat use in an Alabama piedmont stream**

*\*Knight, J. R., Alabama Cooperative Fish and Wildlife Research Unit, Auburn  
University, Auburn, Alabama  
Irwin, E. R. USGS, Alabama Cooperative Fish and Wildlife Research Unit*

Redeye bass are a valuable resource in Alabama; however, management strategies are not developed because life history data are lacking. Our research describing life history characters of redeye bass includes movement and habitat use components. We radio tagged and tracked 12 redeye bass (August-October 2003) in a piedmont stream (Hillabee Creek, Alabama). Most fish were located between 5 and 20 times by triangulation and specific locations were determined using the null antennae method. Microhabitat variables were estimated in a 1-m area surrounding fish locations. Linear home range varied from 13.1m to 2,561m and was not related to size. Eight of eleven fish moved little, but two fish moved downstream and remained there during the study. Another fish moved downstream, but returned to its capture

location. Fish were associated with instream cover (75% of locations; e.g., boulders, undercut banks, or bedrock ledges). Also, fish used shallow water (61% of locations; <0.5m deep) with moderate velocities (56% of locations; <0.10 m/s) and coarse substrata (66% of locations; <20cm diameter). These telemetry data constitute the first for this species. Data will be used for development of a multivariate landscape model to predict quality streams and conservation areas for redeye bass in Alabama

Keywords: Radio Telemetry Redeye bass Habitat use

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### **A Change in Species Dominance of Crappie at Kentucky Lake**

*Rister\*, P.W., and Oster, R., Kentucky Department of Fish and Wildlife Resources (KDFWR), Murray, KY*

The crappie *Pomoxis spp.* population in Kentucky Lake, Kentucky, was sampled using trap nets for nineteen years (1985-2003). During this period, trap-netting data suggests that the density of black crappie *P. nigromaculatus* in the population increased. Prior to 1996, on average, black crappie comprised 20% of the age 1 crappie collected in trap nets. Since 1996, black crappie have accounted for 73% of the catch of age 1 crappie. This apparent shift in dominance comes several years after drought conditions affected the region. These conditions affected Kentucky Lake by increasing the retention time of water, which increased water clarity and the expansion of aquatic macrophytes. Though trap-netting data suggests a change in species dominance from white crappie *P. annularis* to black crappie, the harvest reported in creel surveys has not demonstrated this. Harvestable-size (254 cm) black crappie comprised 18, 68 and 64% of the trap netting catch in 1991, 1998 and 2003, respectively. During the same years, creel survey data indicated that black crappie comprised 16, 17 and 30% of the total numbers of crappie harvested by anglers. This shift in dominance, and the apparent inability of anglers to catch black crappie may be attributing to lower angler harvest of crappie at Kentucky Lake.

Keywords: White Crappie Black Crappie Kentucky Lake

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### **Movement Patterns and Habitat Use of Black and White Crappie at Kentucky Lake**

*Oster, R.A., and Rister, P., Kentucky Department of Fish and Wildlife Resources (KDFWR), Murray, KY*

Trap net data collected from 1985-1996 showed that harvestable-size (254 cm) black crappie *Pomoxis nigromaculatus* comprised <20% of the crappie population in Kentucky Lake. From 1997-2002 black crappie abundance increased and now accounts for 73% of the crappie population. Corresponding increases in angler catch of black crappie, however, has not occurred. To educate anglers and increase utilization of black crappie, we radio-tagged and tracked 30 white crappie *P. annularis* and 32 black crappie from March–July 2003 to define and differentiate movement patterns and habitat use of black and white crappie. Pre-spawn black

crappie preferred shallow (<2 m) inundated mudflats while white crappie selected for deep-water (>4 m) ledges and flats along the river channel. Strong migrations toward spawning areas by both species were correlated with a rapid rise in lake elevation and surface water temperature. During post-spawn, white crappie were found inhabiting areas of significantly greater water clarity than black crappie. Surface water temperature did not differ between locations of black and white crappie throughout the study. Telemetry data suggests that anglers must fish shallower than normal, especially during pre-spawn, to take advantage of the increased abundance of black crappie at Kentucky Lake.

Keywords: White Crappie Black Crappie Kentucky Lake Telemetry

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### **Accuracy and Precision in Aging Crappie (*Pomoxis spp*): An Analysis Using Known Age Fish**

*Ross\*, J.R., Crosby, J.D, and Kosa, J.T., Kentucky Department of Fish and Wildlife Resources, Frankfort, KY*

Previous studies comparing the validity of otoliths and scales for use in aging black and white crappie lack a common trait; the ability to determine aging accuracy through the use of known-age fish. In this study, a known-age reference collection was used to determine both accuracy and precision of ages estimated from scales and otoliths collected from crappie in Kentucky. Four readers (two experienced and two inexperienced) estimated ages using pressed scales and whole otoliths from approximately 250 age-1 to age-5 fish of each species. Aging accuracy for black crappie otoliths averaged 99.6% while scale accuracy was 77.6%. White crappie otolith accuracy averaged 98.5% while scale accuracy was 80.4%. A difference in aging accuracy between inexperienced and experienced readers was evident for both species and was more pronounced with scales. Aging precision, calculated as the coefficient of variation (CV); was higher for otoliths of both species when compared to scales. Aging precision and aging bias also varied between inexperienced and experienced readers. Through the use of known age fish, our aging accuracy and precision data further strengthens the argument for use of otoliths as the recommended aging structure for crappie in mid to southern latitudes.

Keywords: crappie aging precision accuracy otoliths scales white black

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### **Validation of a Model Predicting Crappie Response to a Length Limit**

*Racey\*, C.L., S.E. Lochmann, University of Arkansas at Pine Bluff, and J.M. Carlson, U.S. Fish and Wildlife Service*

An equilibrium yield model was used to evaluate a 254-mm minimum length limit for crappie *Pomoxis spp.* in Lake Chicot, Arkansas. The trends predicted by the model were compared to trends observed up to eight years after implementation of the length limit. The model predicted an increase in population abundance with and without a length limit, but predicted no changes in preferred or memorable relative

stock densities. Contrary to the model, rotenone data from before and after the implementation of the length limit indicated no change in population abundance. Size structure of the population did not change and was not significantly different than the size structure predicted by the model. The model appears to be more useful in predicting trends in size structure than population abundance. The length limit on crappie in Lake Chicot has not affected population abundance or size structure, most likely because of low exploitation and high recruitment variability.

Keywords: crappies model length limit rotenone

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### **Exploitation of Largemouth Bass in Wheeler Reservoir, Alabama and Simulated Effects of Minimum Length Limit Regulations**

*Michael P. Holley\*, Jeffrey W. Slipke, and Michael J. Maceina, Department of Fisheries, Auburn University, AL*

A nearly 16-fold decline in the catch rate of large (> 2.27 kg) largemouth bass *Micropterus salmoides* was observed in Wheeler Reservoir, Alabama over the past 10 years. The objectives of this study were to estimate the exploitation rate of largemouth bass and compare predicted population responses from simulated minimum length limit regulations. Exploitation was seasonal, with most of the harvest occurring during the spring. Four-month exploitation estimates adjusted for tag loss and angler non-reporting ranged from 15 to 23% in spring 2001, and from 10 to 15% in spring 2002. No fish were reported as harvested in the first four months following tagging in October 2002. Simulation modeling predicted that a 406 mm minimum length limit could potentially double the percent of a cohort that would recruit to 508 mm (approximately 2.27 kg), compared to a 305 mm minimum length limit. However, nearly half as many fish were predicted to recruit to the legal fishery with the 406 mm limit, compared to a 305 mm limit. Our results have implications for largemouth bass management in reservoirs that have a substantial contingency of tournament anglers. Restrictive length limits have the potential to increase the abundance of trophy length fish in a population, but at the cost of restricting the number of fish available for anglers to catch and weigh-in at a tournament.

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### **Results of Stocking Blacknose Crappie in Four Florida Lakes**

*Hale, M., Florida Fish and Wildlife Conservation Commission (FWCC), Eustis, FL*

Black crappie are seldom stocked in Florida water bodies, and when stocked, are typically left unmarked. To determine stocking effectiveness, we needed an easy, inexpensive mark for a large number of fish. Crappie with a black pre-dorsal stripe have been stocked in Tennessee for years and satisfied the requirements of an identifiable, inexpensive mark. Between 1998 and 2000, approximately 142,650 blacknose crappie (mean total lengths 70mm to 54mm) from Tennessee were stocked in four Florida lakes that ranged from 19-1,026 ha in area. Crappie populations were sampled by trawl, electrofishing and hoop nets, and a creel survey was conducted for two seasons on one lake. Forty-two blacknose crappie were

captured with the trawl, which accounted for 75% of those caught. A total of 522 blacknose crappie were observed during the two creel surveys, making the creel the most effective way to evaluate stock effectiveness. Stocking effectiveness could not be determined on three of the lakes. Cormorants decimated the sport fisheries on the two smaller lakes while poorly conditioned fish and high mortality impacted our study on the largest lake. The only time that a large number of healthy fish were stocked in a lake not impacted by cormorants resulted in stocked fish composing 20% of the angler harvest two seasons later. It appears that stocked crappie can compose a sizeable percentage of the angler harvest in Florida when stocked under favorable conditions.

Keywords: crappie, blacknosed crappie, stocking

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### **An Evaluation of Supplemental Stocking of Largemouth Bass in Pools of the Arkansas River**

*Heitman\*, N.E., C.L. Racey, and S. Lochmann*

Concerns about a diminishing largemouth bass *Micropterus salmoides* population in the Arkansas River were voiced by tournament and recreational anglers. In June 2002, the Arkansas Game and Fish Commission stocked 50,000 hatchery-reared, oxytetracycline- (OTC) marked largemouth bass (mean TL = 45 mm) into each of two pools (five and nine) of the Arkansas River as one response to the public's concerns. We evaluated the contribution of stocked fish to the 2002 year class in September 2002 and May 2003 by examining otoliths for the presence of an OTC mark. Initial results indicate stocked fish contributed 15% and 22% in pools five and nine in fall 2002 and 13 % in both pools in spring 2003. There was no significant difference between mean lengths for OTC marked and wild largemouth bass for either pool in the fall or spring. However, the 2002 year class largemouth bass (OTC marked and wild) were significantly longer in pool nine than pool five in both fall (183 mm vs. 172 mm,  $P = 0.02$ ) and spring (211 mm vs. 184 mm,  $P = 0.001$ ). Results of this study indicate that stocking might be a viable management technique to supplement natural recruitment in the Arkansas River and should be further evaluated.

Keywords: Largemouth bass stocking oxytetracycline fingerlings river

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## Population/Fishery Assessment

### Criteria and Objectives for Assessing White Bass Populations in Missouri's Large Reservoirs

*Colvin, M.A., Missouri Department of Conservation*

A method of assessing white bass *Morone chrysops* populations sampled with gill nets during fall in Missouri's large reservoirs was developed by establishing criteria and objectives for population parameters of growth, size structure, and age structure. Objectives for growth – defined as the mean lengths of age-1 and -2 white bass in fall – are 300 mm and 350 mm, respectively, in reservoirs where gizzard shad *Dorosoma cepedianum* are the primary prey, and 330 mm and 380 mm in reservoirs where threadfin shad *D. petenense* are the primary prey. Objectives for size and age structure were determined by modeling population structures of white bass using acceptable growth and moderate total annual mortality rates (about 40-50%). Objectives ranges for size structure – percentages of ages-1 and older white bass that exceed 300 mm and 380 mm – are 65-85% and 5-25%, respectively, for gizzard shad prey reservoirs, and 80-100% and 30-50% for threadfin shad prey reservoirs. Objective ranges for age structure – percentage of ages-1 and older that are also ages-4 and older – are 10-20% for all reservoirs. Using these criteria and objectives, fishery managers can assess the status of their white bass populations and determine problem areas when populations consistently fail to meet objectives.

Key Words: White bass, Population assessment

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### Detection probability models for selected fishes in the Mobile River basin, AL

*Hayer\*, C.A. and Irwin, E.R. Alabama Cooperative Fish and Wildlife Research Unit, Auburn, AL*

The Mobile River basin spans broad ranges of physiographic settings and harbors exceptionally high levels of species richness and endemism. This provides ideal opportunities for testing and refining approaches to predict species occurrences and community attributes in relation to physical variables. Distributional data are needed, especially to evaluate the potential need to protect species. Stream and/or watershed characteristics such as elevation, size, gradient, land use, and position in the system can affect species distributions or occurrence. In addition, detection of species at a given site can vary based on factors such as, sampling error, local extinction rates, habitat or time-of-year. We are calculating detection probabilities for over 60 species of fish to use in distributional models. Fish were collected monthly from four sites in the Mobile River basin using barge electrofishing. Five specific habitat types were sampled and included shallow-slow, shallow-fast, deep-fast, shallow-coarse, shallow-cover habitats. Detection probabilities were estimated

for each species based on presence/absence data using the patch occupancy model in Program MARK. Initial results indicate differences in detection probabilities among species and sites. For some species, habitat did not affect probability of detection, but time of year was important. We recommend incorporating detection probabilities when conducting population assessments.

Keywords: Mobile River basin, presence/absence data, detection probabilities, habitat

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### **A Population Dynamics Model for Prairie Stream Fishes Using Emerald Shiner as a Test Species**

*Durham\*, B. W., and Wilde, G. R., Wildlife & Fisheries Management Institute, Texas Tech University, Lubbock, TX*

The emerald shiner *Notropis atherinoides* is widely distributed throughout the central and eastern U.S. and is a common member of fish assemblages in prairie streams and rivers. Using published life history information, we developed an age-structured population model for emerald shiner. Sensitivity analyses showed that population dynamics were most influenced by survival of age-0 individuals and reproduction by age-1 individuals. To test the utility of the model, we used the long-term data set assembled by Jimmie Pigg on the Canadian River, Oklahoma during 1977 to 1995. We assumed that survival of age-0 individuals was regulated by stream discharge. There was no simple correlation between stream discharge and observed ( $r^2 = 0.01$ ,  $p = 0.65$ ) or predicted ( $r^2 = 0.01$ ,  $p = 0.68$ ) emerald shiner abundance. However, our model, which accommodates variation in stream discharge, accurately predicted trends in emerald shiner population dynamics ( $r^2 = 0.91$ ,  $p < 0.0001$ ). Our model suggests that emerald shiner population dynamics are affected by stream discharge, but that multiple years characterized by high, or low, discharge have a greater effect than single high or low discharge years. Preliminary models for other species suggest this approach is applicable to a variety of prairie stream fishes.

Keywords: population dynamics model stream-discharge emerald shiner

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### **The elephant in the living room: an evaluation of multi-pass electrofishing for estimating stream-dwelling fish abundance**

*Peterson\*, J.T. and Conroy, M. J., U.S. Geological Survey, Georgia Cooperative Fish and Wildlife Research Unit, Athens GA*  
*Thurow, R.F., U.S. Forest Service, Rocky Mountain Research Station, Boise, Idaho*

Multi-pass electrofishing removal methods are commonly used to estimate the abundance of stream-dwelling fish. However, recent studies suggest that traditional removal estimators, such as the Zippin and generalized removal methods, are inadequate for estimating stream fish abundance. We evaluated the efficacy of traditional removal methods for estimating fish abundance by comparing estimates of capture efficiency from multi-pass removal estimates to capture efficiencies

measured by the recapture of known numbers of marked individuals. On average, the removal methods overestimated capture efficiency by 39% and underestimated fish abundance by 88%. The overestimates of efficiency and underestimates of fish abundance were related to stream habitat characteristics, fish species, body size, and the number of removal passes. Further analysis indicated that the removal estimate biases were due to considerable decreases in capture efficiency (mean 1.71 times lower) with successive passes. Traditional removal estimators cannot account for this time-varying heterogeneity in capture probabilities. We propose and evaluate alternative modeling approaches to estimating stream-dwelling fish abundance that can account for potential time-varying heterogeneity.

Keywords: removal methods, sampling bias, abundance estimation

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### **Evaluation of Smallmouth Bass Populations in Abrams Creek and Little River Within Great Smoky Mountains National Park**

*Gregory P. Shaffer\* and S. Bradford Cook Biology Department Tennessee Technological University Box 5063 Cookeville, TN 38505*

Smallmouth bass *Micropterus dolomieu* were sampled during summers 2002 and 2003 from two streams within Great Smoky Mountains National Park (GSMNP), Little River (freestone stream) and Abrams Creek (limestone stream), to determine age and growth, size structure, abundance, mortality, and recruitment for smallmouth bass within GSMNP. Smallmouth bass were sampled using visual observation and electrofishing. Growth rates in Abrams Creek and Little River were significantly different ( $P < 0.05$ ). von Bertalanffy growth curves predicted smallmouth bass in Abrams Creek would reach 305 mm (12 inches) in 6.7 years and reach the same length in Little River in 8.1 years. Proportional stock densities of smallmouth bass in Abrams Creek and Little River were 10% and 13%, respectively. Summer 2003 population estimates averaged 250 bass/ha (22.5 kg/ha) in Abrams Creek and 46 bass/ha (4.5 kg/ha) in Little River. Total annual mortality for ages II to VII was 43% in the Abrams Creek population and 28% in Little River's population. Recruitment variability was 47% and 94% in Abrams Creek and Little River, respectively. When compared to other streams in Tennessee, smallmouth bass in Abrams Creek and Little River exhibited slower growth and possessed a lower abundance of quality size and larger bass, yet had similar mortality and recruitment rates.

Keywords: Great Smoky Mountains National Park smallmouth bass population dynamics electric seine

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## **Abundance, Growth and Mortality of Suwannee Bass, *Micropterus notius*, in Four Florida Rivers**

*Timothy F. Bonvechio\* and Micheal S. Allen, University of Florida, Department of Fisheries and Aquatic Sciences, Gainesville, Florida*  
*Richard L. Cailteux, Florida Fish and Wildlife Conservation Commission, Quincy, Florida*

The Suwannee bass, *Micropterus notius*, is considered a species of special concern due to its small native range in north Florida and south Georgia. Unlike most black basses, growth and mortality of Suwannee bass have not been estimated. Suwannee bass were collected by electrofishing in the Ochlockonee, Santa Fe, Wacissa and Withlacoochee Rivers of Florida. Electrofishing catch-per-unit effort of Suwannee bass was highest in the Wacissa River and lowest in the Ochlockonee River. Growth and total annual mortality (A) data were compared among the four populations. Mean total length (TL)-at-age across the four populations was described by von-Bertalanffy growth curves as  $TL = 386.1 (1 - e^{-0.3733[\text{age} + 0.7772]})$  for females and  $TL = 324.1 (1 - e^{-0.4735[\text{age} + 0.6543]})$  for males. ANCOVA revealed Suwannee bass exhibit sex-specific growth rates similar to largemouth bass, *M. salmoides*, with females exhibiting more rapid growth and obtaining larger sizes than males, respectively ( $P = 0.001$ ). Suwannee bass total annual mortality (A) averaged 40% and ranged from 28% to 46%. The current Florida length limit on Suwannee bass directs fishing mortality almost solely to females but estimates of fishing mortality and sex-specific mortality rates are needed to determine if a problem exists.

Keywords: Suwannee Bass Abundance Growth Mortality

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## **Inland Fisheries Information Systems in Texas**

*Janssen\*, F.W., Texas Parks & Wildlife Department, Austin, TX*

The Inland Fisheries Division of the Texas Parks and Wildlife Department (TPWDIF) is a data-rich organization responsible for managing the freshwater aquatic resources of Texas. A statewide inventory of databases in 1998 identified 85 unique types of data used regularly by TPWDIF staff. Those databases and applications were developed as stand-alone systems located at district fisheries management offices or hatcheries to analyze fish population or production data. While those systems quickly answered questions at the local level, aggregating the data at a statewide level required a considerable amount of time and maintenance to make it useful for researchers and managers. The need for collections of real-time, accurate became more important for planning and dealing with resource management issues. As technology matured, particularly the Internet, the infrastructure was in place to develop intranet-based applications accessible to TPWDIF staff statewide. Today the

data identified in the 1998 inventory are all part of a relational database management system which serves information via a web browser using Microsoft .NET web services. This system has reduced maintenance, prevented duplication of effort, streamlined processes significantly, and made data available which was previously inaccessible. Transforming the data into decision-making information has been a high priority for TPWDIF, which employs three full-time programmers, two database administrators, and a webmaster.

Keywords: Internet data information systems

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### **Sample size requirements for estimating mean length-at-age, von Bertalanffy growth parameters, and age structure of largemouth bass populations**

*Buckmeier, David L., and Schlechte\*, J. Warren, Texas Parks and Wildlife Department - Inland Fisheries Research, Ingram, TX*

Inadequate sampling wastes time and resources; more problematic, data obtained can be misleading. We estimate the numbers of fish needed for mean length-at-age (MLA), von Bertalanffy growth parameters, and age structure of largemouth bass *Micropterus salmoides* using a two-phase stratified subsampling design. We used data from Weiss Reservoir, Alabama, B. Everett Jordan Reservoir, North Carolina, and Sam Rayburn Reservoir, Texas to estimate growth and survival, then created simulated populations for each reservoir. Using the simulated populations, we investigated three initial sample sizes (N=100, 200, and 400), and four subsampling strategies for aging (5 fish per each 25-mm stratum, 5 per 10 mm, 10 per 10 mm, and 15 per 10 mm). We repeated each sampling scenario 500 times to provide estimates of precision. Initial samples of 200, subsampled at 5 fish per 10 mm yielded adequate estimates (80% Confidence Intervals < 25 mm) of MLA through age 3. Accurate estimates (95% Confidence Intervals < 25 mm) of MLA, von Bertalanffy growth parameters, and age structure required a minimum of 400 fish in the initial sample; subsampling rates required a minimum of 5 fish per 10 mm. Precision of age data for fish above age 3 was poor regardless of sampling design. To collect data for older fish, it will either be necessary to collect larger initial samples or to alter the techniques of collecting or processing samples. We are investigating other techniques.

Keywords: Age, simulation, growth, survival, largemouth bass

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## **Assessment of gear adequacy for sampling fish communities in Oklahoma oxbow lakes**

*Reasor\*, J.A., and Patton, T. Department of Biological Sciences, Southeastern Oklahoma State University (SOSU), Durant, OK*

The fish communities and limnological characteristics of oxbow lakes in Oklahoma and elsewhere are poorly understood. We are currently examining physical, biological and chemical characteristics of oxbow lakes in southeastern Oklahoma, and comparing these characteristics to those of similarly-sized man-made reservoirs within the same physiographic regions. In this study, we specifically addressed the sampling effort needed to adequately assess the fish community in oxbow lakes. We sampled three oxbow lakes in three different mid-order drainages using gill nets (2 net-nights each), hoop nets (2 net-nights each), and boat electrofishing (six 5-minute samples). Gillnetting was time consuming and resulted in high mortality rates, but was effective at capturing fish regardless of turbidity. Hoop nets had low catch rates and resulted in the capture of primarily sunfish (*Lepomis spp.*) and crappie (*Pomoxis spp.*). Boat electrofishing required less time than either of the other two gears, had high catch rates and low mortality, but was strongly affected by turbidity. In conclusion, hoop nets poorly represented the overall fish community, but were effective at sampling the panfish community. Gill nets and electrofishing resulted in similar fish community interpretations, but gill netting, while more time-consuming, was more effective than electrofishing in turbid waters. Because water clarity varies widely in oxbow lakes, we recommend a sampling protocol that utilizes both gill netting and electrofishing to assess fish communities in southeastern Oklahoma.

Keywords: Oxbow lake electrofishing gill nets hoop nets turbidity

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## **Status of Paddlefish in the Ozark Pool of the Arkansas River**

*Quinn\*, J.W., R. L. Limbird, F. J. Leone, and P. M. Gaulin, Arkansas Game and Fish Commission, Little Rock, AR*

We studied population characteristics of paddlefish (*Polydon spathula*) in the 4,071-ha Ozark Pool of the Arkansas River during a commercial fishing moratorium. We used large-mesh gill nets (5-, 6-, and 8-inch bar mesh) to sample paddlefish from November 2002 to March 2003. We captured 1,066 unique paddlefish and recaptured 75. Fish were measured for eye-to-fork length, and marked with individually numbered jaw tags. Fish were sampled during three time periods, November-December, January-February, and March-April. A high flow event occurred on March 18th that prompted us to end the study for the year. Using the Schnabel

multiple-census estimator, a preliminary estimate of the recruited population is 5,025 fish with 95% confidence interval of 4,505-5,681. Mean catch per unit effort of paddlefish was 2.3 fish/108 m<sup>2</sup> of webbing/24 hours. Catch per unit effort was greatest near the full moon of each month. About 50% of the paddlefish captured were greater than the 36-inch minimum length limit, and length frequency distributions were very similar for 5- and 6-inch bar mesh.

Keywords: Paddlefish Arkansas River

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### **Characterization of floodplain lake fish assemblages in the Lower White River, Arkansas**

*Lubinski\*, B.J., University of Arkansas-Pine Bluff (UAPB), Jackson, J.R., Arkansas Tech University (ATU), and Eggleton, M.A., UAPB*

The lower White River, Arkansas represents one of the least altered river-floodplain ecosystems (RFE) in the United States. The lower White River floodplain encompasses approximately 75,880 ha of bottomland hardwood forest that contains over 300 lakes scattered throughout public and private lands. River regulation including irrigation and navigation channel projects threaten to alter the natural hydrology of the lower White River RFE. The objective of this research was to examine relationships between fish communities and environmental variables associated with river/lake morphology and flooding regimes in lower White River floodplain lakes. Fish communities were sampled by experimental gill nets, mini-fyke nets, and night-time electrofishing during the summer and fall of 2002; environmental variables were measured concurrently. Multivariate direct gradient analyses suggested that lake depth, lake surface area, and distance to the main river channel were most important in the structuring of fish communities in lower White River floodplain lakes. We believe the degree to which fish communities are structured along variables associated with river regulation may help guide river management and species conservation efforts. This project also helps define baseline conditions for temperate-zone RFEs and assess empirical fish-environment relationships prior to alteration in the lower White River.

Keywords: White River, floodplain, floodplain lakes, fish communities, assemblages, multivariate analysis

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## Habitat

### **Utilization of select dredged holes within the Tampa Bay estuary, Florida by fishes and macrocrustaceans, and the associated user groups of these resources**

*Sherwood, E.T., McMichael, R.H., Matheson, R.E., and Heagey, R.F.*

In the Tampa Bay estuary, Florida, navigational channels are routinely maintained by dredging, but options for disposal of dredged material are limited. One proposed option is to use dredged material to fill in or partially fill existing dredged holes and thereby create the potential for new shallow-water habitats. Little is known, however, about the value of existing dredged holes to fish and macrocrustaceans in the Tampa Bay estuary. Through a co-operative agreement with the Tampa Bay Estuary Program, the Fisheries-Independent Monitoring Program of the Florida Fish and Wildlife Conservation Commission's Florida Marine Research Institute has been studying the fish and macrocrustacean communities commonly found in 10 subtidal dredged holes and 1 upland borrow pit in Tampa Bay since October 2002. Preliminary results indicate apparent differences in fish and macrocrustacean community structure inside versus outside the dredged holes. In general, dredge-hole habitats contained more species and a greater abundance of many species than do other nearby habitats. Furthermore, a variety of fisheries species were identified as using the dredge-hole habitats, and local fishers targeting these species often fished in and around the dredged holes.

Keywords: dredged hole, borrow pit, fisheries community, dredging

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### **Rehabilitating Urban Streams Saves Habitat and Money**

*Steve Filipek, Arkansas Game and Fish Commission, Little Rock, AR*  
*James Ahlert, Arkansas Game and Fish Commission, Russellville, AR*  
*Darrell Bowman, Arkansas Game and Fish Commission, Mt. Home, AR*

A city's 404 permit application to channelize and concrete a low order warmwater stream running through town keyed the US Army Corps of Engineers to contact the AGFC's Stream Team to review the city's plan. An Arkansas River Valley ecoregion stream's had been modified by road construction and was eroding several backyards causing the mayor to hire an engineering firm to rectify the problem. The firm's plan called for channelizing the stream and making it a concrete trapazoid, devoid of fish and wildlife habitat. The Stream Team surveyed the stream and developed an alternative bioengineering plan utilizing vortex weirs, log cribs, grading, matting and revegetating exposed stream banks, and some rock armoring. This plan was

presented to the mayor, town council, engineering firm, and a neighborhood group as a more natural alternative keeping the stream's current sinuosity, aquatic habitat, and riparian habitat intact. The resulting rehabilitation work cost \$30,000, which was \$70,000 less than the original price tag. The engineering firm has begun utilizing this design on other projects as well.

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### **Streambank Stabilization to Save a Bridge**

*Evans\*, D.A. Arkansas Game & Fish Commission*

Significant streambank destabilization has many negative impacts on the environment. It can lead to the loss of riparian habitat, productive farmland and aquatic biodiversity through sedimentation. Elevated sediment loads increase water purification costs and shorten reservoir life spans. Rapidly moving cut banks can threaten or damage manmade structures in short periods of time. The potential loss of significant infrastructure often calls for the use of unusual stabilization techniques. There are a variety of techniques available to stabilize eroding streambanks. Some of these techniques have a long, proven history, and others are relatively new and untried. One of these "new" techniques was utilized on an Ozark Mountain stream to help prevent the loss of a new bridge. By using very large rocks, gravel and the construction of a new channel, the stream was redirected to a more advantageous approach to the bridge. This project saved the county a significant amount of money and the local residents a major inconvenience. It also curtailed the future introduction of many tons of sediment into the local aquatic system.

Keywords: streambank stabilization

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### **Seasonal use of small tributaries by juvenile smallmouth bass in the New River Gorge National River, West Virginia**

*Welsh\*, S.A., and Wellman, D.I. U.S.G.S., WV Cooperative Fish and Wildlife Research Unit*

Smallmouth bass support an important recreational fishery in the New River Gorge National River. Trophy-sized catches of smallmouth occur commonly within the New River Gorge, and recent regulations have changed a section of the river to catch and release. An understanding of habitats of juvenile smallmouth in the New River Gorge has several important management implications, including juvenile survival and recruitment to the fishery. During a study of impacts of July 2001 floods in the New River gorge, we sampled fishes from flood plain sections of 12 tributaries during five seasonal periods (fall 2001, spring 2002, summer 2002, fall 2002, and spring 2003). This study focused on post-flood recolonization of fishes, but also documented seasonal use of tributaries by juvenile smallmouth bass. High gradients, flood impacts, drought conditions, and seasons influenced use of tributaries by juvenile

smallmouth, but highest abundances of smallmouth occurred during fall. Juvenile smallmouth bass likely used small tributaries to avoid predation risks associated with riverine habitats. This research supports the importance of connectivity between small tributaries and large rivers, and indicates that small tributaries provide important refuge habitats for juvenile smallmouth.

Keywords: smallmouth bass *Micropterus dolomieu* juveniles tributary habitats New River West Virginia

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### **Population Characteristics of Largemouth Bass Associated with Changes in Abundance of Submersed Aquatic Vegetation in Lake Seminole, Georgia**

*Steve M. Sammons, Department of Fisheries, Auburn University, AL*  
*Michael J. Maceina, Department of Fisheries, Auburn University, AL*

Population characteristics of largemouth bass *Micropterus salmoides* including growth, body condition (relative weight), size structure, and survival were examined in relation to abundance of submersed aquatic vegetation (SAV) coverage (primarily hydrilla *Hydrilla verticillata*) in three embayments of Lake Seminole, Georgia and compared to a previous study. Plant coverage changed little in the Chattahoochee River arm and slightly increased in the Flint River arm from 1998 to 2002. Hydrilla was reduced in Spring Creek beginning in 2000 by a drip-delivery fluridone system; SAV coverage declined from 72% in 2000 to 22% in 2001. Growth of age 1-3 of largemouth bass was higher in Spring Creek than in the other embayments and overall growth rates up to age 10 predicted from von Bertalanffy models were higher in the Spring Creek and Chattahoochee River embayments than in the Flint River embayment. Relative weights of largemouth bass were highest or ranked highest in Spring Creek for all but the largest size group. Quarterly samples beginning in August 2000 indicated that relative weight of largemouth bass was similar between the Chattahoochee River arm and the Spring Creek arm until August 2001, when relative weight of largemouth bass up to 500 mm became greater in Spring Creek. Annual survival of fish ranked highest in Spring Creek and lowest in the Chattahoochee River arm. Relative weights were inversely related to changes in SAV and were similar between 1998 and 2003 in the Chattahoochee River arm, and lower in 2003 in the Flint River for smaller fish. Relative weights of all sizes of largemouth bass in Spring Creek were higher in 2003 than in 1998 after SAV were reduced. Growth was similar between years in the Flint and Chattahoochee River arms, but growth increased significantly in 2003 for all ages of fish in Spring Creek after SAV declined. Mean annual survival in all reservoir arms decreased from 78% in 1998 to 55% in 2003. Abundance of SAV continues to be a strong structuring factor determining largemouth bass population characteristics in Lake Seminole. Our study demonstrates that large benefits in growth and condition of largemouth bass can result from large-scale treatment of SAV in heavily vegetated reservoir systems.

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## **The effect of a large-scale habitat manipulation on age-0 centrarchids**

*Strakosh\*, T.R., Kansas Cooperative Fish and Wildlife Research Unit, Division of Biology, Kansas State University, Manhattan, KS*  
*Gido, K.B., Division of Biology, Kansas State University, Manhattan, KS*  
*Guy, C.S., Montana Cooperative Fishery Research Unit, Department of Ecology, Montana State University, Bozeman, MT*

Many Kansas reservoirs are currently experiencing a decrease in sportfish production characteristic of the aging processes that occur in impounded systems. Water willow *Justica americana* was planted for littoral zone habitat enhancement to aid in the recruitment of age-0 largemouth bass *Micropterus salmoides* and *Lepomis spp.* The main objective of this study was to test if water willow can benefit age-0 largemouth bass and *Lepomis spp.* During 2001, 2002, and 2003 monthly samples were collected between June and August from three Kansas reservoirs. A 149 m<sup>2</sup> enclosure was sampled using multiple-pass electrofishing. Habitat and physiochemical variables were measured inside the enclosure. Otoliths were removed from age-0 largemouth bass for aging to estimate growth rates. A stepwise linear regression was conducted investigating the effects of habitat variables on age-0 largemouth bass and *Lepomis spp.* densities. The amount of variance in age-0 largemouth bass and *Lepomis spp.* densities explained by environmental variables ranged from 26% to 62.1% ( $P < 0.001$ ). Growth rates in coves with water willow tended to be higher than coves without, and may be attributed to a density dependent effect. In general, water willow was positively associated with high densities of age-0 largemouth and *Lepomis spp.*

Key words: Age-0 largemouth bass, lepomis, reservoirs, waterwillow, habitat

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## **New cage design for establishment of white water lilies (*Nymphaeae tuberosa* or *odanata*)**

*John W. Stahl, Oklahoma Department of Wildlife Conservation, Byron, OK*

In the past few years, federal and state wildlife organizations have been attempting to re-establish native aquatic vegetation in aging reservoirs with varying degrees of success. Predation has been a major problem in attaining establishment and spreading. Plant cages built on the corral design are effective against fish and reptile predators, but offer little protection against mammalian predators due to their open bottoms. In 2003, the Northwest Region of the Oklahoma Department of Wildlife Conservation (Fish Division) experimented with a new cage design. The new cage design resembles a "pizza pocket". It is constructed of two galvanized 25.4 mm square wiring (61 cm by 122 cm). The fully enclosed white water lily tubers successfully avoided predation. Five area lakes were used with success ranging from fair to excellent. Some degree of establishment and spreading from the cages was observed the first year.

## **Relationship between habitat and sportfish populations over a twenty-year period at Lake Tohopekaliga, Florida**

*Tugend\*, K.I., Florida Fish and Wildlife Conservation Commission, Eustis, FL*

I determined how fluctuations in habitat and water quality were related to growth, condition, recruitment, and abundance of sportfish species at Lake Tohopekaliga. Angler effort, catch and catch success of largemouth bass *Micropterus salmoides* were positively correlated with hydrilla coverage ( $R^2=0.28-0.80$ ). Similar comparisons with electrofishing data did not yield any significant relationships with habitat variables or creel estimates ( $P>0.05$ ). Up to age 4, mean total length was significantly higher in 1987 than later years when chlorophyll-*a* concentrations were much lower and hydrilla expanded in the system. However, no relationship was detected between condition and habitat among years. Creel estimates were generally not related to habitat variables for black crappie *Pomoxis nigromaculatus* or sunfish species *Lepomis spp.*. Harvest success rates of these species have experienced periodic fluctuations but effort has gradually declined over the last twenty years. Catch-curve residuals for most species were marginally related to hydrilla coverage depicting peaks in year-class strength at 30-40% coverage. I found that the largemouth bass population has remained relatively stable over the last twenty years, although growth has decreased slightly since the late 1980s. Changes in habitat may also be responsible for the reduction in use of this resource by other angler groups.

Keywords: growth condition recruitment abundance largemouth bass sunfish black crappie

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## **Relations between hydrological variables and year-class strength of sportfish in eight Florida waterbodies**

*Timothy F. Bonvechio\* and Micheal S. Allen, University of Florida, Department of Fisheries and Aquatic Sciences, Gainesville, FL*

Hydrological variables have influenced recruitment of sportfishes in lakes, reservoirs and rivers. We evaluated how annual and seasonal hydrological variables were related to year-class strength (i.e., residuals from catch curves) of sportfish across eight Florida waterbodies. Multiple regression equations computed for black bass *Micropterus spp.* were combined across rivers and year-class strength was negatively related to spring median flow rates and in some cases positively related to winter median flow rates (all  $P < 0.10$ ). Conversely, *Lepomis spp.* were combined from the rivers and the multiple regression equations indicated that year-class strength were positively related to pre-fall median flow rates and negatively related to fall median

flow rates (all  $P < 0.10$ ). Management implications of this work include changes pertaining to minimum flows and levels (MFL's). Detecting impacts of flow on year-class strength of sportfish were easier to detect in rivers. High flows at least once every three years in the fall may allow inundation of floodplain habitat, thus favorable environmental conditions for *Lepomis spp.* Setting MFL's during periods of drought (i.e., three years or more) should consider impacts to short-lived species such as *Lepomis spp.*

Keywords: Hydrology Year-class strength Residuals Minimum flows and levels

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### **Relationships between River Surface Level and Fish Assemblage in the Ocklawaha River, Florida**

*Rogers\*, M.W., M. S. Allen, University of Florida and M. D. Jones, Florida Fish and Wildlife Conservation Commission*

Increasing water needs in Florida have led to legislation mandating the establishment of minimum flows for Florida rivers. We reviewed a long-term Florida Fish and Wildlife Conservation Commission electrofishing data set from the Ocklawaha River, Florida collected during 1983-1994 to evaluate trends in fish community metrics relative to historical river levels. Electrofishing data were used to estimate catch per effort and biomass per effort of selected species, fish diversity, richness and evenness. Catch rates and community variables were compared between years and significant differences were related to historical water levels using multiple regression models. Results indicated that differences in fish metrics were more common at the site with increased river level variability. Multiple regression models indicated that fish abundance and species richness were negatively related to river levels and species diversity was negatively related to variability in river level during the two years prior to sampling. Spotted sunfish *Lepomis punctatus* exhibited the most species-specific variability among years and abundance was positively related to flows. Low river levels negatively influenced fish abundance and fish communities, and minimum flow levels in Florida should manage for the periodicity of low flow events to prevent sequential years of adverse effects on fish populations.

Keywords: minimum flows Florida sportfish diversity river stage

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## **The Influence of Reservoir Hydrology and Water Quality on Black Bass Recruitment in Alabama Reservoirs**

*Matthew R. Euten, Auburn University Fisheries, Auburn, Alabama*

Variation in largemouth bass *Micropterus salmoides* recruitment was quantified in six reservoirs in two Alabama river systems and compared to hydrologic variables in an attempt to explain factors associated with the formation of strong and weak year-classes. Residuals from catch-curve regressions for age 3 and older fish from were used to describe year-class strength. In the Tennessee River system, strong-year classes were positively related ( $R^2 = 0.29 - 0.38$ ,  $P < 0.01$ ) to summer (June-July) retention (volume/discharge) in three mainstream impoundments. In these reservoirs, June-July retention greater than 15-30 days increased the probability of a strong year-class. In a shorter retention time (<40 days), non-fluctuating reservoir on the Chattahoochee River, a combination of a wet winter (prior to spawning) followed by a dryer summer was a modest predictor ( $R^2 = 0.28$ ,  $P < 0.01$ ) of year-class strength. In two other Chattahoochee River impoundments that had regulated annual fluctuations (1.8 to 4.6 m), higher pre-spawn inflows into these reservoirs and post spawn hydrologic conditions were also modest predictors ( $R^2 = 0.24 - 0.42$ ,  $P < 0.01$ ) of largemouth bass year-class abundance. Overall, climatic conditions that influenced reservoir hydrology were not very strong predictors of largemouth bass year-class strength and typically could not be managed to enhance recruitment.

Keywords: largemouth bass, recruitment, hydrology

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## Nongame Aquatics

### **Population densities and movement patterns of the threatened blackside dace, *Phoxinus cumberlandensis***

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The blackside dace, *Phoxinus cumberlandensis* Starnes and Starnes, 1978, is a rare stream fish geographically restricted to the Upper Cumberland River drainage in northern Tennessee and southeastern Kentucky. The objectives of this study were (1) to determine population densities of blackside dace within its current range, and (2) to determine whether dace populations are relatively sedentary or vagile. Seventy-two 200 m sites within 28 streams that historically harbored blackside dace populations were sampled from 20 June 2003 through 12 August 2003 using single-pass electrofishing. Dace were captured in 52 of the 72 sites and 26 of the 28 streams; however, most sites (58%) had single-pass catch rates of  $\leq 10$  dace per 200 m. Single-pass catch rates averaged  $21 \pm 34$  (mean  $\pm$  SD) dace per 200 m. Petersen mark-recapture population estimates were also conducted on nine of the sites within five different streams. Population estimates ranged from 37 to 444 individuals per 200 m site. From these data, a regression model was constructed to calibrate the single-pass electrofishing for the other 63 sites. To determine movement patterns, 788 blackside dace were tagged with visible implant elastomer injections in the Big Lick Branch and Rock Creek systems of southeastern Kentucky. Most dace (83% in Big Lick Branch and 63% in Rock Creek) were recaptured within their original site of tagging; however, several individuals have moved considerable distances from their original site, including the first documented intertributary movement for this species. Mean distances moved upstream in Big Lick Branch ( $119 \pm 112$  m) and Rock Creek ( $850 \pm 1,316$  m) were more variable than but not statistically different from mean distances moved downstream ( $77 \pm 29$  m) and ( $369 \pm 734$  m), respectively. However, the mean overall distance moved was statistically greater in Rock Creek than Big Lick Branch. Dace movement will continue to be monitored in these systems through March 2004

Keywords: Upper Cumberland River, blackside dace, population estimates, electrofishing, movement, visible implant elastomer

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### **Is seining appropriate for monitoring endangered benthic species?**

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Bortone, S.A. The Sanibel-Captiva Conservation Foundation

We compared visual survey and seining methods for estimating abundance of endangered Okaloosa darters *Etheostoma okaloosae* in 20 replicate stream sections during August 2001. For each 20-m stream section, two divers systematically located and marked the position of darters and then a second crew of 3-5 people exhaustively seined the same area. Visual estimates of abundance were significantly

(300%) higher than seine estimates. The two sampling methods were weakly, but positively, correlated with one another. Visual surveys, but not seines, detected the presence of Okaloosa darters at a site where they were greatly outnumbered by brown darters *E. edwini*. Visual surveys required a few additional minutes to complete, but provided ancillary data on microhabitat use and other behaviors. In 2003, we did successive removal passes after our visual survey. Visual counts averaged 60% of, and were highly correlated with, Zippin estimates of actual abundance. Our results indicated that visual surveys provide more accurate estimates of the abundance of benthic stream fishes than seines for this species and range of environmental conditions. We recommend using visual surveys to monitor benthic fishes in clear streams, especially for threatened and endangered species that require minimal handling and habitat disturbance.

Keywords: Endangered, Monitoring, Seining, Visual, Methods, Etheostoma, Darters

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### **Resource Use Patterns and Potential Competitive Relationships Involving Nonindigenous Red Shiner in the Southeastern USA**

*Herrington\*, S. J., and DeVries, D. R. Auburn University, Auburn, AL*

Red shiner, *Cyprinella lutrensis* (Cypriniformes: Cyprinidae), has been introduced into aquatic ecosystems throughout North America, often negatively affecting indigenous biota. This species has recently become established in several southeastern USA river systems; however, no studies have addressed its ecology and potential impacts on native fish assemblages. Seasonal patterns of resource use between nonindigenous red shiner and an assemblage of stream fishes were examined to determine resource partitioning and potential competition in tributaries to the Chattahoochee River, Georgia, USA. Habitat and trophic resource use of the fish assemblages of two streams containing red shiner were quantified in summer, winter, and spring during 2002-2003. All species exhibited resource use patterns that varied with season, depth, flow, substrate, and cover in both streams. Red shiner occupied swiftly-flowing habitats over gravel substrates in the spring and summer and slack-water habitats over silt and detritus in winter, patterns significantly overlapping with several indigenous fishes, most notably the bandfin shiner, *Luxilus zonistius*. Red shiner also fed on similar but larger-sized taxa than indigenous species occupying the same habitats. Results suggest the potential for competition for both spatial and trophic resources between nonindigenous red shiner and indigenous fishes in these stream systems.

Keywords: red shiner, *Cyprinella lutrensis*, nonindigenous, introduced species, competition, assemblage resource use dynamics

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## **Survey of Nontroglobitic Fishes in the Subterranean Rivers of Mammoth Cave National Park, KY**

*Ruhl\*, Michael and Lienesch, Philip., Department of Biology, Western Kentucky University, Bowling Green, Ky*

Mammoth Cave National Park (MCNP) is home to the longest cave system in the world and is dissected by the Green River, a watershed with one of the highest fish species diversities on the continent. A direct aquatic link exists between the subterranean rivers of the cave system and the Green River, via cave springs. The history of the subterranean river systems in MCNP is filled with eyewitness reports of various species of surface water (nontroglobitic) fishes including introduced rainbow trout. This survey is an attempt to document the occurrence of Green River fish species in the cave system of MCNP. Four sites were selected on three subterranean waterways. These sites, Owl Cave, Echo River, and Dead Sea and River Styx Shallow, were chosen for volume of water and accessibility. Five methods were incorporated into the sampling regime. Passive sampling methods included gillnetting, lighted larval fish traps, and baited minnow traps. Active methods utilized were backpack electrofishing and dipnetting. In combination these methods successfully captured over 300 fishes (mostly larval) representing eight families. The results will be discussed with reference to the hydrology of the cave system and the possible implications of trout stocking on indigenous cave fauna.

Keywords: cave fishes, subterranean, nontroglobitic

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## **An Isotopic Examination of Cave and Epigeal Trophic Structures in Mammoth Cave National Park**

*Compson\*, Z. C., and Lienesch, P. W.*

High-water events in the Green River create flow-reversals which flush native and introduced fishes into Mammoth Cave, posing natural threats to the underground cave fauna. However, little is understood about how natural flood events affect the trophic structures of cave fauna. Of specific interest are natural springs which serve as gateways connecting the cave and epigeal ecosystems. The purpose of this study was to utilize isotopic ratios of carbon and nitrogen in order to 1) describe the trophic structure of epigeal, spring and cave aquatic systems within Mammoth Cave National Park and 2) elucidate spatial differences in trophic structures between these systems. Fourteen sites were sampled from fall 2002 to fall 2003. Samples were dried, pulverized, weighed and sent to the Colorado Plateau Stable Isotope Laboratory at Northern Arizona University for isotope analyses. Two a priori hypotheses were tested and discussed: 1) the trophic structures of cave and spring sites will be more general than those of epigeal sites and 2) fish living in spring

heads will assimilate (Del) values intermediate to those of organisms in cave and epigeal aquatic systems. Answers to these questions give scientists a clearer understanding of the interaction between epigeal and cave ecosystems and provide valuable insight into the regulation of introduced game predators, such as Muskellunge (*Esox masquinongy*) and Rainbow Trout (*Oncorhynchus mykiss*), that are so valuable to the culture and economy of southern Kentucky.

Keywords: isotope trophic structure cave springs cave system Mammoth Cave Muskellunge *Esox masquinongy* Rainbow Trout *Oncorhynchus mykiss*

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### **Habitat Use of an Introduced and Native Crayfish Species in the Spring River Drainage**

*Rabalais, M.R., and D.D. Magoulick, Arkansas Cooperative Fish and Wildlife Research Unit, Fayetteville, AR*

The crayfish *Orconectes neglectus chaenodactylus* has recently been introduced into the Spring River drainage in southern Missouri and northern Arkansas and appears to be displacing the native species *O. eupunctus*. To examine if *O. eupunctus* shifts its habitat use in the presence of *O. neglectus chaenodactylus* we sampled six habitats (riffle, run, pool, vegetation, backwater, and stream margin) using a quadrat sampling method at three sites: 1) an upstream site where only *O. neglectus chaenodactylus* occurs, 2) a zone of overlap where both species occur, and 3) a downstream site where only *O. eupunctus* occurs. At each site we examined habitat use and selection, and species-environmental relationships. We found no significant shift in habitat use, selection, and species-environmental relationships by *O. eupunctus* between the downstream site and the zone of overlap. Our study suggests that competition for habitat is not a factor in the displacement of *O. eupunctus* from its former range by *O. neglectus chaenodactylus*, but further study is needed to examine other factors.

Keywords: Crayfish, Habitat Use, Conservation

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### **Reintroduction of lake sturgeon in the Coosa River System of Northwest Georgia**

*Marion\*, C. Vecsei, P.J., and Peterson, D.L. School of Forest Resources, University of Georgia, Athens GA*

The lake sturgeon *Acipenser fulvescens* was once an abundant member of the unique fish assemblage of the Coosa River System of northwestern Georgia. Habitat degradation and exploitation after 1900, however, resulted in the extirpation of the species by the late 1970s. Recent conservation and protection measures implemented in this region have greatly improved water quality and other habitat parameters critical for lake sturgeon survival. In fall 2002 and 2003, the GDNR began the initial phase of a long-term reintroduction program with the release of several thousand juvenile lake sturgeon into two major tributaries of the Coosa

River. Beginning in the fall 2003, we used bottom-set gill nets in a stratified random sampling design to begin assess poststocking survival of age-1 sturgeon. The continuing goal of this project is to establish strictly controlled scientific protocols to monitor the success of this reintroduction program. Ultimately, the restoration of the lake sturgeon in the Coosa River may serve as a model of fish restoration within Georgia and other southeastern states.

Keywords: lake sturgeon, reintroduction, post-stocking survival, restoration

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### **Population Dynamics & Life History of Lake Sturgeon in the Muskegon River, Michigan: Primary Steps Towards Rehabilitation of a Remnant Stock**

*Vecsei, P.J., and Peterson, D. Warnell School of Forest Resources, University of Georgia, Athens, GA*

Although lake sturgeon (*Acipenser fulvescens*) were once abundant in all of the Great Lakes, overfishing and the construction of dams that blocked spawning migrations have devastated most populations. Little is known about the current status or distributions of these remnant lake sturgeon populations. This study's objectives were to obtain basic life history information and an estimate of the annual spawning run of lake sturgeon in the Muskegon River, one of the last remaining populations in eastern Lake Michigan. During Spring 2002 and 2003, population size was determined for migrating adult sturgeon using a mark-recapture estimate. Gonadal biopsies in 2002 indicated that only one of the thirteen individuals captured was female, while in 2003, two of the ten adults were females. Using radio-telemetry, we monitored spawning migrations and habitat use of adults and in 2003, a major spawning site was found- both eggs and larval sturgeon were captured. Experimental netting for age 1+ juveniles has yielded a single individual. Annual recruitment and survival of young-of- year seem minimal and various means of rehabilitation are being considered.

Keywords: lake sturgeon, rehabilitation, population dynamics, life history

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## Culture

### **Overview of Texas Hatchery Management of Golden Alga, *Prymnesium parvum***

*Southard\*, G.M. Texas Parks and Wildlife Department (TPWD), San Marcos, TX*

During the spring of 2001, the toxin-producing alga *Prymnesium parvum* was identified as the cause of widespread fish mortality at the Texas Parks and Wildlife Department (TPWD) Inland Fisheries Dundee State Fish Hatchery, resulting in complete loss of the striped bass and hybrid striped bass production for that year. Also greatly impacted were programs involving largemouth bass, smallmouth bass, rainbow trout, channel catfish, and koi carp. The TPWD formed the *P. parvum* task force, with the goal of developing strategies to effectively control this alga in order to produce fish. A basic management plan was created, including methods to identify and quantify *P. parvum*, monitor toxicity levels, and investigate physical and chemical control methods to counter blooms and toxic events. Applications that were deemed effective include UV sterilization of hauling tank water, the use of potassium permanganate to mitigate toxicity, and ammonium sulfate and copper sulfate to destroy this toxin-producing alga. Although these methods have enabled TPWD to produce fish at these *P. parvum*-afflicted facilities, some challenges remain. Chemical treatments are temporary. Current *P. parvum* management practices are time consuming and labor intensive. More sensitive and efficient methods are needed.

Keywords: *Prymnesium parvum*, harmful algal bloom (HAB), toxin mitigation

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### **Fish Farming In Africa: Constraints and Solutions**

*David Olurin Olaleye, St. Augustine's College, Gambia*

About 75% of Africans are engaged in one way or the other in agriculture. It is interesting to know that Africa can not feed herself. African farmers engage in different aspect of agriculture such as crop production, animal husbandry and fishery. Of all these agricultural practices, little attention is given to paid farming. This may be due to the believe that fish should not be kept by man. They believe that people should depend on wild fishes from the rivers, streams, seas and oceans. Catching of these wild fishes is left in the hands of old people who are left in the villages where these farmers are concentrated. Africa is blessed with land that is suitable for rearing fish in order to reduce malnutrition, which is common especially among the children in Africa. The money that is supposed to be used for developmental projects is being used for importation of fishes from Western countries so as to alleviate the problem of malnutrition. This paper wants to look at problems facing fish farming in Africa and suggest possible solutions to them so that the money being spent by the government on importation of fishes will be used for other developmental projects and to ensure that in the future Africa will be one of the leading continents in fish production.

## **Effect of rotifer enrichment on sunshine bass fry growth and survival**

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Lochmann, S.E. \*, Aquaculture/Fisheries Center--UAPB, Pine Bluff, AR  
Harry K. Dupree, Stuttgart National Aquaculture Research Center, Stuttgart, AR*

Sunshine bass culture in tanks starts with feeding the larvae live rotifers. Production might be increased if the rotifers are enhanced with highly unsaturated fatty acids before being fed to the larvae. The enrichment procedure involves time, effort, and cost. This experiment was done to determine if significant differences in survival, growth, and condition resulted from rotifer enrichment. Sunshine bass larvae were cultured in replicated tanks from age 4 days to age 12 days. Larvae were fed diets of rotifers that had been raised on: 1) a diluted paste of Nannochloropsis and Culture Selco 3000®; 2) Nannochloropsis, Culture Selco 3000, and Pavlova, and 3) Nannochloropsis, Culture Selco 3000 and Super Selco. No differences in survival, growth, or body condition were found among larvae subjected to the treatments. Lack of differences in production characteristics indicates that the first diet, which is the least expensive and requires the least amount of effort should be fed to the larvae.

Keywords: Sunshine bass, larvae, Nannochloropsis, Pavlova, enrichment, rotifer

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## **Techniques for converting juvenile lake sturgeon (*Acipenser fulvescens*) to a commercial diet**

*Kornberg\*, J.S., and Peterson, D., University of Georgia, School of Forest Resources, Athens, GA*

The lake sturgeon (*Acipenser fulvescens*) was once part of the ichthyofauna of the Coosa River system in northwest Georgia. Habitat degradation and exploitation throughout the early 1900's resulted in the extirpation of the species by the late 1970's. Recent water quality improvements have created conditions believed to be suitable for the survival and potentially successful reproduction of lake sturgeon. The Georgia Department of Natural Resources stocked several thousand juvenile lake sturgeon into the upper Coosa River system in 2002 and 2003 in an effort to re-establish the species. As part of this effort, researchers at the University of Georgia have conducted feeding experiments with the objective of determining optimal methods for rearing lake sturgeon to stockable sizes. One experiment involved a 3x3 randomized block design and evaluated which of three different methods of feed presentation was best at converting juvenile sturgeon from a natural to a commercially available diet. Results of this study will aid in re-establishing this species by providing the best methods for producing fish to sizes that may allow the best opportunity for their post-stocking survival in this system.

Keywords: lake sturgeon feeding experiments Coosa River Georgia

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## **Fluctuating Asymmetry and Condition in Golden Shiner and Channel Catfish Reared in a Breakdown Product of Sarin**

*Green\*, C.C., and Lochmann, S.E. University of Arkansas at Pine Bluff, Department of Aquaculture and Fisheries*

Stress during embryological development can result in small random differences between left and right sides of a bilateral trait. This fluctuating asymmetry (FA) has been proposed as a measure of the level of stress a group of organisms experienced during embryological development. Toxicants have been shown to increase FA among groups with increasing exposure during development. In addition, studies have shown a relation between asymmetry and condition. The Pine Bluff Arsenal (PBA) has been ordered to incinerate a number of the chemical weapons currently stored at the facility in accordance with the Chemical Weapons Convention Treaty of 1997. In the event of an accident during incineration, sarin or its decomposition products have the potential to be expelled into the environment. Isopropyl methylphosphonic acid (IMPA) is the main hydrolysis product of Sarin. This study examines the use of FA as a biomarker of developmental stress due to sublethal exposures to a toxicant. We found significant differences in composite FA among groups of channel catfish *Ictalurus punctatus* and no significant differences among golden shiner *Notemigonus crysoleucas* exposed to sublethal concentrations of IMPA during development. This study found no relation between individual relative condition and asymmetry.

Keywords: Condition, Fluctuating Asymmetry, Chemical Warfare Agents, Golden Shiner, Channel Catfish

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## **Effects of Conditioning Sediment on Growth and Survival of Juvenile Freshwater Mussels in an Indoor Culture Facility**

*Wisniewski\*, J.M., and Layzer, J.B. Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, TN*

Algae and detritus are believed to be important nutritional sources for juvenile freshwater mussels. Two experiments were conducted to determine whether conditioning of sediment affects growth or survival of juvenile mussels. Three treatments (0, 7, or 14 days) of conditioning sediment with algae or detritus were randomly assigned to each culture trough. During the conditioning period, either algae (20 ml) or detritus (20 ml) were added to the culture troughs. After introduction of juveniles, replicate treatments received either 0 or 0.5 mm of a dietary supplement (Microvert), 3 days per week. Mean lengths of 4-week-old juveniles cultured in the no conditioning treatment and the 14 day detritus-conditioned sediment were larger than those cultured in sediment conditioned for 7 days ( $p < 0.05$ ); however, survival did not differ among treatments. At 8 weeks of age, mean length of juveniles did not differ among treatments, but mean survival was greater for treatments receiving the Microvert supplement ( $p < 0.05$ ). Conditioning sediment with algae had no effect of growth or survival.

Keywords: Juveniles Mussels nutrition conditioning

## Long-Term Growth and Survival Of Cultured *Lampsilis Abrupta*

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Protocols for the propagation and short-term culture of endangered freshwater mussels are well established; however, long-term culture of most species has not been successful. Over a two-year period, a number of factors including infestation intensity, diet, substrate particle size, date of propagation, and age transferred to a hatchery raceway were tested for possible effects on the long-term growth and survival of juvenile *Lampsilis abrupta*. No juveniles resulting from May and November propagation trials survived 8 weeks of indoor culture. A 2<sup>4</sup> factorial design was used with juveniles propagated in March and cultured indoors for 12 weeks. Of the four variables tested, only diet significantly affected growth. None of the treatments significantly affected survival; overall survival was 11 %. In contrast, survival until the end of the growing season each year ranged from 31 to 38 % for 6-13 week-old juveniles transferred to a hatchery raceway. Previous attempts at introducing juveniles <6 weeks old into the raceway were unsuccessful. After one growing season in the raceway, mean lengths ranged from 8.1 +/- 0.5 to 12.3 +/- 2.0 mm. In all, 85 % of these juveniles survived until the end of the second growing season, and reached a mean length of 30 +/- 7.6 mm.

Keywords: *Lampsilis abrupta* long-term culture endangered freshwater mussels

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## Posters

### **Fish Community Composition in a Reservoir Cove Isolated by Excessive Sedimentation**

*Bahm\*, J. A., Sutterfield, A. W., and Patton, T. M. Department of Biological Sciences, Southeastern Oklahoma State University, Durant, OK*

Lake Texoma is a large reservoir constructed on the mainstems of the Red and Washita Rivers in Oklahoma and Texas, and currently provides a host of uses. This reservoir is experiencing high sedimentation rates, especially in the Washita River arm, and several coves have become isolated from the mainstem of the reservoir due to sediment deposition. In this study, we examined the effect of this isolation on the fish community. We used gill nets to compare community composition between the mainstem of the reservoir and a recently-isolated cove (approximately 160 ha). Nets were placed to sample the fish community along the longitudinal gradient in the isolated cove, and in an adjacent section of the mainstem of the reservoir (total 16 net nights). Fish species presence and absence was similar between the two bodies of water, but rank relative abundance differed between the two bodies of water, and the longitudinal distribution of fish communities in the isolated cove was atypical. Most reservoirs show longitudinal gradients of fish communities comprised predominantly of riverine fishes upstream, transitional fishes in intermediate regions, and pelagic fishes near the dam. The study cove fish community was strongly represented by riverine fishes in the upstream area as well as adjacent to the sediment bar "dam." In this respect, this isolated cove differed from conventional ecological theory describing longitudinal patterns of fish distributions in reservoirs, and reflects one of the ramifications of excessive sedimentation.

Keywords: sedimentation, reservoir sedimentation, reservoir fish communities, longitudinal gradient

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### **Fish Community Structure Before Habitat Restoration in Big Escambia Creek, Escambia County, Florida**

*Blalock-Herod\*, H.N. U.S. Fish and Wildlife Service, Panama City, FL. Herod, J.J. U.S. Fish and Wildlife Service, Niceville, FL*

An assessment of fish community structure at one location within Big Escambia Creek (BEC), Escambia County, Florida was conducted in May 2002 in an effort to determine baseline information about species richness, abundance, and diversity before a large-scale habitat restoration project is initiated. This baseline will be used to establish criteria for monitoring the fish community characteristics before and after restoration activities. The results obtained from the BEC site are compared with a reference site from Little Escambia Creek (LEC) in order to determine if variations in fish community structure are due to natural phenomenon or restoration activities. Alpha level analysis for BEC indicated 35 species, from 18 genera, representing 14

families. Diversity ( $H'$ ) was 3.75. Percent abundance for the community was dominated by cyprinids (42%). Sunfishes (22.8%) and a single species, mosquitofish (16.7%), comprised the second and third largest portions of the community, respectively. Alpha level analysis for LEC indicated 26 species, from 13 genera, representing 9 families. Diversity ( $H'$ ) was 3.41. Cyprinids (55.1%) dominated the LEC fish community. The other two groups with highest abundances were darters (10.8%), and sunfish (9.4%). Beta level, between BEC and LEC communities, results show that communities are 75% similar (Sorenson Similarity Index).

Keywords: nongame habitat restoration community

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### **Fishery Composition of Banks Lake National Wildlife Refuge, Georgia**

*Blalock-Herod\*, H.N. and Popp, K. US Fish and Wildlife Service, Panama City, FL*

Banks Lake National Wildlife Refuge (NWR) is a 4,049-acre refuge consisting of 1,500 acres of marsh, 1,549 acres of cypress swamps, and 1,000 acres of open water. Fishery data from Banks Lake National Wildlife Refuge (NWR) were collected during seven sampling periods in open water habitats from 1992 through 2001. Banks Lake NWR has supported over 18 species of fish from 12 families. Descriptive statistics for each species collected during the study are provided for comparative purposes. Bluegill CPUE remained fairly constant from 1992 to 2001 with the only significant increase in CPUE occurring in 1995. Significant changes in total length and proportional stock density (PSD) were also detected for bluegill. Between 1992 and 2001, 24% of the bluegill community was greater than quality size. Largemouth bass CPUE has remained constant over time; however, statistically significant changes have occurred within mean total length and PSD. During the study period, approximately 68% of the largemouth bass were quality size or greater.

Keywords: Swamp blackwater sport fishery largemouth bass bluegill

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### **Fish Community of Okefenokee National Wildlife Refuge, Georgia**

*Blalock-Herod, H.N. U.S. Fish and Wildlife Service, Panama City, FL. Herod, J.J. U.S. Fish and Wildlife Service, Niceville, FL*

Okefenokee Swamp is a 1,775 km<sup>2</sup> freshwater wetland located in southeastern Georgia and northern Florida. Fish community data were collected from the east side of Okefenokee National Wildlife Refuge, Georgia on 22 and 23 January 2002 using boat electrofishing in prairie and canal habitats. Overall community composition consisted of 557 individual fish, from 14 species, representing 10 families. Community composition as CPUE among species was not different between the prairie and canal habitats ( $p = 0.8291$ ). Overall species composition was dominated by bowfin (57%). Fliers were the second most common species (16%). Changes in the fish community since 1993 will be discussed.

Keywords: Swamp blackwater Okefenokee community

### **Identification and quantification of quality habitat for the yellowcheek darter, *Etheostoma moorei***

*Brophy\*, M.R. and Stoeckel, J. Arkansas Tech University, Russellville, AR*

The yellowcheek darter, *Etheostoma moorei* (Raney and Suttkus), is endemic to four headwater streams of the Little Red River, Arkansas. Much of its habitat was flooded by the formation of Greers Ferry Lake in 1962. It is currently ranked globally as a G1 and statewide as an S1 species. Future creation of quality habitat could benefit this species. I will locate sites that contain relatively high densities of yellowcheek darters and examine the associated habitats at the drainage basin, macrohabitat/reach, and microhabitat levels. I will ultimately quantify the physical characteristics that comprise quality habitat and make recommendations for future habitat creation efforts.

Keywords: yellowcheek darter *Etheostoma moorei*

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### **Economic Value of Fishing at a Low-use Reservoir**

*Christopher J. Chizinski\*, Kevin L. Pope, David B. Willis, Gene R. Wilde, and Edwin J. Rossman*

Lake Kemp, Texas is a 15,592-acre reservoir with a low-use fishery (i.e., few anglers visit Lake Kemp annually). From 25 May 2000 to 25 May 2001, recreational users were contacted at Lake Kemp to determine the economic value of angling. Average consumer surplus of anglers was \$60.24 per day, which generated an annual consumer surplus of \$296,708. Although this value is relatively small compared to heavily used Texas reservoirs, anglers on numerous smaller public and private water bodies likely generate a majority of direct expenditures on recreational angling. Thus, more management effort in Texas and the rest of the USA should be directed toward these low-use fisheries.

Keywords: Economic value low-use travel cost

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### **Trends in the Recreational Tarpon (*Megalops atlanticus*) Fishery in North America**

*Dailey\*, W., and Landry, Jr., A. M., Texas A&M University, Galveston, TX  
Hein, S., Louisiana Department of Wildlife and Fisheries, Bourg, LA*

The tarpon is a highly prized sportfish supporting seasonal fisheries throughout its temperate and tropical range. Tarpon are the primary target of tournaments in Texas, Louisiana and Florida and their anglers have included such historical figures as U. S. Presidents Theodore and Franklin Roosevelt and Hall of Fame slugger Ted Williams. The internationally-renown 'tarpon rodeos' of Port Aransas and Port Isabel, TX are defunct today while modern counterparts held in Boca Grande, FL and Grand Isle, LA continue to generate economic impacts in the millions of dollars.

Management of the highly migratory tarpon by state and federal agencies has been complicated by a lack of data on annual landings. While trophy tags sales in Texas, Alabama and Florida might be used as a proxy for fishing pressure, sales have largely been flat in Florida and non-existent in Texas and Alabama since their respective inceptions approximately 10 years ago. Tarpon landings at tournaments in Gulf and South Atlantic states including Louisiana's International Grand Isle and Golden Meadow Tarpon Rodeos have decreased in recent decades, and demonstrate a reduction in length of the seasonal fishery due to delayed arrival of tarpon on local fishing grounds. Landings at tournaments in Boca Grande and Oriental, NC have fluctuated in recent years. Boca Grande tournament landings have decreased in the previous five years while Oriental and Atlantic coasts landings have exhibited an increasing trend. We discuss how recent trends in silver king landings in North America suggest changes in tarpon migratory behavior.

Keywords: *Megalops atlanticus*, tarpon, recreational landings

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### **Lab Evaluation of a Bioenergetics Model for *Menidia beryllina***

*Huber\*, C. G., Chizinski, C. J., and Pope, K. L. Texas Tech University Wildlife and Fisheries Management Institute*

Inland silverside *Menidia beryllina* are native to the eastern coast of the USA and have been introduced into numerous inland water bodies as prey for sport fishes. In some waters, inland silverside have displaced native species such as the brook silverside *Labidesthes sicculus*. A bioenergetics model (growth = consumption – [respiration + egestion + excretion]) was developed for inland silverside as a tool to further understand their biology and interactions in aquatic communities. Respiration rates and maximum consumption were positively related to temperature and negatively related with fish mass, which is consistent with models developed for other species. A laboratory validation of this model was completed to assess model accuracy. Fish were collected from the wild and held at two temperatures while fed ad libitum. Observed growth (change in mass) will be compared to predicted growth to assess this bioenergetics model.

Keywords: *Menidia beryllina* Bioenergetics Consumption Respiration

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### **Preliminary Habitat Assessment for Endangered and Threatened Freshwater Mussel Species of the Ochlockonee River Basin of Florida and Georgia**

*Huizenga, K. and Blalock-Herod\*, H.N. U.S. Fish and Wildlife Service, Panama City, FL*

The Ochlockonee River provides habitat for many freshwater mussels including four species federally listed as endangered or threatened. The protection and restoration of these quality mussel habitats is of the utmost importance to maintaining healthy, sustainable populations of mussels. Habitats and their physical (e.g., site length/location, width and depth, stream type, substrate composition, riparian land

use bank erosion potential, and flood plane accessibility) and chemical features (e.g., DO, temperature, conductivity, pH, turbidity, ammonia, copper and chlorine) were documented using GPS and examined using ArcView GIS 3.2. Preliminary sites have been assessed for their need for protection or restoration based on mussel community, habitat features, and land ownership.

Keywords: habitat restoration freshwater mussels endangered threats

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### **Monitoring and Research Activities Supporting Imperiled Fish Management: Investigating impact from road crossing structure on streams inhabited by the Okaloosa darter (*Etheostoma okaloosae*)**

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Okaloosa darter (*Etheostoma okaloosae*) was listed as Federally Endangered on June 04, 1973. Okaloosa darters, a narrow endemic species, inhabit six stream systems that are restricted to Okaloosa and Walton counties, Florida. These streams have a drainage basin of 176 square miles (USFWS 1998). We initiated a baseline inventory regarding stream habitat and tested how structural crossing types may alter habitat and channel morphology. These investigations were initiated to establish current datasets about; 1) existence of current road crossing structure, 2) stream habitat and morphology parameters within 200 meters of crossing structure, 3) differences in habitat and morphology in directions from crossing (e.g., upstream vs. downstream), and 4) in-stream habitat features occupied by Okaloosa darters. It is expected that highly impacted streams are less suitable for the Okaloosa darter. Approximately 133 crossings in Okaloosa darter streams were identified using base maps. As part of an ongoing project to inventory habitat, 50 sites have been visited. Of these, 22 sites have existing crossings and are used in the stream morphology and stream habitat analysis presented. Results suggest statistically significant relationships and we provide results-based recommendations that can be used for adaptive management strategies.

Keywords: endangered habitat fish passage Okaloosa darter adaptive management

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### **Analysis of environmental variation in a Great Plains reservoir using principal components analysis and geographic information systems**

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We present a method for spatial interpretation of environmental variation that integrates principal components analysis (PCA) of environmental data with geographic information systems (GIS). We used data from an Oklahoma reservoir (Skiatook Lake) that has longitudinal variation in physicochemical conditions to illustrate our method. We measured 19 physicochemical features of Skiatook Lake, mapped them using GIS, and then calculated and interpreted four principal components. Principal component 1 (PC1) was readily interpreted as longitudinal

variation in water chemistry, but the other principal components were difficult to interpret. Site scores for principal components 1-4 were displayed in a GIS using weighted overlays of the 19 measured environmental variables, with the eigenvectors from the PCA as the weights. Principal components 1-4 were then ordered into a landscape hierarchy. PC1 was interpreted as a reservoir scale change in water chemistry, PC2 was a microhabitat variable of rip-rap substrate, PC3 identified coves/embayments, and PC4 was related to shoreline characteristics (e.g., shoreline slope). The use of GIS improved our ability to interpret the more obscure principal components (2-4), thus, making the spatial variability of the reservoir environment more apparent.

Keywords: landscape multivariate Skiatook Lake Oklahoma PCA GIS

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### **Mass-marking rainbow trout and brown trout fingerlings with oxytetracycline**

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Immersing juvenile salmonids in a solution of oxytetracycline (OTC) to mark them has not been adequately described in the literature. We immersed fingerling rainbow trout *Oncorhynchus mykiss* and brown trout *Salmo trutta* in a 500-mg/L solution of OTC for 6 h to determine marking efficacy. The technique marked 100% and 92% of rainbow trout and brown trout otoliths, respectively. In a blind test using known marked and unmarked otoliths, one reader correctly identified 99% of rainbow trout and 95% of brown trout otoliths as either marked or unmarked. Reading errors for rainbow trout and brown trout were of omission. Mortality of OTC-marked trout was less than 3.5% and statistically similar to control groups. Fifteen thousand fingerling brown trout stocked into a Tennessee river were treated on the hatchery truck with 500 mg/L OTC and all of the fish in a subsample (n = 25) that were held for 30 d were marked. An OTC mark was subsequently detected on all brown trout known be treated (n = 13) that were recaptured up to 9 months post-stocking. We concluded that OTC immersion is an effective technique for mass marking fingerling rainbow trout and brown trout during short-term stocking evaluations.

Keywords: rainbow trout, brown trout, oxytetracycline, immersion, Tennessee, tailwater

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### **Modification of the Standard Peeler Pot Using Three Different Culling Devices to Reduce Bycatch**

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The capture of bycatch in non-selective fishing gear is one of the biggest issues facing fisheries today. Commercial fishermen in North Carolina have observed that peeler pots trap a considerable amount of bycatch such as eels (*Anguilla rostrata*), pinfish (*Lagodon rhomboides*), other small finfish, non-harvestable peelers, and hard

blue crabs that are not ready to shed. A randomized block design with repeated measures was used to test the effectiveness of three culling devices (38 mm/51 mm/38x38 mm) in reducing bycatch in peeler pots in Pamlico Sound, North Carolina, in the summer of 2002. It is believed that with the use of these culling devices, we can eliminate most bycatch found in peeler pots, increase the yield in peeler pots, and improve the quality of peelers harvested. Eliminating bycatch from peeler pots would increase economic productivity, with less time being spent in culling the catch. Improving the quality of peelers harvested allows immature peelers to escape and eventually contribute to the population. This boost in crab stock could better enhance the overall crab population and help protect the future of the crabbing industry.

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### **ECU-AFS: Five Years of Excellence for the ECU Student Subunit of the American Fisheries Society**

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The East Carolina University Student Subunit of the American Fisheries Society (AFS) celebrates its 5th anniversary. Formed in 1998, our membership includes students, faculty, and others with fisheries and coastal related interests. The ECU-AFS is proud to be a part of the Tidewater Chapter. ECU-AFS annual meetings provide members with many of the same benefits found at the chapter and national level. Fisheries professionals from North Carolina are invited and encouraged to interact with ECU-AFS members, allowing students to get to know these professionals on a personal level. Additionally, ECU-AFS members obtain experience on how to run effective professional meetings by serving on planning committees. A typical ECU-AFS annual meeting will include an extravagant entrée such as a clam bake or catfish dinner, a featured speaker, and raffle. All proceeds from the annual meeting raffle are added to our Student Leadership Development Fund. ECU-AFS provides members with professional development workshops to enhance essential skills specifically related to the fisheries scientist. Examples of past workshops include Introduction to GIS, Professional Poster Making, USCG Auxiliary Boating Safety Certification Course, and an Instructional Electrofishing Workshop. ECU-AFS fund raising events such as annual banquets, raffles, etc. provide money for students to attend professional meetings at both the chapter and national level within AFS.

Keywords: Tidewater Chapter ECU-AFS Professional Development

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### **Potential host determination and propagation of the Arkansas Fatmucket, *Lampsilis powelli* from the Ouachita and Saline River drainages**

*Scott\*, M.C., Farris, J.L., Harris, J.L., Christian, A.D. Arkansas State University, Jonesboro, AR*

Propagation of freshwater mussels continues to require the discovery of better life history information to thwart the decline of threatened species. This study concentrated efforts to determine the host fish species for the Arkansas Fatmucket,

*Lampsilis powelli*, which was listed as Threatened by the Fish and Wildlife Service in 1990. Gravid female mussels and potential fish hosts from the Alum Fork Saline River were collected during the spring of 2003. Host trials were conducted at the Mammoth Spring National Fish Hatchery in Mammoth Spring, Arkansas with glochidia introduced to 22 fish species from seven families. A total of 337 juvenile *L. powelli* were collected from fish belonging to the family Centrarchidae, while no other fish families produced juvenile mussels. Most juveniles transformed on the spotted bass (*Micropterus punctulatus*), while fewer were produced from longear sunfish (*Lepomis megalotis*), bluegill sunfish (*Lepomis macrochirus*), and green sunfish (*Lepomis cyanellus*). Our results were similar to other host trials involving Lampsiline mussels in that fish from the family Centrarchidae have the highest transformation success. This information coupled with future host trials and field observations will help to build the critical myriad of information that can be applied toward the management and recovery of this species.

Keywords: Freshwater mussels Propagation Host fish Threatened Species

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### **Validation of Annulus Formation in Pectoral Fin Rays from Shovelnose Sturgeon**

*Whiteman, K.W. and Travnicek, V.H. \* Missouri Department of Conservation (MDC), Columbia, MO*

Numerous studies have examined age and growth of shovelnose sturgeon *Scaphirhynchus platyrhynchus*, but only one of these studies attempted to validate age estimation techniques. Therefore, our objective was to use marginal increment analysis to validate annulus formation in pectoral fin rays of shovelnose sturgeon collected from the Missouri River. We also compared precision of age estimates between two different readers. Marginal increment distance indicated that an opaque band was laid down in pectoral fin rays during the summer for most of the population. However, opaque bands were formed throughout the year in some individuals, and this is a concern when using fin rays for age estimation. Agreement of age estimates by two readers for shovelnose sturgeon was only 18%, and differences in ages between the two readers increased for older-aged fish. Presence of split annuli, false annuli, spawning bands, imbedded rays, and deteriorating sections made individual growth rings difficult to separate. Our findings verified that opaque bands are formed annually during the summer in pectoral fin rays of most shovelnose sturgeon, but some individuals form opaque bands during other times. Pectoral fin rays will likely continue to be the most practical method of age estimation in shovelnose sturgeon, but ages estimated by this method should be used with caution.

Keywords: shovelnose sturgeon age validation

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