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Abstracts are listed in alphabetical order according to primary author.

Effects of Gamma Irradiation on Spat of the Eastern Oyster

Ardjosoediro, I., N. Lee, J. E. Supan, and T. R. Tiersch, Aquaculture Research Station, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, Louisiana 70820

The oyster industry in Louisiana with an annual farm value of ~50 million dollars, represents an important economic and sociological component of coastal communities. Annual oyster production in Louisiana provides about two-thirds of the oyster production in the Gulf Region. The eastern oyster industry, however, is currently subjected to several problems including environmental pollution, saltwater intrusion with resulting marsh loss, oyster predation, increased harvesting pressure, and diseases. In addition, profits are lost during the spawning season due to poor meat yields. Commercial application of radiation has been proven in chemical, civil, electrical, and mechanical engineering. The use of radiation in agriculture started around 1940 when gamma radiation was applied to control livestock insect pests by inducing reproductive sterility. The possibility of producing sterile oysters through irradiation represents a potential benefit for the oyster industry. Improved meat yields during spawning season could increase profits. Furthermore, hatchery production of seedstock could more readily take advantage of genetically modified oysters if irradiation prevented unwanted provided control of reproduction. The effects of gamma radiation on the spat of *Crassostrea virginina* were evaluated during this study. Spat were produced using standard procedures at the oyster hatchery at Grand Isle, Louisiana. The spat were 11.5 ± 2.3 mm in length (mean \pm SD) and 9.5 ± 1.9 mm wide. They were exposed to gamma radiation doses of 0, 10, 20, 30, or 40 krad at a rate of 1546 rad/min. The study lasted 8 months from September 1998, through April 1999. In a preliminary trial, gonadal development was evaluated histologically in April of 1999. Gametic stage and sex (male, female, hermaphrodite, or unidentifiable) were determined for each oyster. During this study all spat died when exposed to 20 krad and above. The remaining oysters (0 and 10 krad) were evaluated for gonadal development. The gametic development of the non-irradiated oysters was higher (mean gametic stage = 2) than that of the oysters exposed to 10 krad (gametic stage = 1.3) (Table 1). The occurrence of hermaphrodites was higher among the irradiated oysters (4 of 15; 27 %) than among the non-irradiated oysters (1 of 13; 8%).

Table 1: Gonadal development of eastern oysters exposed as spat to 0 or 10 krad of gamma radiation. Included are sample size (n), sex, number of individuals at each stage of development (1 to 6), and mean gametic stage for the entire sample.

Dose (krad)	n	Sex ^a				Gametic stage ^b						Mean
		M	F	H	U	1	2	3	4	5	6	
0	13	8	4	1	0	1	1	1	8	1	0	2
10	15	6	2	4	3	1	1	2	4	0	0	1.33

^a M, male; F, female; H, hermaphrodite; U, unidentifiable.

^b 1, immature; 2, developing; 3, early maturity; 4, maturity; 5, late maturity; 6, regression.

Heat-Related Zebra Mussel Mortality in Lake Dardanelle, Arkansas

Baker, W. P., J. N. Stoeckel, and C. J. Gagen, Arkansas Tech University, Fisheries and Wildlife Biology Program, Russellville, AR 72801

Zebra mussels (*Dreissena polymorpha*) are exotic bivalves known to cause limnological changes in North American freshwater systems. They first were discovered in Lake Dardanelle, Arkansas in 1992. We have sampled veliger, juvenile, and adult stages of zebra mussels in the lake since 1993. The population grew exponentially, reaching a maximum mean density of 7,302/m² in 1997 prior to a heat-related die-off in July of that year that resulted in an estimated mortality of 80%. Another heat-related die-off in the summer of 1998 resulted in mortality of approximately 90% of the remaining population. In 1999, zebra mussel densities were much lower than the previous two years with a mean density of 344/m². We have also sampled turbidity and Secchi disk visibility biweekly. Changes in these parameters correlated with changes in zebra mussel densities. As the zebra mussel population increased in density, we observed a gradual decrease in turbidity and an increase in

Secchi disk visibility. Mean turbidity for 1997, the year of maximum zebra mussel density, was 14.5 NTU, the lowest during the seven year sample period. Secchi disk visibility was greatest in 1997 with a mean of 77.6 cm. After the die-off in 1997, turbidity gradually increased and Secchi disk visibility decreased. In northern climates, populations of zebra mussels are cyclic due to die-offs of older cohorts, but this does not seem to be the case in southeastern reservoirs such as Lake Dardanelle. In these reservoirs, exponential increases in number of zebra mussels occur in years with relatively cool summer water temperatures, and massive die-offs occur when water temperatures remain above 30 °C in excess of one week. Thus, in shallow southern reservoirs we can expect boom and bust cycles in zebra mussel populations, and that the magnitude of limnological and ecological impacts caused by zebra mussel infestation will fluctuate with size of the zebra mussel population.

Evaluation of Selected Desktop Statistical Software for Fisheries Data Analysis

Barkoh, A., Texas Parks and Wildlife Department, HC 7, Box 62, Ingram, Texas 78025

Kurten, G. L., Texas Parks and Wildlife Department, 507 Staples Road, San Marcos, Texas 78666

Muoneke, M. I., Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744

Five desktop statistical packages were evaluated to determine which is most suitable for adoption by Texas Parks and Wildlife Department's Inland Fisheries Division as an alternative to SAS, which has a high "total cost of ownership." The packages (SPSS, Statistica, Systat, Statistix, and Minitab) were selected for evaluation using word-of-mouth, internet search, and review of two fisheries-related journals. Cost (\leq \$1000) and scope of statistical techniques (i.e., comprehensiveness) were used as criteria for an initial screening that eliminated SPSS and Statistica from further evaluation because they were relatively expensive. Minitab, Systat, and Statistix were further compared for ease of use, reporting, documentation, and technical support. These packages were subjected to the same battery of data manipulation (data import, merging, and transformation) and statistical analyses (t-test, analysis of variance, linear correlation, linear regression, and Kruskal-Wallis test) of fisheries data, and their performances were compared. Our evaluations revealed that Minitab (\$975), Systat (\$695-995) or Statistix (\$295-495) would meet the analytical needs of the majority of the Inland Fisheries staff. However, to meet the needs of both novice and advanced users, Minitab or Systat would be better choices, because they have more extensive collection of basic, advanced, and specialized statistical and graphical techniques.

Investigations of Localized Mollusk and Echinoderm Harvest Along the Texas Coast and Possible Management Implications

Blankinship, D. R. and P. F. Trial, Texas Parks & Wildlife Department, 95 Fish Hatchery Road, Brownsville, Texas 78520

Hammerschmidt, P., Texas Parks & Wildlife Department, 4200 Smith School Road, Austin, TX 78744

Concerned citizens and an environmental group have brought the unregulated harvest of live mollusks and echinoderms from the marine environment to the attention of fishery resource managers in Texas. Of particular concern is the taking of these animals from unique and easily accessible habitats where local populations of mollusks and echinoderms could be severely impacted. Resource managers in Texas are working to characterize this fishery and determine the need for a fishery management plan and possible regulation. Stakeholders have been instrumental in educating potential fishery participants. An update on the investigation's findings and fishery characterization will be presented.

Fish Habitat Associates in a Midwestern Prairie Stream; Evidence of Habitat Partitioning

Bonner, T. H. and G. R. Wilde, Department of Range, Wildlife, and Fisheries Management, Texas Tech University, Lubbock, Texas 79409, (806) 742-2841

General patterns in fish-habitat associations were found for the historically dominant minnows of the Canadian River, Texas and New Mexico. Upper reaches of prairie streams typically are characterized as unstable aquatic environments with large daily and seasonal variations in temperatures, flows, conductivity, and turbidity. Previous studies and ecological theory suggest that in highly variable environments, abiotic factors play a greater role in species persistence and habitat selection than biotic factors; habitat selections are transitory, no single variable is important in habitat selection, and no stable patterns existed in habitat partitioning among species. However, we found stable patterns in habitat selection and partitioning along depth and current velocity gradients. Arkansas River shiners Notropis girardi and speckled chubs Macrhybopsis aestivalis typically inhabited shallow depths, with the speckled chub selecting significantly swifter currents ($P < 0.05$) during the winter, spring, and summer. Plains minnows Hybognathus placitus and flathead chubs Platygobio gracilis typically inhabited significantly greater depths ($P < 0.05$), with the flathead chub selecting significantly swifter currents ($P < 0.05$) during the spring and summer. These distributional patterns were consistent with species morphology and feeding preferences, thus

suggesting strong biotic influences on assemblage structure. Other abiotic factors such as temperature, conductivity, turbidity, and substrate were significantly correlated ($P < 0.05$) with flow (depth or current velocity), confounding the interpretation of preference or avoidance for a particular habitat variable. However, it is doubtful that any observed physical or chemical parameter exceeded the physiological tolerances of these species. Understanding underlying structuring mechanisms of fish assemblages is critical to future conservation and restoration projects currently underway in prairie streams throughout the Midwest.

Angler Regulation Awareness and Harvest on a Contaminated River Fishery: Results of the 1997 Shenandoah River System Creel Survey

Bowman, D. W., Arkansas Game and Fish Commission (formerly Virginia Department of Game and Inland Fisheries)

The South Fork of the Shenandoah and the Shenandoah River mainstem in Virginia, are contaminated with mercury and PCBs, respectively. The system supports a very popular smallmouth bass fishery along with largemouth bass, various sunfishes, and channel catfish. A roving creel survey was conducted to assess angler awareness of health advisories and sport fishing regulations and how those affected angling pressure and harvest. The survey consisted of two creel clerks floating a section of the river during three week-days and each weekend-day per week, from April through October 1997. The clerks counted every boat and angler and interviewed every angler possible with a 27 question interview form. Six aerial flights per month provided comparative pressure counts. Aerial flights were interrupted for 1 1/2 months due to crashing the airplane. Results of the survey demonstrated extremely low harvest rates for all species. Yet anglers demonstrated poor knowledge of contaminants and the associated health advisories, along with poor knowledge of sport fishing regulations. These results demonstrated the prominent catch-and-release mentality of today's Shenandoah River anglers regardless of the presence of contaminants in the system.

Laboratory-Scale Manipulation of Oysters

Buchanan, J. T., Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA 70803
 Paniagua, C. G. and T. R. Tiersch, Aquaculture Research Station, Louisiana State University Agricultural Center, Baton Rouge, LA 70803
 Cooper, R. K., Department of Veterinary Science, Louisiana State University, Baton Rouge, LA, 70803

The eastern oyster *Crassostrea virginica* provides an important national fishery. There is a need for research in disease resistance and microbial elimination in oysters, and gene transfer research can lead to advances in this area. Cryopreservation of oyster gametes and larvae are important as well. To pursue research in these areas, it was necessary to develop research-scale techniques for the holding of oysters and the culture of larvae. There are unique needs associated with culturing oysters in the laboratory. Along with consistent production of high quality gametes and larvae, consideration must be given to experimental replication, avoidance of contamination, and containment of genetically modified organisms. All of our work was done with artificial seawater in recirculating systems over 100 km from the nearest coastal area. We examined the effect of several variables on the production of gametes and larvae of the eastern oyster. First, we developed protocols for holding broodstock in the laboratory, acclimation to laboratory conditions, and collection of gametes. We developed methods to assay gamete quality and for cold storage of gametes. Second, we optimized methods for the small-scale production of oyster larvae by artificial fertilization by examining the effect of container volume, aeration, and artificial water source on larval survival. Using these techniques, we successfully transferred the gene for red-shifted green fluorescent protein (*rsGFP*) into sperm and observed expression of the gene in oyster larvae. We have also observed expression of this gene after transfer into adult oysters and in embryos. These techniques for oyster husbandry in the laboratory have been used in experiments to cryopreserve eastern oyster sperm and trochophore larvae. A program such as this would be useful for the small-scale production and culture of shellfish larvae for a variety of experimental purposes.

Annulus formation and validation in pectoral spines of channel catfish

Buckmeier, D. L., Texas Parks and Wildlife Department, Heart of the Hills Research Station, HC 07, Box 62, Ingram, TX 78025; 830/866-3356; FAX 830/866-3549; daveb@krc.com
 Irwin, E. R., USGS – Alabama Cooperative Fish and Wildlife Research Unit, Auburn University, 311 Funchess Hall, Auburn, AL 36849; 334/844-9190; FAX 334/844-9208; eirwin@acesag.auburn.edu

Pectoral spine sections through the basal recess are typically used to age channel catfish *Ictalurus punctatus*. However, validation of ages based on articulating process sections of pectoral spines of flathead catfish *Pylodictis olivaris* indicates that

annuli can be lost because of expansion of the central lumen as fish age. Previous research has indicated 58-82% accuracy for spines sectioned through the basal recess for channel catfish (ages 2-4). Otoliths and pectoral spines were collected from known-age channel catfish (ages 1-3) to compare the accuracy of age assignments derived from each structure and determine time of annulus formation. Two methods were used to process pectoral spines for aging. First, spines were sectioned through the articulating process (through the dorsal and anterior processes) and viewed using transmitted light. Second, the cut portion of the spine was viewed using a fiber optic filament to illuminate annuli. Both methods accurately aged channel catfish (mean=90%) and minimized error due to loss of annuli from expansion of the central lumen. In addition, the fiber optic method reduced processing time. Both methods were less accurate as fish age increased. Marginal increment analyses indicated annulus formation occurred in late April and May. Annuli on otolith sections were present; however, they were generally faint and difficult to discern.

White Crappie Natural Mortality, Exploitation, And Regulation Analysis and Lake Chicot, Arkansas

Carlson, J. M. and S. E. Lochmann, Department of Agriculture and Fisheries, University of Arkansas, Pine Bluff, AR 71602, USA

Estimation of fishing and natural mortality in fish populations is a prerequisite to sound management action in Lake Chicot (a 5,500-acre oxbow lake in Chicot County, southeast Arkansas). The manipulation of fish mortality is a common management tool used to affect stock size. Approximately 500 adult crappie (*Pomoxis* spp.) will be collected from Lake Chicot using trap nets. Captured fish will be weighed, measured, marked with anchor tags, and returned to the lake. A \$5, \$20, or \$100 monetary reward will be offered to anglers for retaining tags and reporting areas of capture, length, and weight of tagged fish caught. Contact information for submittal of reports and reward claims will be listed on the tag. Adjustments in the number of tags returned will be made to account for angler apathy, tag mortality, and tag retention. A second collection of crappie will be made to calculate a catch curve. Data acquired will be used to estimate natural mortality and exploitation rates. These data may be used to better manage the crappie fishery and assign the decline in catchability noted by fishermen to natural or fishing mortality. Once exploitation and natural mortality rates are known, they will be used as parameters in modeling the crappie population to determine the potential effects of manipulating regulations governing Lake Chicot. Mortality estimates and population modeling could then aid in the design of a well-directed management plan to return crappie catches to historic levels and address angler concerns. Preliminary returns extrapolated to the entire year indicate an approximate exploitation rate of 16-24%. If accurate, future management should focus on natural mortality sources.

A Preliminary Analysis of the Freshwater Mussel (Unionacea) Community Inhabiting Big Piney Creek, Newton, Johnson and Pope Counties, Arkansas.

Davidson, C., Arkansas Department of Environmental Quality, Box 8913, 8001 National Dr., Little Rock, AR 72219
Antwine, M., C. Jones, and J. Stoeckel, Arkansas Tech University, Department of Biological Sciences, Russellville, AR 72801
Hilburn, C., U.S.D.A. Forest Service, Ozark-St. Francis National Forest, Russellville, AR 72801

Qualitative and quantitative data on the mussel community of the upper and middle reaches of Big Piney Creek, Arkansas do not exist. During August and September, 1999, we surveyed from approximately 3.2 km downstream of Limestone, Arkansas to the Highway 164 bridge, and collected 343 mussels (259 live and 84 relict individuals) from 10 beds and 12 aggregations. Twenty species were identified during our survey, and an additional five species are known to occur in Piney Bay, a lower portion of Piney Creek flooded by Lake Dardanelle. The predominant species of mussel found was *Actinonaias ligamentina* (48.3% of the total number). Areas of mussel beds ranged from 10 m² to 525 m², densities of mussels within beds ranged from 0.9 mussels/m² to 6.4 mussels/m². Shell dimensions were indicative of a mature mussel population, but no juvenile mussels were collected. However, we observed gravid females of several species. Information on species composition, locations of mussel aggregations, and densities of mussels within the beds provides base-line data for long-term tracking of trends within the mussel community, and can be used to more effectively manage Big Piney Creek and its watershed.

Largemouth Bass Annual Exploitation in Felsenthal National Wildlife Refuge, Arkansas as Determined by a Tag-Reward Study

Dennis, D. C., Arkansas Game & Fish Commission, P.O. Box 110, Camden, AR 71711, (870) 836-4612 Ext.11; Fax (870) 836-6508; cdennis@agfc.state.ar.us

Lochmann, S., Department of Aquaculture and Fisheries, University of Arkansas at Pine Bluff, Pine Bluff, Arkansas 71601, (870) 543-8165; Fax (870) 543-8124

Currently, there is a concern with an apparent lack of largemouth bass (*Micropterus salmoides*) exceeding 51 cm or 2.27 kg in Felsenthal National Wildlife Refuge (FNWR) reservoir, a 15,000-acre impoundment in south central Arkansas. Refuge anglers have reported annual fish die-offs during the summer months. Analysis of electrofishing data revealed that RSD-P was at the low end of the acceptable range and tournament data indicated a recent decrease in the number of tournaments in which the largest bass was greater than 2.27 kg. During November 1997, a 1-year tag-reward study was initiated in FNWR reservoir to quantify exploitation. A total of 519 bass were captured, tagged with a small, PDB-type Hallprint dart tag, and released. The annual exploitation rate was adjusted for tagging mortality, tag loss, and non-reporting of tagged fish. Anglers harvested a high percentage (76%) of tagged largemouth bass. This was reflected in an annual exploitation rate (u) of 46%. Total annual mortality (A) is being calculated based on cove rotenone and electrofishing data in FNWR. Using this data, we will compare the criteria for implementing a regulation change based on the Arkansas Largemouth Bass Management Plan and MOCPOP.

Estimating the Densities of Common Carp and Their Biomass-Dependent Effects on Ponds

Drenner, R. W., J. L. Smith, S. Mann, M. Chumchal, J. Fennell, W. H. Nowlin and C. M. Edwards, Department of Biology, Texas Christian University, Fort Worth, Texas 76129, USA

We conducted two studies at the Eagle Mountain Fish Hatchery, Ft. Worth, Tx to examine: (1) the use of electrofishing catch-per-effort (CPE) to estimate population densities of common carp (*Cyprinus carpio*), and (2) the biomass-dependent effects of carp on water quality. The first study involved May-July night-time electrofishing of 18 ponds with carp densities ranging from 6 to 507 carp/ha. Carp density was a statistically significant linear function of electrofishing CPE ($P < 0.01$, $r^2 = 0.43$). The second study involved May-June sampling of water quality variables in 11 ponds with carp biomass ranging from 0 to 466 kg/ha. Chlorophyll *a* and total phosphorus increased as significant linear functions of carp biomass ($P < 0.05$, $r^2 = 0.38$, 0.39 , respectively).

“EQIP”ing the Landowner with Solutions to Streambank Erosion Problems

Filipek, S., Arkansas Game and Fish Commission, Stream Team Program, #2 Natural Resources Dr., Little Rock, AR 72205, (501) 223-6371, fax (501) 223-6461, sfilipek@agfc.state.ar.us

Oliver, M. (mloliver@agfc.state.ar.us) and K. Shirley, Arkansas Game and Fish Commission, 151 Hwy. 201, Mt. Home, AR 72653, (877) 425-7577, fax (870) 425-7883

Glennon, B., Natural Resources Conservation Service, Federal Bldg., Room 5404, 700 W. Capitol, Little Rock, AR 72201

Sediment is the number one pollutant in Arkansas and in the United States as well. Sediment can severely impact aquatic biota in streams in a number of ways including smothering of eggs, fry and food organisms and degradation of in-channel habitat. Research has shown habitat degradation as a major cause in fish composition changes. The source of a substantial amount of the sediment reaching many streams is erosion of the streambanks and channels themselves and/or associated riparian areas. The 1996 Farm Bill provided several programs for federal and state agencies to work with private landowners to restore degraded land and habitat, and to renovate impacted riparian areas. A 250-m long by 6-m high bank on Crooked Creek, a nationally renown smallmouth bass (*Micropterus dolomieu*) stream, was eroding at a rate of 2 m/year due to clearing to the edge of the stream as well as instream gravel mining. Using a Farm Bill program called EQIP (Environmental Quality Incentive Program) administered by the National Resources Conservation Service, Arkansas Game and Fish Commission fisheries biologists led a team of several state, federal, and volunteer entities to attempt to repair the streambank and reduce erosion. A cedar tree revetment in association with erosion control matting, revegetation using rooted and unrooted cuttings were used to control the bank sloughing. A limited amount of channel work was done to change the hydraulic control and to move the stream back to its original channel. The total cost of the project (\$26K) was shouldered by several agencies so that the landowner was only out 25% of total costs. This work decreased sediment input from this bank by 1,000+ tons/year.

Habitat Partitioning by a Lotic Crayfish Community of the Ozark Plateau with Emphasis on the Imperiled Mammoth Spring Crayfish

Flinders, C. and D. Magoulick

The American Fisheries Society Endangered Species Committee recently listed the Mammoth Spring crayfish (*Orconectes marchandi*) as endangered, as populations were known in only two streams of Missouri and Arkansas and little was known of the distribution, life history, and ecological factors affecting *O. marchandi* populations. As part of a study to determine the status of the Mammoth Spring crayfish, we examined habitat partitioning and the importance of physical characteristics in determining crayfish community structure at two sites each on the Warm Fork River, Missouri and Janes Creek, Arkansas. Twenty replicate quadrat samples were collected from six macrohabitat types (riffle, run, pool, stream margin, vegetated areas, and backwater) at each site and the physical characteristics from each sample were quantified. Four crayfish species were collected (*O. marchandi*, *O. ozarkae*, *O. punctimanus*, and *Cambarus hubbsi*) and divided into two size classes for examination by CCA. Species-size class composition differed significantly by stream, site, and macrohabitat type. Densities of *O. marchandi* were similar in both streams with small crayfish positively associated with stream margin and backwater habitats and large specimens positively associated with pools in both streams, and with runs in Janes Creek. *Cambarus hubbsi* and *O. punctimanus* were significantly more abundant in the Warm Fork than in Janes Creek with both large and small *C. hubbsi* found primarily in the faster riffles and runs and small *O. punctimanus* in vegetated habitats. *Orconectes ozarkae* was less abundant in the Warm Fork than in Janes creek with small crayfish showing a positive association with vegetated habitats and large crayfish with runs. Separate analyses performed on each stream ordinating environmental variables with relative crayfish abundance indicated that measured environmental variables were responsible for a significant amount of spatial variation in crayfish density. In both streams, vegetation, mean current velocity, water depth, and percent canopy cover were the most important factors in explaining differential crayfish density. Crayfish density was positively associated with vegetated areas and negatively associated with water depth, current velocity, and absence of canopy cover. These data show habitat partitioning in this lotic crayfish community and demonstrate the importance of physical variables in explaining crayfish community structure with stream margin, backwater, and pool macrohabitats appearing particularly important to the imperiled Mammoth Spring crayfish.

Fishing for Future Anglers

Forsrage, A., Texas Parks and Wildlife Department, Texas Freshwater Fisheries Center, 5550 FM 2495, Athens, Texas, 75751, (903) 670-2224, Fax (903) 676-3474, allen.forsrage@tpwd.state.tx.us

Most fisheries managers in the nation are dealing with a dramatic decline in fishing license sales. Texas fishing license sales have declined dramatically since peaking in 1983. Officials blame urbanization, cost, and increased competition for leisure time. Responses to this problem have precipitated an assortment of aquatic and sportfishing promotions designed to recruit new anglers. The Texas Parks and Wildlife Department, Inland Fisheries staff has reached over 103,842 youth through 558 youth fishing events from January 1, 1996 to August 31, 1999. In addition, in 1996 a new educational-based fisheries outreach facility, the Texas Freshwater Fisheries Center, opened an agency-city-private collaboration. The focus of this effort was to provide an educational, entertaining visitor experience that promotes freshwater sport fishing and the enhancement, conservation, and stewardship of aquatic resources in Texas. In addition, the center was designed to generate revenue to defray the cost of operations. In the first three years of operation, the center has had 213,858 visitors of which 73,920 were school-age youth and generated over one million dollars in project income.

Texas Trophy Bass Program

Forsrage, A. and T. Owens, Texas Parks and Wildlife Department, Texas Freshwater Fisheries Center, 5550 FM 2495, Athens, Texas 75751

ShareLunker program data from 1986-1999 were evaluated to determine benefits of this angler participation program. This program allowed anglers to loan largemouth bass weighing at least 5.90 kg to the department for research, spawning, and public relations/education purposes. During the 13-year period, 298 anglers participated in the program providing the department an opportunity to analyze a segment of the largemouth bass fisheries that could not be studied using traditional sampling methods. In addition to collecting age, length, weight, and genetic data, these fish were used in our fish hatchery program for production and future brood fish programs. The program also resulted in education about the value of catch and release plus marketing of the department's management and culture efforts. Results indicate that carefully designed angler participation programs allow state agencies to collect life history and performance data while providing a program that increased public participation in catch and release fishing of trophy largemouth bass.

Community Involvement – A More Comprehensive Approach to Recovering Endangered Species

Garrett, G. P., Texas Parks and Wildlife Dept.; HOH Research Station; Ingram, TX 78025

Texas Parks and Wildlife has embarked on an aggressive approach to resolving endangered species problems through cooperative programs with local governments and especially private landowners. Our work in the Balmorhea area involved local citizens, the city, three universities, four NGOs, five state and three federal agencies. Together we created a “natural” ciénega, made progress towards eliminating a source of genetic contamination, enhanced bird watching opportunities and began developing an improved sport fishery. We are now working on two Conservation Agreements in other West Texas locations that are designed to resolve problems with two additional fish species and if successful, will preclude the need to list these species as endangered. With the Devils River Minnow Conservation Agreement we will work closely with landowners and the City of Del Rio to determine and resolve life history requirements and restore populations to natural levels. In so doing we will also be protecting the quality of the Devils River and associated streams. A major component of the Pecos Pupfish Conservation Agreement will be creation of alternate habitat on private lands. By involving individuals and local governments in conservation of endangered species, we are more likely to achieve long-term benefits for natural resources as well as public health and quality of life.

Utilization of Salt Marsh Edge Habitats by Newly Settled Sciaenids in West Galveston Bay, Texas

Geary, B. W., J. W. Webb, J. R. Rooker, Texas A&M University, 5007 Avenue U, Galveston, Texas

Postsettlement patterns of habitat use along salt-marsh shorelines of West Galveston Bay, Texas were examined for spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), and Atlantic croaker (*Micropogonias undulatus*) from the commercially valuable family Sciaenidae. Monthly collections were made from May through December 1997 using a 1.5-m beam trawl pulled along the edge of salt-marsh shorelines and tidal creeks ranging in location from near a tidal pass (< 2 km) to > 25 km from the tidal pass. *Cynoscion nebulosus* occurred in collections May-October peaking in June ($0.245/\text{m}^2 \pm 0.059$ SE). *Sciaenops ocellatus* were collected September-November with peak densities in September ($0.09/\text{m}^2 \pm 0.059$) while *M. undulatus* occurred October-December peaking in November ($0.03/\text{m}^2 \pm 0.009$). Over 98% of the fish collected were <30 mm standard length (SL), with all *C. nebulosus* and *S. ocellatus* ≥ 5 mm SL; all *M. undulatus* collected were ≥ 7 mm SL. *Cynoscion nebulosus* were smaller, and significantly more numerous, along interior bay shorelines than at shorelines near the tidal pass. Conversely, *S. ocellatus* were collected in significantly higher numbers, and at a smaller size, at shorelines near the tidal pass. A similar, but nonsignificant, trend was observed for *M. undulatus*. Few *C. nebulosus* and *S. ocellatus* were collected from tidal creeks located at the rear of a tertiary bay, although the majority collected were larger than occurred in either interior bay or shorelines in the vicinity of the tidal pass. The smallest size classes of *M. undulatus* were collected in tidal creeks as well as near a tidal pass. This research suggests that settlement of *C. nebulosus* and *S. ocellatus* may occur at the first salt marsh habitat encountered (i.e. interior bay and tidal pass area shorelines, respectively), with movement to remote tidal creeks occurring after initial settlement. No clear pattern occurs in *M. undulatus*, with settlement occurring at salt marsh habitats in various locations.

Fish Assemblages of Richland Creek and Keechi Creek Wildlife Management Areas, Texas

Gelwick, F. P., B. Healy, N. Dictson, J. Goff, and T. Lantz, Texas A&M University

These Wildlife Management Areas are located within the Trinity River Drainage in the Post Oak Savannah Ecological Region and contain mostly bottomland hardwood forest. The Areas are state-owned and were purchased by the Texas Parks and Wildlife Department with funds provided by the Texas Waterfowl Stamp and from mitigation funds. The acquisition fulfilled the wildlife habitat mitigation obligation for losses resulting from reservoir construction. The areas were purchased primarily for the preservation of bottomland hardwoods, managed for wildlife species and their habitats and to provide quality consumptive and non-consumptive public use of these resources. While waterfowl management is a major focus, these areas also contain a range of aquatic habitats for fishes. To provide a baseline survey for monitoring biodiversity of fishes in these habitats, we took samples in spring, summer and early fall of 1998 and 1999 in Richland Creek WMA, and 1999 in Keechi Creek WMA. Principal habitats included a spring, streams, oxbows, sloughs, swamps, ponds, and diked wetlands. The life histories and trophic guilds for dominant species were used to characterize fish assemblages in each habitat. The spring was characterized by water-column invertivores with equilibrium life histories. Streams contained

primarily omnivores, benthic invertivores and water-column invertivores with opportunistic and periodic life histories. Oxbows, ponds, and diked wetlands were dominated by a range of trophic groups, including predators, with periodic and equilibrium life histories. Swamps and sloughs were dominated by omnivores with both periodic and opportunistic life histories. Management of these areas should include consideration of natural flow regimes that maintain the range of habitat types and their natural ecological functions in order to sustain such diverse assemblages of fishes.

Preliminary Results on the Impacts of Environmental Perturbations on Commercial Fishermen

Harden M. M. (harden_mm@wlf.state.la.us), T. L. Romaire (romaire_tl@wlf.state.la.us), and J. G. Hanifen (hanifen_j@wlf.state.la.us), Louisiana Department of Wildlife and Fisheries, P.O. Box 98000, Baton Rouge, LA 70898-9000; 225/765-2382; FAX 225/765-2624

In the spring of 1998 the Department began the large-scale study, "Monitoring the Effects of Environmental Perturbations on Commercial Fishermen". This project, funded by NOAA, consists of a logbook survey and an environmental monitoring program. The logbook survey involves the collection of trip specific information: fishing conditions and location, landings, trip-related expenses and vessel expenses. The environmental monitoring program consists of 10 offshore sampling trips per year and collects profiles with a multi-parameter sensor for conductivity, temperature, depth and dissolved oxygen, and bottom water samples at up to 40 stations. The goal of these sampling trips is to identify the hypoxic fronts and further relate this environmental data directly to fishery effort determined by the logbook survey. Analysis of this full year of logbook collections describes commercial fishing effort and provides comparisons between the occurrences of hypoxia in the 1998 and 1999 summers environmental monitoring programs' sampling, and documents the "Dead Zone" in the study area. Data collected on the annual SEAMAP cruises are also utilized. Grant NA76FK0429 from the National Oceanic and Atmospheric Administration funded this work. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies.

Distribution of Benthic Stream Fishes and Crayfish in the Sam Houston National Forest

Healy, B. D. and F. P. Gelwick, Department of Wildlife and Fisheries Sciences, Texas A&M University

Benthic stream invertivores are sensitive to environmental disturbances such as siltation and drought that reduce available habitat and food resources. The distribution and abundance of crayfish and benthic stream fishes are a focus of conservation efforts because their numbers have been declining and they are likely sensitive to such environmental disturbances. However, differences in their sensitivity to various types of environmental disturbances could influence their relative distribution and abundance. In addition, some studies indicate that crayfish may negatively influence distribution and abundance of benthic stream fish via competition for food resources and predator-free space. In habitats where resources are scarce due to environmental disturbance, such interactions are likely to be stronger. To evaluate the distribution and possible interactions among members of this benthic invertivore guild, we surveyed 35 discrete mesohabitat units (pools or runs) in 6 streams within the San Jacinto and Trinity River drainages in East Texas using block nets and back-pack electrofishing. For initial samples in fall 1999, percent similarity was 40% for crayfish and benthic fish occurrence across sampled mesohabitats. Within mesohabitats, the abundance of both crayfish and benthic fish increased with habitat area except in the largest runs, in which small crayfish (40.2 mm mean length, rostrum to tail) were abundant, but few benthic fishes (46.8 mm mean SL) were collected. Because ontogenetic niche shifts for both crayfish and benthic fishes may occur, our continued sampling during January through April will document temporal change in distribution and abundance of these taxa by size class.

The History and Current Status of the Invasive Exotic Plant Giant Salvinia (*Salvinia molesta* (Mitchell)) in Texas

Helton, R. J., Texas Parks & Wildlife Department, Jasper, Texas 75951

A new and highly invasive aquatic plant species, *Salvinia molesta* (Mitchell) or Giant Salvinia, was discovered in Houston, Texas, in the spring of 1998. Distribution through October 1999 has been confirmed in 2 public reservoirs, 3 streams and approximately 30 private ponds, primarily across the eastern half of the state. Public education efforts as well as Integrated Pest Management (IPM) strategies have been implemented to halt the plant's spread. A threat to the state's aquatic resources exists.

A Simple Procedure for Transporting and Deploying Large Holding Nets

Hernandez, J. L., J. C. Chamberlin and R. W. Wienecke, Texas Parks and Wildlife Department, HC 07, Box 62, Ingram, TX 78025

A recent evaluation of angling mortality associated with black bass (*Micropterus* spp.) tournaments required the use of large cylindrical holding nets (5.5 m in diameter and 9.1 m deep) capable of holding 200 adult largemouth bass (*M. salmoides*). Because typical work boats are only 5-6 m in length, a means had to be developed to effectively and efficiently transport and deploy the nets. A scissor-like apparatus was fabricated to fit a 5.5-m flatbottom boat. Each arm of the scissors was constructed of a 6.1-m, 5.1- x 8.0-cm board. Upon launching the boat, the apparatus was extended (scissored open) and attached to the gunwales with clamps with the midpoint of the scissors approximately 2 m from the front of the boat. Each holding net was secured to PVC-pipe framing and assembled atop two parallel 6.1-m, 5.1- x 8.0-cm wooden runners on shore. The runners allowed the assembled net to be carried to the boat and placed on the scissor-like frame, providing support for the net while allowing it to extend beyond the front of the boat. Once transported to the deployment site, a second boat simply pulled alongside the transport boat and raised the ends of the runners, allowing the holding net to slide down the runners into the water. When in the water, weighted bottom holding net frames sank while the top buoyant frame floated on the surface. Assembly and deployment of each net took about 30 minutes and required a crew of about 5 people.

Effect of Low Summer Streamflow on Smallmouth Bass Movements in Crooked Creek

Hodges, S. W. and C. J. Gagen, Fisheries and Wildlife Biology Program, Arkansas Tech University, Russellville, AR 72801

Natural hydrologic conditions cause the surface flow of many streams in the interior highlands to dry extensively during the summer. The objective of this study was to determine how smallmouth bass respond to low summer streamflow in Crooked Creek. Twenty-four smallmouth bass were surgically implanted with radio transmitters in the spring of 1998 and another 27 in the spring of 1999. The fish were tracked through August. The downstream region of the 50-km study section lost surface flow in both years; whereas, the upstream end remained perennial. Fish were captured and released farther downstream in 1999, however, depths at fish locations were similar in both years (mean of 84 cm in 1998 and 93 cm in 1999). Water velocity was also similar at fish locations in 1998 and 1999 (means of 12 cm/s and 17 cm/s, respectively). Fish that were tagged and released in areas prone to drying, moved to avoid being trapped in diminishing pools except one, which was trapped in a pool and died. We also observed that fish captured and released in perennial conditions (N=21) showed little net movement; whereas, those in the drying portion (N=30) moved great distances upstream (mean net movement of 658 m versus 14,700 m, respectively). Substantial downstream movements were associated with rain events that resulted in re-wetting of the downstream reaches. Most of the fish (78.4%) were still swimming in the stream at the end of the study. These data were consistent with the hypothesis that smallmouth bass move to more perennial reaches to increase survival probability in streams that dry extensively.

Mortality Assessment of Tagging Largemouth Bass

Hollingsworth, S. D., K. L., Pope (kpope@ttu.edu), and G. R. Wilde (gwilde@ttu.edu), Department of Range, Wildlife, and Fisheries Management, Texas Tech University, Lubbock, Texas 79409

We compared delayed (6 days) mortality rates among tagged (Floy tag) and untagged largemouth bass *Micropterus salmoides* that were captured by angling and electrofishing. No difference in delayed mortality rates was found between tagged and untagged largemouth bass. Delayed mortality was higher for largemouth bass collected by angling than electrofishing. Overall, delayed mortality rates were high for all fish captured, likely due to poor condition (i.e., low relative weights) of largemouth bass.

Some Life History Aspects of the River Shiner in the Arkansas River, Crawford County, Arkansas

Hudson, L. D., Fisheries and Wildlife Biology Program, Arkansas Tech University, Russellville AR 72801
Buchanan, T. M., Department of Biology, Westark College, Fort Smith, AR 72903

The river shiner, *Notropis blennioides*, is widely distributed throughout the Arkansas and Mississippi rivers and well as the lower Wisconsin River. Most previous records of the river shiner are from the Mississippi River and the lower Wisconsin River and contain little information. The purpose of this study was to determine some aspects of the river shiner's food habits, reproductive biology, and age and growth in a population in the Arkansas River, Crawford County, Arkansas. We collected samples of the river shiner by seine monthly from May 1996 through April 1997, biweekly from May 1997 through September

1997, and every three hours for a twenty-four-hour period on June 29 and 30, 1998. The reproductive season extended from May through September with notable peaks in both June and August. During the reproductive season we noted tubercle formation in males on the dorsal side of the pectoral fin rays 2 - 7. The diet of the river shiner consisted mainly of detritus and algae although a variety of food items were found, including insects, crustaceans, seeds, and vegetation. Seasonal feeding intensity was greatest during the summer. The 24-hour feeding intensity was greatest around 6:30 p.m. However, feeding never completely ceased during the sample period. Length frequency distributions indicate that the river shiner lives for approximately 2 years and reaches lengths up to 68 mm standard length. The river shiner's long success in the Arkansas River is probably due to its long reproductive season and its utilization of a wide variety of food sources in its diet.

Utilization of Constant Recording Monitors to Establish Patterns and Trends in Environmental Conditions

Hutcherson, B. M. (hutcherson_b@wlf.state.la.us) and T. L. Romaine (romaine_tl@wlf.state.la.us), Louisiana Department of Wildlife and Fisheries, P.O. Box 98000, Baton Rouge, LA 70898-9000; 225/765-2950; FAX 225/765-2624;

The monitoring of environmental water data in real-time has been useful for fisheries management in many ways, such as setting seasons, establishing the necessity to open and close areas to fishing, and identifying areas with the potential for outbreak of *Vibrio* in shellfish. During the summer of 1999, after a drier and warmer spring than usual, the data furnished the LDWF biologists with up-to-the-minute tracking of environmental conditions. The data received from the Louisiana Office of State Climatology is mirrored in the results from the data collection platforms along the coast which record water temperature, salinity, water elevation, wind speed, wind direction, and precipitation.

Current research focus is turning to Harmful Algal Blooms in the Gulf of Mexico. Some species can cause animal mortality and problems for humans. The data from the DCP stations can be used in conjunction with other environmental data to establish patterns associated with HABs.

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Overview: Methods for Estimating Ploidy Levels

Jenkins, J. A.. U.S. Geological Survey, National Wetlands Research Center, Lafayette, LA.

Numerous studies have demonstrated the link between triploidization and sterility in aquatic animals. Sterility may preclude gonadal development or functional germ cell production, and energies may be diverted toward growth and other performance characteristics rather than reproduction. Induced triploids have an extra chromosome set through treating fertilized eggs with either temperature shock, hydrostatic pressure, or chemical treatments shortly after fertilization. While there are no gross morphological differences between diploid and triploid animals, several methods have been devised to assess ploidy status. Diagnosis of triploidy by red blood cell size is possible due to increases in cell size and in nuclear volume measured by microscopy or Coulter counter. Direct chromosome numbers and morphologies can be determined through karyology. Silver-stained nucleoli can be counted in cells from any tissue. Quantification of DNA by flow cytometry is effective because triploid cells contain 1.5 times the quantity of DNA than diploid cells. These methods, and a new prediction method being developed in our laboratory, will be considered with regard to expense, availability, accuracy, and labor requirements.

Impacts of Zebra Mussel Infestation on the Fish Community of Lake Dardanelle, Arkansas

Jones, C. W. and J. N. Stoeckel, Arkansas Tech University, Fisheries and Wildlife Biology Program, Russellville, AR 72801

Zebra mussels (*Dreissena polymorpha*) were found in Lake Dardanelle, Arkansas in 1992. Since that time, mean densities of adult mussels sampled at 15 sites have been observed as high as 7,302/m². Filter-feeding activities of dense zebra mussel populations can drastically increase water clarity and otherwise alter the ecology of rivers and reservoirs. To assess the impacts of zebra mussels on the fish community of Lake Dardanelle, we compared three years of pre-infestation data for key biological parameters to three years of post-infestation data. We compared pre- and post-infestation densities of the major zooplankton groups, the growth rates of largemouth bass and blue catfish, and the abundance and size structure of freshwater drum, blue catfish, largemouth bass, gizzard shad, and threadfin shad populations. Zooplankton were collected biweekly by pulling a 64 Fm mesh conical net from a depth of 3 m to the surface. Fish for age and growth analysis, and for abundance and size structure analysis were collected at two sites in annual rotenone samples.

Analysis of Stocking and Harvest Variables in Earthen Florida Largemouth Bass Fingerling Rearing Ponds

Kurten, G., Texas Parks and Wildlife Department, Inland Fisheries, A. E. Wood Fish Hatchery, 507 Staples Road, San Marcos, Texas 78666

Six years (1992-1997) of data from 197 Florida largemouth bass (*Micropterus salmoides floridanus*) rearing ponds was analyzed to examine the relationships between fingerling harvest variables and fingerling stocking variables and zooplankton densities. Fish growth was the most reliably predicted harvest variable ($r^2=0.44$). Growth was adequate to produce 38-mm fingerlings at maximum fish stocking densities of 690,000 fish/ha only if Cladoceran and Copepod densities were at the highest values for the dataset. Fish survival increased with fry stocking size. The optimum stocking size to provide 60% survival of fingerlings was about 20 mm. Harvest biomass and harvest length appeared to be improved by lengthening the interval between pond filling and fish stocking. Harvest density was improved by increasing one indicator of fish stocking size; stocking biomass and by increasing stocking densities. Survival seemed to be a poor indicator of production success because, while survival rates decreased with stocking density, actual harvest densities increased. Zooplankton densities at stocking and at seven days after stocking were, generally, weak indicators of harvest variables. However, Cladoceran and Copepod nauplii densities at stocking and Rotifer densities at seven days after stocking appeared to be significant indicators of fish production success. The low correlation of fish production and zooplankton variables and the indication that lengthening the pond filling to stocking interval improves harvest biomass and harvest length seem to indicate that managing for immigration and development of other, larger pond invertebrates may improve fish production above managing for zooplankton alone when the target production size for Florida largemouth bass fingerlings is 38 mm.

The Influence of Road Crossings on Fish Movement in Ouachita Mountain Streams

Landrum, C. and C. J. Gagen, Fisheries and Wildlife Program, Arkansas Tech University, Russellville, AR 72801
Standage, R. W., U.S. Department of Agriculture Ouachita National Forest, Hot Springs, AR 71902

Low-water bridges are common in forested upland ecosystems. This study was initiated to measure the influence of road crossings on fish movement and assess the impact of the crossings on fish communities. We established three, sample sites in each of six upland tributaries of the Ouachita River, Arkansas. Three of the tributaries had crossings modified in an attempt to improve fish passage. The three sample sites included a 50-m reach upstream of a low-water bridge, another 50-m reach downstream of the bridge, and a 50-m reference reach. The low-water bridge was within a non-sampled 50-m reach between the upstream and downstream sampled reaches. Similarly, a 50-m reach without a low-water bridge, was not sampled between the downstream and reference reaches. We captured fish by electrofishing and marked them differentially by reach with a sub-cutaneous injection of a biologically compatible fluorescent dye three times in the spring and three times during the summer. Fish were less than half as likely to move 50 m across reaches with low-water bridges compared to 50-m reaches without low-water bridges. Fish moved upstream and downstream equally between reaches not separated by low-water bridges, but were twice as likely to move downstream, rather than upstream, between reaches separated by low-water bridges. Average species richness was higher for fish communities downstream of the low-water bridges compared to upstream (12.5 versus 6.3) indicating that the reduced movement could affect community structure. Two low-water bridges back-filled with rip-rap to eliminate the plunge pools below the aprons were the only ones allowing upstream fish passage. These preliminary findings suggest that engineering design could lessen the impact of road-crossings on the structure of fish communities in streams.

Use of Geothermal Water in the Production of Channel Catfish

Lang, R. P., R. P. Romaine, G. S. Roppolo, and T. R. Tiersch, Aquaculture Research Station, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA 70820

The purpose of this project was to use geothermal well water to raise pond temperatures to induce early spawning in channel catfish *Ictalurus punctatus*. From February 23 to March 5, groups of 15 female and 8 male channel catfish were stocked into six 0.04-ha ponds with an average depth of 1.3 m. Temperature was controlled by addition of water (~29 °C) from a 700-m well, and was raised from ambient at ~2 °C per d until reaching the target of 26 °C. One week prior to the addition of heated water, spawning cans (80-L) were placed at the corners of all ponds. Data loggers were suspended 1 m above the pond bottom and temperature was recorded at 24-min intervals. Cans were checked every 3 d until four egg masses (per pond) were collected and the cans were removed. The ponds were seined and artificial spawning was induced in recirculating systems by pairing of males with females injected with synthetic leuteinizing hormone-releasing hormone (100 µg/kg). Eggs were stripped into greased bowls and fertilized with sperm collected from males from the same pond. Percent

fertilization was estimated for egg masses when collected from the pond and at 24 h after fertilization for artificially spawned masses. Ponds 1 and 2 were heated from March 14 to April 22. Egg masses were collected from March 26 to April 10. In total, 47% (7 of 15) of the females spawned from Pond 1; fertilization was $91 \pm 2\%$ for pond spawns and $88 \pm 2\%$ for artificial spawns ($n = 3$). For Pond 2, 67% (10 of 15) of the females spawned; fertilization was $90 \pm 4\%$ for pond spawns and $91 \pm 2\%$ for artificial spawns ($n = 6$). Pond 3 was heated March 23 to April 22, and egg masses were collected from April 7 to April 16. Artificial spawn data was not collected, and fertilization for was $90 \pm 4\%$ for pond spawns. Pond 4 was heated from March 23 to Mar 30, and then allowed to return to ambient temperature. Egg masses were collected from April 10 to April 28. In total, 60% (9 of 15) of the females spawned; fertilization was $80 \pm 9\%$ for pond spawns and $73 \pm 12\%$ for artificial spawns ($n = 5$). Masses were collected from unheated ponds (5 and 6) from April 28 to May 7. For Pond 5, 30% (5 of 15) of the females spawned; fertilization was $83 \pm 6\%$ for pond spawns and 90% for artificial spawns ($n = 1$). For Pond 6, 40% (6 of 15) of the females spawned; fertilization was $89 \pm 2\%$ for pond spawns and 90% for artificial spawns ($n = 2$). Heated Ponds 1 through 4 each produced four egg masses each before the onset of natural spawning. Thus, channel catfish in ponds can spawn when ambient water temperature would otherwise be below the minimum temperature threshold for natural spawning ($\sim 24^\circ\text{C}$) if the ponds are provided with supplemental heat. In addition, temporarily raising pond temperature accelerated the onset of natural spawning. Future studies could address polyculture in heated ponds and explore alternative sources of energy to heat ponds.

Effects of Cobalt-60 Gamma Irradiation on the Production of the Malaysian Prawn *Macrobrachium rosenbergii*

Lee, N. and T. R. Tiersch, Aquaculture Research Station, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA 70802

Commercial production of the Malaysian prawn *Macrobrachium rosenbergii* did not start until the early 1960's when Ling successfully closed the life cycle indoors. This was followed by the success of Fujimura in the late 1960's in mass rearing of larvae and in pond culture techniques. In spite of these successes, the production of farmed freshwater prawn remains around 3% of total global crustacean aquaculture production. The basic constraint to profitable culture of this species is growth suppression and variation due to social pecking orders. This leads to highly skewed size distributions with large variance necessitating markets for many size classes. High doses of ionizing radiation have been successfully used to induce sterility in some aquatic species, and aquatic animals exposed to low doses of ionizing radiation in some cases showed better survival and growth than unexposed animals. However, the effects of ionizing radiation have not been studied in prawns. In this paper, we evaluate the use of ionizing radiation to improve yield of cultured prawns. Juvenile prawns (4.5 ± 0.5 cm and 0.7 ± 0.2 gm) were irradiated using a Shepherd irradiator (Model 484R) at the LSU Nuclear Science Center. Five doses were chosen (0, 0.5, 1.0, 1.5 and 2.0 krad) because our earlier studies yield total mortality at 2.5 krad and above. Each treatment consisted of 42 animals (equivalent to a density of 60,000/ha) and was replicated four times. Prawns were fed sinking pellets (32% protein) and were raised for 16 weeks in 5,600 L tank (7-m² bottom area and 1.2 m depth). At the end of the study, percent survival, weight, total length and morphological characteristics of the prawns were recorded.

Dose (krad)	Survival (%)	Individual weight (gm)	Yield (gm/tank)	Total length (cm)
0	69 ± 17^a	34.2 ± 11.3^a	993 ± 194^{ab}	14.0 ± 1.7^a
0.5	86 ± 16^a	32.3 ± 12.1^{ab}	$1,171 \pm 253^a$	13.8 ± 1.9^a
1.0	67 ± 11^a	29.2 ± 11.2^b	825 ± 109^b	13.6 ± 1.9^a
1.5	24 ± 13^b	24.7 ± 12.9^c	253 ± 122^c	12.9 ± 2.3^b
2.0	1 ± 1^c		1 ± 3^d	

Values sharing a superscript letter were not significantly different.

The average body weights, total length and percentage of individuals weighing 22 gm and above decreased with increased doses of gamma rays. The number of virgin females increased with increased doses and the number of gravid and open females decreased with increased doses. However, prawns exposed to 0.5 krad of gamma rays have better survival than did the control and other treatments. This resulted in higher production (1,673 kg/ha) at the end of the study (Table 1) which is equivalent to 254 kg/ha more than the control (1,419 kg/ha).

Morphometric and Lipid-Based Measures of Condition for Sunshine Bass Fry

Lochmann, S. and G. Ludwig, Aquaculture and Fisheries Center, University of Arkansas at Pine Bluff, P.O. Box 4912, Pine Bluff, Arkansas 71603 slochmann@uaex.edu

Survival of sunshine bass during fingerling production varies considerably. The variability may be due to food limitation, predation, or other environmental factors. Assessment of condition of fry early in the production run might give an indication of probability of survival. To calibrate a morphometric and a lipid-based measure of condition in fry we reared sunshine bass in 260-L black cylindrical tanks. Stocking rate was 20 fry/L. Fish were fed natural zooplankton (65 microns < plankton < 150 microns) daily at a rate of 20 prey items/L. Beginning at age 9 days fry were offered 50% protein microencapsulated feed at a rate of 1g/2.4 h. On the first day of each week for three weeks, twenty fry were videotaped and preserved at -70 C. Approximately 200 fry denied food by placing them in 3.7 L glass jars with gentle aeration. On the second day of each week 15 fry from the cylindrical tank and 15 fry from the glass jar were videotaped and preserved. This was repeated as long as there were fry in the glass jars. Morphometric measurements taken from the video images including total length, head length, head height, eye diameter, body depth at the pectoral fin, body depth at the anus, and gut height. We examined ratios of body measurements previously shown to be useful in assessing condition in striped bass. We were fairly successful in discriminating relatively well-fed fry from food-deprived fry. Fry were processed for lipid analysis using an Iatroscan TLC-FID system. We also used the ratio of triacylglycerols to sterols as a measure of condition. This spring we will collect fry from outdoor ponds to look for a correlation between condition and survival during the 6-week production cycle.

Status and Distribution of Pallid Sturgeon, Shovelnose Sturgeon, Blue Sucker, and Other Large River Fishes in the Arkansas, White, and St. Francis Rivers, Arkansas

Phillips, J. W. and W. G. Layher, Layher Biologics RTEC, Inc., Pine Bluff, AR

Portions of the Arkansas, White and St. Francis Rivers were sampled during 1999 in an attempt to document the occurrence of the endangered pallid sturgeon (*Scaphirhynchus albus*). A combined effort of 495 hoop net nights, 17 gill net nights, and 14 trotline nights failed to capture any pallid sturgeon. Blue suckers (*Cycleptus elongatus*) were captured in all of the rivers, however they were most abundant in the lowest section of the Arkansas River. They were usually associated with deep, swift habitat with one notable exception. Large numbers of blue suckers were captured in relatively calm water adjacent to a flooded oxbow of the Arkansas River. Shovelnose sturgeon also occurred in all three rivers. The White River sampling accounted for the majority of the sturgeon catch. Most were caught in fast, moderately deep water near drop-offs. Due to the proximity of all three rivers to the Mississippi River, it is likely that pallid sturgeon at least periodically inhabit some or all of these streams. This sampling effort targeted 26 river segments collectively in all three rivers and represents a minimal effort.

Intracytoplasmic Sperm Injection (ICSI) in Zebrafish Eggs

Poleo, G. A. and T. R. Tiersch, Aquaculture Research Station, Louisiana Agricultural Experimental Station, Agricultural Center, Louisiana State University, Baton Rouge, LA 70820

Direct injection of sperm into the cytoplasm of oocytes was first reported in sea urchin and amphibians 30 years ago. More recently, this technique has been found to be useful in humans to overcome some of the problems related to male infertility. In domestic animals intracytoplasmic sperm injection (ICSI) has become an area of intensive research due to its potential for stock improvement. This technique also has been recognized as a valuable method for the preservation of endangered species with difficulties to reproduce in captivity. However, aside from the original studies of sperm injection in echinoderms, other work has not been reported in aquatic organisms.

Using zebrafish *Danio rerio* as a model we were able to inject single sperm into eggs and obtain phenotypically normal larvae. As observed in other organisms, we also found that injection of sperm can cause lethal damage. However, unlike mammals, in which inviable embryos only undergo early development, zebrafish developed to the post-gastrula stage despite altered phenotypes. From 74 eggs injected with single sperm cells, five embryos developed to the gastrula stage, two developed abnormally past gastrulation and one developed normally and hatched. Measurement of the DNA content of the normal fish, by flow cytometry, showed it to be diploid. However, with this experiment we were not able to distinguish the contribution of male and female gametes. To overcome this we have begun use of a zebrafish line possessing a recessive phenotype for pigment (gold) and fin shape (long fins) as an egg donor, together with sperm from zebrafish carrying dominant phenotype for pigment (wild type).

These preliminary results show that ICSI is possible in fish and opens the door to new areas of research, ranging from basic reproductive biology to the production of hybrids with commercial value that otherwise would not be possible. Another potential application is the use of sperm preserved by methods other than freezing, which would reduce storage costs.

Outputs from Smith-Root Boat Electrofishers

Pope, K. L., Department of Range, Wildlife, and Fisheries Management, Texas Tech University, Lubbock, Texas 79409, kpope@ttu.edu

Van Zee, B. E., Texas Parks and Wildlife Department, Inland Fisheries Division, P.O. Box 835, Canyon, Texas 79015

We evaluated the outputs from eight Smith-Root electrofishers (two factory-rigged 5.0 GPP boats, four biologist-rigged 5.0 GPP boats and two biologist-rigged 7.5 GPP boats) using an oscilloscope to determine the actual waveforms (voltage as a function of time), current and power produced for various settings. No differences were found in average power outputs among the six 5.0 GPP electrofishing boats and outputs were similar among the two 7.5 GPP boats. Thus, biologist-rigged electrofishing boats using Smith-Root manufactured generators and control boxes are an effective and cheaper alternative to Smith-Root factory-rigged electrofishing boats. We were unable to calculate power output produced by the Smith-Root electrofishers with only information obtained from the control boxes (e.g., the ammeter is calibrated to indicate the voltage range suggested for electrofishing). Thus, additional meters (e.g., voltage meter capable of measuring true root mean square) would be needed to determine power output in the field. An increase in resistance (simulating a decrease in water conductivity) resulted in a decrease in average power and current and a slight increase in voltage. Further research is needed to assess electrical fields produced in water with different conductivities. Furthermore, we need an assessment to determine how much power (and associated power density) is needed to sample fish.

Comparison of Performance Characteristics between Coppernose and Native Texas Bluegill Populations

Prentice, J. A., Texas Parks and Wildlife Department, Heart of the Hills Research Station, HC 7, Box 62, Ingram, Texas 78025, 830-866-3356, jprentic@krc.com

Growth, catchability and survival of coppernose bluegill *Lepomis macrochirus purpureus* and bluegill *L. m. macrochirus* from East (Neches River system) and West (Rio Grande system) Texas populations were compared. The three types of bluegill were stocked together (each identifiable by coded-wire micro-tags) in each of four 0.25-hectare hatchery ponds. Bluegill types were evaluated with and without an established fish community present in ponds for age 0 and I⁺. Coppernose attained larger sizes in length and weight than East or West Texas bluegills regardless of whether established fish communities were present. However, no differences in catchability were found among bluegill types, except for age age-1 bluegill without a fish community when coppernose had a lower catch rate. During that year coppernose provided a significantly lower catch rate than the other bluegill types. No differences in survival among bluegill types were found with or without an established fish community present. Due to larger sizes attained by coppernose bluegill, this fish can aid improved management and quality of selected sunfish fisheries. However, potential low catchability of coppernose compared to other bluegills observed in this study should be considered in any management plan before introduction.

Supplemental Stocking of Crappie in Lake Chicot, AR

Racey, C. L., Department of Aquaculture and Fisheries, University of Arkansas at Pine Bluff, Pine Bluff, AR 71611

The populations of black (*Pomoxis nigromaculatus*) and white (*P. annularis*) crappie in Lake Chicot, AR appear to have remained stable in recent years. However, the perception of the fishing public and the Arkansas Game and Fish Commission (AGFC) is a distinct decline in the crappie population. The University of Arkansas at Pine Bluff and AGFC have initiated a fingerling stocking program in Lake Chicot. Approximately 133,600 white crappie from the Joe Hogan State Fish Hatchery in Lonoke, AR and 6300 white crappie from ponds in Lake Village, AR were released in November and December of 1998. Another stocking of white crappie fingerlings is planned for late fall of 1999. All crappie will be marked with oxytetracycline prior to release. Trap nets will be used to sample the population at periodic intervals. Although fingerlings are not completely recruited to this gear type, the catch per net night is a reasonable means of assessing changes in relative abundance, short-term survival and overall contribution of stocked crappie to the population.

Genetic Structure and Movements of Angler-Caught Trophy Largemouth bass as Determined through a Privately-Sponsored Catch and Release Program

Ryan, M. J. and M. W. Brice, Texas Parks and Wildlife Department, 3802 East End Blvd. S., Marshall, Texas 75672

Fries, L., Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, 507 Staples Rd., San Marcos, Texas 78666

Largemouth bass (≥ 3.6 kg) entered into a trophy catch and release program sponsored by Bass Life Associates (BLA) at Caddo Lake (10,854 ha) were used to determine the percentage of recaptured entries, movement based on angler-reported catch locations, and genetic composition. One hundred and sixty seven largemouth bass entries were pit-tagged and released at participating marinas between February 15, 1997 and May 31, 1999. Following initial tagging, largemouth bass entries were scanned to determine if they had been previously tagged. Blood samples were obtained from initial entries and used to determine genetic composition using randomly amplified polymorphic DNA. Anglers entering a bass into the program were asked to identify the location of their catch on digitized-grid maps. Catch locations of recaptured bass were used to assess movements of fish following release. Sixty-seven percent of the trophy bass entered into the program were caught during the months of March and April. Of the 167 fish tagged, 18 fish (10.8%) were recaptured at least once and 4 (2.4%) were recaptured twice. The distance between initial and recapture locations ranged from 0.3 and 7.2 km (mean = 2.7 km) and corresponding time intervals between catches for individual fish ranged from 9 to 457 days (mean = 192 days). Most of the initial and recaptured largemouth bass entries (85%) were caught in the middle portion of Caddo Lake (approximately 2500- to 3000 ha), suggesting possible habitat preferences and/or homing tendencies. Genotypic composition of the BLA entries was 12.9% (N = 11) Florida largemouth bass, 41.76% (N = 38) F₁ intergrade, 43.96% (N = 40) later generation and backcross intergrades, and 2.2% (N = 2) northern largemouth bass. Considering the size of Caddo Lake and the fact that tagging was conducted over a 3-year period, percentage of recaptures was most encouraging and suggests BLA's program has contributed to the fishery by recycling trophy bass. BLA's catch and release program provided a more efficient means of gathering data on trophy largemouth bass compared to electrofishing sampling. Largemouth bass ≥ 580 mm (N = 167) were collected at a rate of 0.50 fish/man hour (total man hours = 336) during this study compared to 0.02 fish/man hour (N = 3) in 144 man hours expended during electrofishing collections over an eight year period. The program also provided a means through which the sponsor, anglers, and TPWD biologists could work together in a cooperative environment to monitor direct benefits of the angler incentive program and gather genetic and life history information on rare and valuable trophy largemouth bass.

Incorporating User Conflicts into Experimental Design: A Lake Fork Perspective

Schlechte, J. W., R. W. Luebke and T. O. Smith

Texas Parks and Wildlife (TPW) has been asked to suspend slot-length-limit regulations during black bass (*Micropterus* spp.) tournaments. Such a waiver would allow tournament anglers to retain black bass within the slot-limit; non-tournament anglers would not be granted this exemption. To measure the biological, economic and social impacts of a tournament in which slot-limits had been waived, we planned a series of six experimental tournaments. The experiment contains several unusual features designed to accommodate the concerns of the various stakeholders. Some examples of such features are: a) two independent tournaments simultaneously collecting fish, b) TPW observers on tournament boats, c) informational meetings for TPW employees and for participants of each of the independent tournaments and d) attitude, opinion and economic questionnaires designed and administered to seven unique stakeholder groups. Following the first tournament, analyses suggested that the data from the two parallel tournaments were similar and mortality results were defensible. As a measure of our success: although none of our constituents seemed entirely pleased with the preliminary results, all factions appear to have accepted them.

An Inventory of Urban Fish Communities in Lubbock, Texas

Shavlik, C. E. (c7scc@ttacs.ttu.edu) and K. L. Pope (kpope@ttu.edu), Texas Tech University, Lubbock, TX 79409, 806-742-1981, 806-742-2280 (FAX)

Twenty-three city park lakes were electrofished in June 1999 to assess the fish communities. Catch per unit effort (CPUE), size structure (proportional stock density), and condition (relative weight) were used to characterize fish populations. Fifteen species were collected; the most prevalent species were common carp *Cyprinus carpio* (21 lakes) and bluegill *Lepomis macrochirus* (19 lakes). Principal components analysis on CPUE of eight fish species was used for preliminary data exploration. Principal component 1 separated traditionally desirable (e.g., largemouth bass *Micropterus salmoides*, bluegill, and gizzard shad *Dorosoma cepedianum*) and undesirable species (e.g., goldfish *Carassius auratus*, white crappie *Pomoxis annularis*, green sunfish *Lepomis cyanellus*, and common carp) for water less than 45.4 hectares. Principal component 5

distinguished between trophic levels (piscivores: white crappie, green sunfish, and largemouth bass; plantivores/insectivores: common carp, gizzard shad, black bullhead *Ictalurus melas*, and goldfish). A positive relationship (Spearman rank correlation: $r=0.65$; $P=0.002$) existed between largemouth bass and bluegill CPUE, suggesting that abiotic factors (e.g., habitat quality) are more important than biotic (e.g., predator-prey interactions) factors. In addition, gizzard shad and green sunfish were rarely (5 of 20 lakes) found in the same water bodies and when they were present together, green sunfish CPUE was low (i.e., $<6/hr$).

Using Agency Internet Websites to Obtain Public Input

Smith, T.O. and K. Kurzawski, Texas Parks and Wildlife, Inland Fisheries Division, 4200 Smith School Road, Austin, Texas 78744

As part of strategic planning, the Inland Fisheries Division of Texas Parks and Wildlife (TPW) solicited public input on the status of fishing in Texas. The popularity of our Internet website provided an opportunity to quickly design, implement, and analyze an inexpensive method of obtaining public input from visitors to our website. The input was in addition to public meetings, and written and verbal correspondence normally used to incorporate stakeholder preferences into the strategic planning process. The public input survey contained questions asking for opinions on the future of freshwater fishing in Texas. Input was received between May 18 and June 18, 1999. A total of 314 responses were received. Most (98%) respondents were male, licensed Texas anglers (99%) with a median age of 40 years. Stocking fish was reported by 44% of respondents as an action that TPW Inland Fisheries could take to ensure excellent fishing in the future. The most frequent response for improving fishing (34%) was regulating personal watercraft. The number of available fishing sites was most frequently reported (43%) by respondents as the thing they liked about fishing in Texas. Personal watercraft was mentioned most frequently (30%) by respondents as something they disliked about fishing in Texas. Agency websites offer fisheries managers another tool for obtaining public input. This tool provided an inexpensive, real-time snapshot of public preferences. In the future, websites may also be used to conduct angler surveys, but emphasis should first be placed on understanding the characteristics of website users and the associated biases.

Isolation and Sequencing of the Gdf-8 Gene in Largemouth Bass

Wade, D., Texas Parks and Wildlife Department, 5550 FM 2495, Athens, TX 75751

Growth development factor-8 (GDF-8) or myostatin is a member of a large family of genes that affect muscle growth and development and is highly conserved among vertebrate species. Inactivation of the myostatin gene results in excessive muscle mass and an overall increase in size. Recent advances in molecular biology have allowed agriculturists to exploit different expression of the gene to improve growth in food animals. Animals with a low fat and high muscle content can be achieved in less time and on 60 to 80 of the total food requirement and without effecting the consistency of the meat. Isolation and sequencing of this gene in largemouth bass could lead to an understanding of the genetic makeup of "lunker" bass and facilitate its use in a selective breeding program for largemouth bass.

Comparing the Use of Hydrated Lime and Agricultural Lime in Earthen Florida Largemouth Bass Rearing Ponds

Wyatt, T., L. Hall, and N. Thompson, Jasper State Fish Hatchery, Inland Fisheries Division, Texas Parks and Wildlife Department, Rt. 2 Box 535, Jasper, Texas 75951

Agricultural lime and hydrated lime were compared as liming materials in earthen ponds to determine their effects on water quality, zooplankton density, and production of Florida largemouth bass (*Micropterus salmoides floridanus*) fingerlings. Twelve 0.28-0.36-ha ponds were randomly divided into three groups of four ponds each and assigned to three treatments. Treatment 1 used agricultural lime broadcast at 30.5 kg/ha; treatment 2 used hydrated lime broadcast at 30.5 kg/ha; and (control) treatment 3 used agricultural lime applied at 2,245 kg/ha by front-end loader to the corners of each pond. All ponds were fertilized according to an established regime with both inorganic and organic fertilizers. The water quality variables, dissolved oxygen, pH, nitrogen, phosphorus, alkalinity, hardness, and chlorophyll-a as well as zooplankton density, were measured throughout the study and compared among treatments. The fish production variables, harvest length, harvest biomass, percent survival, and growth as well as the cost of producing fish, were also compared among treatments. Except for zooplankton density, harvest biomass, and cost of producing fish, measured variables were statistically similar among treatments. Zooplankton density was significantly lower in treatment 2 ponds than in treatment 1 or 3 ponds, and similar between the latter two treatments. Harvest biomass was significantly higher for treatment 3 than for treatment 1 or 2, and similar between treatments 1 and 2. The cost of producing fish based on the purchase price of lime was significantly higher

