

Oral Presentation

Catfish Management

Evaluation of the Recreational Catfish Fishery on Lake Wilson, Alabama

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On Lake Wilson, Alabama, a popular catfish fishery exists and we initiated a study to assess population metrics and estimate exploitation. Currently, bag or length limits are not used to manage this fishery. Blue catfish *Ictalurus furcatus*, channel catfish *Ictalurus punctatus*, and flathead catfish *Pylodictis olivaris* were collected using low-pulse DC electrofishing, a sub sample of fish were aged with otoliths to describe longevity, growth and survival. Fish greater than 30 cm total length (TL) were tagged with Carlin dangler tags and exploitation estimates were made based on angler returns that provided a reward. Male blue catfish and channel catfish grew faster than females, and only 5% of all fish greater than 75 cm TL were females. The time to reach harvestable size (30 cm) was 2.3, 3.0, and 3.6 years for channel catfish, blue catfish, and flathead catfish, respectively. Maximum ages for channel catfish, blue catfish and flathead catfish were 10, 17, and 34 years and average annual survival rates were 69, 68 and 85%, respectively. Most angler effort was directed at blue catfish and we observed length-dependent differences in mortality as total annual mortality was 48% for fish less than 685 mm TL and only 9% for fish greater than this length. However, exploitation estimates from tag returns ranged from 2% to 7% for blue catfish when adjusted for non-reporting. Simulation modeling predicted blue catfish exploitation likely ranged from about 20 to 30% based on calibration of observed and predicted length distributions. At exploitation rates greater than 20%, growth over fishing for blue catfish has likely occurred.

Keywords: growth mortality exploitation

Abstract Number: 100685

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Oral Presentation

Catfish Management

A method for predicting potential predation by flathead catfish on razorback suckers in the lower Colorado River

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Flathead catfish are well established in the Colorado River below Parker Dam. This section of river is also within the native range of razorback suckers and is the site of

ongoing recovery efforts. Previous studies have shown that flathead catfish actively feed on razorback suckers when they coexist within a given area, and recent work suggests that mortality of stocked razorbacks is very high. Razorback body size was compared to flathead gape size to determine at what size catfish were able to ingest a given size of razorback sucker. The size distribution of flathead catfish present below Parker Dam was then analyzed to determine the abundance of catfish by size within the river. Proportions of flathead catfish available to prey upon various sizes of razorback suckers were calculated and compared to mortality curves estimated for various stocking sizes of razorbacks. This information was used to determine at what size razorbacks could or should be stocked to minimize mortality induced by flathead predation. Ultimately, all razorbacks of any size are vulnerable to predation by the largest flathead catfish within the system, but increased stocking size could lead to higher survival by decreasing the proportion of flatheads large enough to feed upon stocked razorbacks.

Keywords: flathead catfish gape predation razorback sucker

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Oral Presentation

Catfish Management

Blue Catfish Population Characteristics in Selected Oklahoma Reservoirs: Implications for Management of Trophy Fisheries

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Low-frequency, pulsed-DC electrofishing samples were collected on nine Oklahoma reservoirs in late summer 2003-2005. Population samples from seven of these reservoirs were aged using sectioned otoliths. Total catch rates ranged from 124 to 694 fish/h. Precision of the catch data was comparable to that of spring electrofishing for largemouth bass. Catch rates of blue catfish ≥ 760 mm (preferred size) were < 5 fish/h, with no fish of this size being collected from two reservoirs. Precision of these catch data was low with coefficients of variation of the mean exceeding 0.45 in all cases. Total catch and catch of preferred-size blue catfish was not correlated to conductivity of the waters sampled. Blue catfish were aged to 24 years. Length at age varied widely both within and among populations, but generally took between 10-15 years to reach preferred size. Annual mortality rates were typically between 20%-30%. Given these population characteristics and the increasing angling pressure on the "trophy" portion of these populations, more restrictive harvest regulations are needed to maintain viable trophy fisheries. Future research needs include telemetry studies to determine movement patterns and habitat preferences, exploitation estimates, and angler preference surveys to determine desires for and acceptance of "trophy" regulations.

Keywords: blue catfish catch rates age and growth mortality

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Oral Presentation

Catfish Management

Size-based mortality cap and relative growth equations for channel catfish

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Size-based mortality cap and relative growth equations are relatively new techniques that will help managers predict the management potential of newly proposed fisheries or assess results of ongoing management strategies. A standard size-based mortality cap equation was established for channel catfish, based on von Bertalanffy growth parameters from throughout the range of the species and the Beverton-Holt mortality model. Mortality caps were originally designed to allow fisheries managers to determine the maximum allowable total mortality rate (Z) for a given minimum length and target mean length of harvest, but the standard mortality cap equation can be rearranged to model the feasibility of proposed length limits or mean length harvested. A standard relative growth equation was also developed for managers to compare the growth pattern of a population of interest to the average for the species. Examples of how mortality cap and relative growth equations can be used will be presented.

Keywords: Channel catfish Mortality caps Relative growth

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Oral Presentation

Catfish Management

Comparison of native and introduced flathead catfish populations in Alabama and Georgia: growth, mortality and management

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We compared growth of flathead catfish *Pylodictis olivaris* from two native populations in Alabama (Coosa and Tallapoosa rivers) and two introduced populations in Georgia (Ocmulgee and Satilla rivers). We also compared mortality rates and outcomes of varying management regimes (Minimum Length Limits) among the populations. Slopes of TL – to – log (age) regressions for introduced fish were higher than the slopes for native fish, and von Bertalanffy growth coefficients were greater for introduced flathead catfish (Ocmulgee: $K = 0.195$; Satilla: $K = 0.201$) than for native individuals (Coosa: $K = 0.057$; Tallapoosa: $K = 0.059$). Therefore, introduced catfish grew more rapidly than fish in their native range. Mortality was higher in the Satilla River population ($Z = - 0.602$) than in the Ocmulgee River ($Z = - 0.227$) and Coosa River ($Z = - 0.156$) populations. However, fish in the Satilla River population were introduced for only ten years and presumably did not reach their theoretical maximum age, potentially biasing the mortality estimate for the Satilla River population. Simulation of management regimes in FAST (Fishery Analyses and Simulation Tools) predicted that maximum biomass (MB) of flathead catfish in the Ocmulgee (MB = 1668 kg) and Satilla (MB = 1137 kg) rivers was substantially larger than maximum biomass in the Coosa (MB = 873 kg) and Tallapoosa (MB = 768 kg) river populations. We contend that rapid growth of introduced flathead catfish has major implications for their management and conservation of native fishes, which have been negatively affected by flathead catfish predation.

Keywords: Flathead catfish, introduced, native, growth, mortality, management

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Oral Presentation

Catfish Management

Daily aging of age-0 catfishes with implications for assessing the effects of environmental variables on early life history stages

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Although daily aging procedures have been extensively used for other temperate teleosts, daily aging of catfishes has not been reported. Daily aging allows for assessment of hatch dates and growth rates in relation to environmental factors for early life history stages. We developed daily aging procedures for channel catfish.

The technique differed from that used for other species given that otoliths were encased in clear epoxy resin and fixed with thermoplastic cement perpendicular to the plane of the slide. Otoliths were ground using fine (600 grit) sandpaper on one side until the core was visible. Otoliths were then inverted and remounted and were ground to create a thin tranverse section. Otoliths were viewed using a compound microscope; transmitted light and mineral oil were used to illuminate daily rings. Daily rings were clear and easily enumerated for wild fish up to 90 days old. We are currently validating the technique using known age fish and, thus far, have accurately aged fish up to 35 days. We are currently applying the technique to assess variation in growth rates and hatching success in relation to hydrology of mainstem and tributary sites in the Tallapoosa River basin, Alabama.

Keywords: Daily aging, channel catfish, validation, early life history

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Oral Presentation

Catfish Management

Assessing a reservoir catfish population using volunteer angler creel, low frequency electrofishing, age and growth and reward tags

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Much of modern warmwater fisheries management has focused on scaled fish species like black bass, crappie, walleye and hybrid striped bass. It hasn't been until recently that natural resource agencies have begun to focus more attention on catfish management. Catfish management efforts in large reservoirs have been limited, partly because so little is known about reservoir catfish population dynamics. This study was done at Truman Reservoir – a 22,258-ha Corps of Engineers flood-control reservoir in West Central Missouri. Blue catfish *Ictalurus furcatus* and flathead catfish *Pylodictis olivaris* populations were evaluated using low frequency (15 Hz and 30 Hz) electrofishing, a volunteer angler creel, reward tags and current age and growth information using spines and otoliths. Low frequency electrofishing produced high catch rates for blue catfish (133/hr; N=1,717), but did not accurately represent the existing blue catfish population structure (PSD=4% and RSD762=.4%) when compared to the volunteer creel (PSD=47% and RSD762=9%). Electrofishing produced moderately high catch rates for flathead catfish (28/hr; N=359) and a more accurate representation of size structure when compared to the volunteer creel. Angler exploitation rates were determined using \$50 reward tags. The annual angler exploitation rate was determined to be 24% for blue catfish and 2.5% for flathead catfish. Growth rates for blue catfish (mean length at age 8 was 481 mm) and flathead catfish (mean length at age 8 was 428 mm) were slower than expected.

Slow growth rates will limit the potential for more restrictive regulations at Truman in the future.

Keywords: flathead catfish, blue catfish, low frequency electrofishing, reservoir catfish, angler creel, age a

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Oral Presentation

Catfish Management

Recent Developments in Tennessee Catfish Management

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A combination of biology and politics have shaped policy for catfish management by the Tennessee Wildlife Resources Agency (TWRA) over the past several years. As the sport of catfish angling has evolved, users have demanded that the agency become proactive in our management efforts. Our challenge to answering this call was a lack of survey data directed to the three catfish species that would allow us to develop specialized size objectives. During 2000, telephone survey data estimated that 62% of Tennessee anglers would like to see a few bodies of water managed specifically for large catfish (> 30 lbs.). After some prodding from the public and commissioners, we determined that the Mississippi River would be the best waterbody in which to attempt to improve a fishery through strict harvest restriction. In 2003, a 34-inch maximum size limit (1 fish over the limit per day) was proposed by TWRA for the Mississippi River, but this was passed as a statewide limit by the agency's commission. Although size structure data on large catfish is still lacking, a recent study of catfish angler opinions indicated that they were happy with the statewide catfish regulation.

Keywords:

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Oral Presentation

Catfish Management

Voodoo Electrofishing: Low frequency electrofishing as a tool for assessing blue catfish populations in Virginia's tidal rivers.

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Following successful introduction to the Rappahannock and James rivers in the mid-1970's and the York River system in 1985, blue catfish (*Ictalurus furcatus*) quickly became widely distributed and extremely abundant in these large tidal systems, as a result substantial recreational fisheries have developed around these populations. Low frequency electrofishing has been the primary sampling technique employed by fisheries managers to assess these newly established populations. However, use of data derived from low frequency electrofishing has been problematic, with water-to-water or year-to-year comparisons confounded by variability in gear effectiveness – related in some as yet undefined way to differences in water conductivity, temperature, and flow. Comparing and contrasting the results obtained from low frequency electrofishing with those of high frequency electrofishing elucidates specific drawbacks of low frequency electrofishing and the relative biases of the two gear types. Low frequency electrofishing gear bias often results in the size-distribution of catch being highly skewed towards smaller individuals, with larger individuals severely under represented in the sample, confounding age and growth analyses, survival estimates, and relative abundance estimates for specific size-classes, and impacting any assessment of the trophy potential of a given population.

Keywords: Low frequency electrofishing blue catfish

Abstract Number: 100829

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Oral Presentation

Catfish Management

Establishment, expansion, and recent changes in the Santee-Cooper blue catfish fishery.

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Blue catfish *Ictalurus furcatus* have become a dominant component of the Santee-Cooper ecosystem and the number one target for recreational anglers. The blue catfish population was established with a total of 180 sub-adult fish, averaging 0.68 kg, stocked in 1964 and 1965. Blue catfish were first observed in reservoir samples in the mid-1970s, when they also began entering the recreational fishery. A 10 year old fish captured in 1977 verified reproduction occurred as early as 1967. Fish collected and aged from 1977 to 1981, during early population expansion, showed one of the most rapid growth rates reported in the literature. Total weight of blue catfish sampled in winter gillnets increased from the early 1980's into the 1990's, then stabilized over the last 10 years. The occurrence of fish greater than 74 cm in

gillnet samples has increased steadily. Recent age and growth work indicates a significant decline in growth rate from the 1977-1981 time period and differences in growth between the two reservoirs comprising Santee-Cooper. Recreational anglers, recreational trotliners, and commercial fishers have shared the blue catfish fishery. The popularity of recreational catfish angling and a perceived decline in abundance of large catfish have led to a call to eliminate commercial fishing. However, catfish angling effort is less than 4 angler-hours per acre and appears insufficient to prevent an over abundance of blue catfish. Allocation of just the large catfish (> 91cm) to the recreational fishery would be desirable, if a reduction in over-all harvest could be avoided

Keywords: Blue catfish Santee-Cooper Introduction Age and growth Commercial fishing Recreational Fishing

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Oral Presentation

Catfish Management

Introduced flathead catfish, dam removal, and endangered species

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The flathead catfish *Pylodictis olivaris* is a widely introduced, large predator, impacting native fishes. We quantified diel and seasonal movement, habitat use, and diet of introduced flathead catfish in the Deep River, North Carolina, in a reach between two hydropower dams during 2004-2005. Seasonally, flathead catfish utilized larger areas during summer (mean linear range 6,903 m) and fall (mean 6,569 m) than those during winter (mean 599 m). Daily linear ranges differed between summer (mean 305 m) and fall (mean 220 m). Microhabitats occupied during summer (mean depth 2.5 m) were shallower than those during fall (mean 4.8 m) or winter (mean 4.8 m), and mean velocities were similar among seasons (means for summer 0.048 m/s, fall 0.053 m/s, and winter 0.054 m/s). Flathead catfish inhabited a downstream, deeper, impounded river section throughout the year, except during spawning, when it also shared upstream habitat with the endangered Cape Fear shiner *Notropis mekistocholas*. Examination of 698 samples of flathead catfish stomach contents (356 empty) found only rare occurrences of minnow prey species and no Cape Fear shiners. These findings suggest that flathead catfish microhabitat does not overlap with the shallow, higher velocity microhabitat of the Cape Fear Shiner even within the same river reach. The planned removal of the downstream dam in this reach would result in reduced habitat supporting flathead catfish and expansion of areas suitable for the Cape Fear Shiner.

Keywords: flathead catfish dams endangered rivers diet habitat telemetry invasive

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Oral Presentation

Contributed

An Internet Survey of Private Pond Owners and Manager in Texas

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The primary emphasis of this survey was to determine what specific problems Texas private impoundment owners/managers confront, how widely these problems occur, and where owners/managers get their information on pond management. A secondary emphasis was to examine the potential utilization of the Internet to gather information and distributed outreach materials. A random sample of 2,999 private impoundment (i.e. no public waters) applicants for Triploid Grass Carp Permits from Texas Parks and Wildlife was utilized as the survey mailing list. A 49-question survey was developed and placed on a secure web site. Each questionnaire contained five sections: general pond characteristics, physical pond characteristics, aquatic vegetation, fish and other wildlife, and management goals. Two post-card mailings were made asking the recipients to go online to the web site and fill out the survey. The overall response rate was 21.3 % (excluding non-deliverables and unusable submitted surveys). Summary statistics for each question were calculated and then compared to each other in order to gain a clearer picture of pond management practices employed by Texas impoundment owners/managers. The results indicated some initial discrepancies between management practices and preferences and common management recommendations. This was most dramatically illustrated in aquatic vegetation management and basic understanding of management principles.

Keywords: Internet survey private impoundment management

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Oral Presentation

Contributed Presentation

Fish Communities of the Emory River Watershed With Emphasis on Current Distribution and Seasonal Habitat Use of Spotfin Chub

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The spotfin chub *Erimonax monachus* is a small, uncommon minnow, restricted to the Tennessee River drainage; it is recognized as threatened by the US Fish and Wildlife Service and is considered endangered by the Tennessee Wildlife Resources Agency. Relatively few studies pertaining to the spotfin chub have been conducted on the Emory River Watershed. Objectives of this project were to: (1) determine current distribution and model presence/absence of spotfin chubs throughout the Emory River Watershed, (2) characterize Emory River Watershed fish communities, and (3) describe spotfin chub seasonal habitat use within the known distribution. Spotfin chub distribution and fish communities of the Emory River Watershed were sampled by electrofishing predetermined 200-m sites. In addition, snorkeling drifts were performed between sample sites to obtain precise distribution of spotfin chubs. Fish communities were characterized by percent composition, species richness, and the Index of Biological Integrity (IBI). Seasonal spotfin chub habitat preferences were determined by quarterly snorkeling eight 200-m sites, within the historic range. Current spotfin chub distribution differed from the historical distribution. Drainage area (km²) significantly predicted spotfin chub presence (P=0.0057). Emory River Watershed fish communities demonstrated stable conditions despite varying environmental factors; mean watershed IBI comparisons were similar to historic values. In spring, summer, and fall spotfin chubs occupied run habitats, over bedrock or boulder substrates, while in winter they shifted to pool habitats, over sand substrates.

Keywords: Keywords: Spotfin chub; Emory River Watershed, fish communities, seasonal habitat use

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Contributed Presentation

SPECIES IDENTIFICATION OF SCIAENIDS FISH EGGS IN ARANSAS BAY, TX BY MOLECULAR SPECIES-SPECIFIC MARKERS

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Sciaenid fishes are an important resource for commercial and recreational fisheries, representing millions of dollars to the U.S. economy. Most sciaenid species are estuarine dependant, either through the larval stage or their entire life cycle. The development of a reliable technique to accurately discriminate sciaenids eggs by species would provide an important tool for the study of the spawning biology of sciaenid fishes in the Aransas Bay estuaries and its surrounding areas. Identification of preferred spawning areas as well as spawning seasonality is required for effective conservation and management of fisheries. Visual identification of eggs to species

level is difficult due to overlap in size and/or pigmentation patterns of many sciaenid eggs. The objective of this project is to develop a reliable molecular method to identify sciaenid eggs to species level using molecular species-specific markers. Fragments of the mitochondrial genes cytochrome b (608 bp) and nicotinamide adenine dinucleotide dehydrogenase (NADH dehydrogenase; 900 bp) were sequenced in 11 sciaenid species caught in the Corpus Christi, TX bay system. Sequence comparison showed 85% and 65% identity, respectively. Due to higher heterogeneity, NADH dehydrogenase sequences were used to design species-specific polymerase chain reaction (PCR) primers. The multiplex-PCR identification assay is capable of accurately discriminating among sciaenid species based on the size of NADH dehydrogenase products. Effective discrimination of sciaenid eggs to species level by utilizing multiplex-PCR will allow us to accurately monitor spawning seasonality and spawning grounds preferences necessary to protect essential fish habitats critical to the maintenance of fish populations.

Keywords: Sciaenids, Multiplex PCR, species identification

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Oral Presentation

Contributed Presentation

Various methods to determine the wild or hatchery origin of red drum, *Sciaenops ocellatus*.

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As part of an ongoing research-scale stock enhancement program, in 1999 the SCDNR released fingerlings on seven different occasions into the Ashley River near Charleston, SC. Stocked fish came from either the SCDNR hatchery or a private hatchery. All fingerlings were marked by immersion in an oxytetracycline (OTC) solution prior to release. Fifty individuals were retained from each release for evaluation of OTC marking success and genotyping. However, tissue samples were only collected from the SCDNR broodstock. Fish were sampled from the Ashley River and nearby sites the following year and evaluated for hatchery origin in one of three ways. First, otoliths were read to determine age and the presence or absence of an OTC mark. The other methods involved genetic analysis. DNA from broodstock, fingerlings, and captured fish was genotyped at eight microsatellite loci. Reference populations were created from separate fingerling releases and wild fish. Maximum likelihood analysis implemented in GeneClass2 assigned captured fish to a reference population(s). Of 141 fish, 27 were assigned to the private hatchery, 26 to SCDNR, 56 to the wild, and 32 were unknown. Two reference populations were genetically diverse, indistinguishable from the wild, resulting in multiple assignments for 12 fish. Exclusion analysis using PROBMAX identified the same 26 fish assigned to the SCDNR hatchery by maximum likelihood and an additional 10 fish, originally

classified as unknown by maximum likelihood. All otolith and genetic assignments were compared. Six mismatches were found and attributed to misidentification or poor OTC marking success.

Keywords: red drum, stocking, genetic analysis, hatchery

Abstract Number: 100767

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Oral Presentation

Contributed Presentation

Status of an introgressed Guadalupe bass population in a central Texas stream

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Introductions of non-native smallmouth bass *Micropterus dolomieu* into central Texas streams resulted in introgressive hybridization with an endemic allopatric congener, the Guadalupe bass *Micropterus treculi*. In an attempt to reestablish a dominant Guadalupe bass population and to genetically swamp the smallmouth bass genome, a total of 80,000 hatchery-reared Guadalupe bass fingerlings was stocked in the Blanco River (Guadalupe River drainage, Texas) in 1994 and 1995. Objectives of this study were to examine the proportion and genetic influence of Guadalupe bass, smallmouth bass, and their hybrids 10 years following supplemental stockings of Guadalupe bass in the Blanco River by analyzing allele frequencies at fourteen unlinked microsatellite loci. Genetic analysis identified 40% of individuals as smallmouth bass, 51% as smallmouth bass x Guadalupe bass hybrids, and 9% as other *Micropterus* hybrids. Pure Guadalupe bass were not collected. Despite supplemental stockings, introgression continues in the Blanco River and has likely continued or spread in other areas documenting the need for a current review of the genetic integrity of the Guadalupe bass throughout its range.

Keywords: Guadalupe bass smallmouth bass hybridization introgression *Micropterus*

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Oral Presentation

Contributed Presentation

Trends in Texas populations of Gulf flounder (*Paralichthys albigutta*) following management measures targeting southern flounder (*P. lethostigma*)

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Many species of flounder occur in the Gulf of Mexico, but Gulf (*Paralichthys albigutta*) and southern flounder (*P. lethostigma*) are the two species that have been recreationally or commercially harvested from Texas bays. Due to the decline in southern flounder abundance, the Texas Parks and Wildlife Department (TPWD) Commission implemented a number of management measures in an attempt to increase the population. These included, but were not limited to, increasing minimum size limits, reducing bag limits, and initiating bag limits for commercial harvest. Even though these measures were designed to reduce harvest and increase the abundance of southern flounder, they have also had an effect on Gulf flounder. Two additional measures adopted by the Commission in recent years that may have also had a positive effect on flounder populations were requiring by-catch reduction devices during inshore shrimping operations and TPWD Shrimp License Buyback Program. Using TPWD's long-term fisheries independent and dependent databases, the status and trends of Gulf flounder are assessed and compared to those of southern flounder. Effects of management efforts are compared to juvenile recruitment and adult relative abundance of both species. Recommendations for future management of both species are discussed.

Keywords: Gulf flounder, southern flounder, effects from management, juvenile recruitment, relative abundance

Abstract Number: 100845

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Oral Presentation

Contributed Presentation

Adaptive management of a highly-regulated Southeastern river: tools for stakeholders

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In conjunction with multiple stakeholders, we have developed an adaptive management plan to determine corrective flow prescriptions in a highly regulated Southeastern river. Adaptive management is a long-term, iterative process that requires consensus decision-making by stakeholders. Multiple management goals, combined with uncertainty inherent in natural systems, hampers consensus decision making in many cases. Development of a decision support model to aid stakeholders

in making complex decisions is a primary tool for implementation and evaluation of adaptive management. Our decision support model was developed by incorporating stakeholder objectives and empirical data into a Bayesian belief network. The model was instrumental in determination of a flow strategy for adaptive management of the Tallapoosa River below R.L. Harris Dam. The model evaluated three scenarios for flow management at the dam and included accessory options (i.e., spawning windows or recreational flows). Response variables (e.g., impact to power production, number of boatable days, fish spawning success) were linked to value objectives and were measurable. The adaptive management plan was implemented in spring of 2005, and monitoring and reparameterization of the model is underway.

Keywords: adaptive management decision support model regulated rivers

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Oral Presentation

Contributed Presentation

Seagrass Protection Initiative in the Redfish Bay State Scientific Area

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The Seagrass Conservation Plan for Texas published in 1999 contained specific recommendations for agency actions to protect seagrass habitat. Mechanical damage to seagrass was one particular concern listed in the plan. Redfish Bay State Scientific Area (12,955 hectares) was designated in June 2000 by the Texas Parks and Wildlife Commission (TPWC) for the purpose of protecting fragile shallow water seagrass beds. Redfish Bay is a shallow coastal embayment near Aransas Pass, Texas which contains the northernmost extensive seagrass beds in the western Gulf of Mexico. The Redfish Bay State Scientific Area designation had a five year review for sunset provision. Extensive damage to seagrass beds from boat propeller scarring had been documented. Initial protection efforts included three voluntary no-propeller zones as well as education and outreach programs. Voluntary measures appeared to be ineffective, and damage from "prop scarring" continued to occur. In June 2005 TPWC renewed the scientific area designation with the intent of pursuing additional measures of protection. In order to evaluate the effectiveness of any potential new regulations a baseline transect study was conducted in August of 2005 which found $1.5 * 10^{-2}$ Scars/M, $SE=0.4 * 10^{-2}$. A regulation to further protect seagrasses will go into effect in May 2006, making it illegal to destroy seagrasses with boat propellers within the State Scientific Area.

Keywords: Seagrass protection Prop scarring Redfish Bay State Scientific Areas

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Oral Presentation

Contributed Presentation

Golden Alga Fish Kills in the Brazos River Basin

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Fish kills in the Brazos River Basin caused by toxins of golden alga (*Prymnesium parvum*) have been documented since 1988. The frequency, intensity and impacts of the blooms causing these fish kills has increased over the years. Presented is a review of the river impacts and the three lakes involved with bloom progressions, the fish kill intensity, the physical parameters and the chemical environment of these kills.

Keywords: Golden Alga *Prymnesium parvum* Brazos River

Abstract Number: 100670

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Oral Presentation

Contributed Presentation

HATCHING SUCCESS AND SIZE AT HATCH OF SUNSHINE BASS HATCHED AT DIFFERENT TEMPERATURES.

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We re-examined the relation between temperature and egg stage duration, and tested the hypothesis that a longer egg stage would produce a larvae that was longer at hatch. We examined the relation between temperature and percent hatch. We tested the hypothesis that maternal genetic influences were greater than temperature effects on size at hatch and percent hatch. Female white bass were spawned each week for four weeks. Eggs from all the females were fertilized by a single, but different male each week. Eggs were hatched in McDonald hatching jars at 14, 16, 18, and 20 C. Hardness, ammonia, pH, and dissolved oxygen were monitored daily and temperature was monitored every 6 h. Yolk-sac larvae were removed from the jars, photographed individually, and enumerated. Standard lengths of larvae were estimated from the photographs. We determined modal hatch and percent hatch for each female at each temperature. Temperature affected egg

stage duration, but not in a linear fashion as had been previously reported. Eggs incubated at a cooler temperature took longer to hatch, but larvae were significantly ($P<0.05$) larger at hatch. Temperature did not have an influence on percent hatch. There was a significant interaction ($P<0.05$) between maternal influence and temperature for length at hatch and percent hatch. Larvae from some females exhibited a monotonically decreasing length at hatch as temperature increased. Larvae from other females exhibited a non-linear response to temperature, with larvae significantly larger at hatch at the lowest and highest temperatures and smaller at intermediate temperatures.

Keywords: sunshine bass larvae hatch success length temperature

Abstract Number: 100671

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Oral Presentation

Contributed Presentation

GROWTH AND SURVIVAL OF SUNSHINE BASS LARVAE STOCKED IN TANKS AT DIFFERENT DENSITIES

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This experiment attempted to determine the relationship among stocking density of sunshine bass larvae in tanks and growth and survival. Sunshine bass larvae, 4 days post hatch (dph), were stocked into blue, polyethylene tanks with 100 L of 8 ppt brackish water. Light intensity at the water surface was about 900 lumens. Larvae at 10 densities, ranging from 29 to 118 larvae/L were stocked into 10 tanks. Rotifers, cultured with Nannochloropsis and Culture Selco® 3000 were fed 4 times per day at 15 rotifers/ml until 12 dph. From 8-12 dph Artemia nauplii were fed 4 nauplii/ml once per day; every four days an additional feeding/day was added until at 22 dph 20 nauplii/ml/day were fed. Six grams of a 55% protein salmon starter meal was fed throughout the day with a belt feeder from 19 dph until 22 dph when the meal was increased to 8 grams/day. Fish were harvested at 26 dph and enumerated gravimetrically. About 30 fish from each tank were photographed and total length and other morphometrics determined. Survival ranged from 18–48%, averaged 35% and increased slightly with the stocking density. Total biomass of fish produced appeared unrelated to stocking rate, Mean individual weight decreased while percent survival, stocking density, and numbers of surviving fish increased. Mean weights of surviving fish averaged 0.12 grams and ranged from 0.036 to 0.33 grams. Lengths and other morphometrics of fish from each tank are being analyzed.

Keywords: sunshine bass larvae density growth survival

Abstract Number: 100672

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Oral Presentation

Contributed Presentation

Nonannual reproduction of female mucklets *Actinonaias ligamentina*

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It is generally believed that most freshwater mussels spawn annually after reaching sexual maturity; however, little data is available on the frequency of spawning by individuals. Apparent instances of nonannual spawning have been attributed to parasites, senescence or some unidentified factor. Mucklets were collected from the Licking River, Kentucky, tagged, and held in a hatchery raceway for 5 yrs to determine the effects on spawning. Each year after the spawning period, the sand-gravel substrate of the raceway was searched to locate mussels. Because mucklets are not sexually dimorphic, all individuals found were examined to determine if they were gravid (marsupial gills containing eggs or glochidia). Gravidity rates varied from 15 % to 30 % among years. Of 31 individuals that were observed gravid at least once, only 1 individual was gravid during all 5 yrs. On average, known females became gravid 3 out of 5 yrs. Gravidity rates of mucklets collected from several sites on two rivers were also less than 30 %, indicating that the gravidity rates observed in captivity were typical of mucklets in the wild.

Keywords: mussels reproduction captivity

Abstract Number: 100801

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Oral Presentation

Contributed Presentation

Linking Fish Abundance Measurements to Stream and Riparian Habitat: Lessons Learned in a 12 Year Study

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How one quantifies fish abundance is a key factor in assessing fish response to habitat changes over time. Fish abundance was considered in six ways: numbers of fish and fish weight, and each of those in terms of stream length, stream surface area, or stream volume. Linking these six abundance measures to terrestrial and

aquatic habitat revealed which factors most directly affected fish populations. Fisheries and stream habitat measurements were obtained intermittently at 21 locations in Idaho, Nevada, and Utah in the 12 years from 1975 to 1986. The six fish abundance measurements were compared with 21 stream habitat measurements. The 21 habitat measures can be grouped into four general categories: riparian vegetation, streambank characteristics, stream channel characteristics, and stream substrate categories. Correlation coefficients were generated for each pairing, a 6 x 21 grid with between 185 and 267 observations in each cell. The degree of linear association between fish abundance and stream habitat varied dramatically depending on whether fish abundance was measured in terms of stream length, stream surface area, or stream volume. Significant correlations also varied depending on whether one measured abundance by numbers of fish or by fish biomass. The highest number of significant correlations and the greatest degree of association occurred where fish abundance was measured in fish weight per unit of stream volume.

Keywords: fish abundance, stream habitat, riparian

Abstract Number: 100679

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Oral Presentation

Contributed Presentation

Testing If Knowing White Crappie Locations Can Improve Trap Net Sampling

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We utilized biotelemetry to observe adult white crappie *Pomoxis annularis* locations at Lyndon B. Johnson (LBJ) and Waco reservoirs in Texas over two, six-month periods (December 2000 – May 2001 and November 2001 – April 2002). We tested whether deploying trap nets at sites near known fish locations and at similar sites predicted to hold fish would result in increased trap-net catch per effort compared to randomly selected sites. Trap-net catch rates for the three deployment strategies were not significantly different in any month (November 2001 – April 2002) for LBJ or Waco reservoirs ($P > 0.083$ for all months). In our study, selecting sampling sites subjectively offered no significant benefit over selecting sites randomly. However, other findings suggested that water depth at the trap-net cod end and reservoir area can influence catch rates regardless of deployment strategy. In our study, trap nets set in deeper water (> 3 m) typically caught fewer fish at both reservoirs and nets set in the upstream third of Waco Reservoir generally caught greater numbers of adult crappies. We found that addressing large and small-scale habitat variables (i.e., linear distance from dam, water depth, bank slope, etc.) may be more important than actual fish locations when deciding on a trap-net deployment strategy.

Keywords: White crappie, trap net, biotelemetry

Abstract Number: 100682

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Oral Presentation

Contributed Presentation

Correlative Relationship of Annual Brown Shrimp Catch to Nursery and Hypoxia Areas in the Northwestern Gulf of Mexico

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The Louisiana Department of Wildlife and Fisheries have spatially quantified salinity measurements for decades; with salinities above 10 ppt deemed favorable for juvenile brown shrimp. Scientists at LUMCON have quantified the hypoxic zone on the Louisiana shelf since the mid-1980's and have identified it as a negative factor in the production of brown shrimp. To determine which independent variable (nursery area or hypoxia area) has influence on shrimp catch; we performed stepwise linear regressions on the data. We modeled shrimp catch vs. nursery and hypoxia areas, using standard stepwise techniques for combinations of statistical subareas established in the Gulf of Mexico. When modeling combined Texas and Louisiana total catch (both inshore and offshore), the hypoxia area was a significant factor, contributing to 26% of the variability in catch ($F=4.967, df=1, P=0.043$). Combined Texas and Louisiana offshore catch was also significantly affected by the hypoxia area ($F=4.765, df=1, P=0.047$). Louisiana nursery area was not a significant variable for Texas and Louisiana combined shrimp catch. However, Texas and Louisiana combined inshore catch was significantly influenced by nursery area size ($F=8.489, df=1, P=0.011$), but not by hypoxia area. For the Louisiana total brown shrimp catch (inshore and offshore), nursery area was a significant factor ($F=13.246, df=1, P=0.002$), but hypoxia area was not. For the Texas total brown shrimp catch (inshore and offshore), hypoxia area was a significant factor ($F=6.229, df=1, P=0.026$), but nursery area size was not. Therefore, both nursery and hypoxia areas are significant factors in determining brown shrimp catch in the Northwestern Gulf of Mexico. More importantly, environmental influences implied by both independent variables are evident in both Texas and Louisiana waters.

Keywords: Brown Shrimp, Hypoxia, Gulf of Mexico, Nursery Area, Regression Analysis

Abstract Number: 100683

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Oral Presentation

Contributed Presentation

Characterization of Benthic Macroinvertebrate Communities within the Emory River Watershed, Tennessee

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Sedimentation resulting from natural and anthropogenic sources is a primary concern within the Emory River Watershed (ERW). Mining, logging, and agricultural practices, as well as urban development occur within the ERW, and these practices generate excess sediment which can negatively influence lotic ecosystems and their resident fauna. Macroinvertebrate communities are directly affected by sedimentation, and any streambed alteration from deposited sediment can have substantial effects upon these communities. Reductions in invertebrate abundance, density, and diversity are common with increased sediment loads. Objectives of this study were to (1) determine how habitat and land use practices within the ERW influence benthic macroinvertebrate communities, and (2) evaluate seasonal variation in benthic communities at select locations. Samples were collected at 57 sites throughout the ERW using semi-quantitative (SQKICK) techniques. Biotic index scores were determined for all sites. Eight additional sites were similarly sampled on a quarterly basis, and data were analyzed to identify variation differences in reach and/or time. In addition, habitat variables were evaluated to determine their influence on benthic communities among all 57 samples. Quality of macroinvertebrate communities varied within the ERW. However, biotic scores (> 32) were indicative of healthy benthic communities. Community variation existed among seasons ($p = .10$); life history stages influenced this variation. Habitat variables influenced macroinvertebrate community composition within the ERW.

Keywords: Emory River Watershed, benthic macroinvertebrate communities, biotic score

Abstract Number: 100684

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Oral Presentation

Contributed Presentation

Swimming performance of five warmwater stream fish species

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Relative swimming ability of fish species may help explain their persistence or absence in flood-disturbed streams. I tested five common fish species from the Arkansas Ozarks (central stoneroller, cardinal shiner, orangethroat darter, green sunfish and longear sunfish) in artificial stream channels with smooth and complex substrates to examine critical swim speeds (CSS) and flood resistance behavior. Stonerollers and cardinal shiners had higher CSS than the other species in the smooth substrate treatment, and orangethroat darters outperformed the sunfish species. In the complex substrate treatment, stonerollers attained higher speeds than green sunfish, whereas all other species did not differ. Cardinal shiners and longear sunfish selected velocity patches that were slower than the flume average in the smooth substrate treatment at the highest swim speeds. Orangethroat darters and green sunfish selected slower patches in the complex substrate treatment at half speed. All other species in all other scenarios did not exhibit significant patch selection. These results suggest that the swimming ability of central stonerollers may give them an advantage over other species during high flows in low complexity substrates, whereas sunfish and darters appear better able to use high complexity substrates as velocity refugia during high flows.

Keywords: swim speed CSS flume

Abstract Number: 100686

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Oral Presentation

Contributed Presentation

Temporal Trends in Largemouth Bass Mortality

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Fishery managers have suspected that changes in angler behavior (i.e., voluntary release of fish) have reduced fishing mortality for largemouth bass *Micropterus salmoides* populations, but temporal trends have not been assessed. We reviewed estimates of largemouth bass exploitation (u) and coincident total mortality (Z) in North America for the past five decades (1953-2003). Exploitation rates ($N = 33$) showed a dome-shaped pattern across the time series with u being relatively low in the 1950's and 60's (range 12-55%, $N = 6$), highly variable and averaging 34% in the 1970's and 80's (range 10-75, $N = 22$), and low since 1990 ($< 20\%$, $N=5$). Corresponding total mortality rates ($N = 28$) followed the same trend indicating additive fishing and natural mortalities. The time series provided evidence that impacts of catch and release mortality are not high, because reductions in u from lower harvest caused similar reductions in total mortality. The reported lack of detectable largemouth bass population responses to harvest restrictions could result, in part, from high rates of voluntary release by anglers. Largemouth bass abundance and age structure will not be strongly influenced by fishing today compared to 20-30 years ago.

Keywords: largemouth bass fishing mortality size limits

Abstract Number: 100687

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Oral Presentation

Contributed Presentation

The growing national threat of the toxic golden alga (*Prymnesium parvum*) and how Texas is addressing it

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The toxic golden alga was first identified in the US from samples during a 1985 fish kill investigation on the Pecos River. World-wide the alga has normally been associated with estuarine and marine waters. Since 2001, golden alga induced fish kills have been expanding in Texas. It has now caused fish kills on five river systems in Texas (Rio Grande, Colorado, Brazos, Red, and Canadian rivers). It has been reported in 13 states (TX, NB, OK, NM, AZ, CO, WY, AR, AL, FL, GA, NC, and SC). It is a small alga with 2 flagella and a haptonema. Besides being motile, it exhibits mixotrophy consuming algae, protists, and bacteria. It releases toxins including ichthyotoxins. An environmental trigger or condition seems to be needed to give it a competitive advantage over the normal algal community (e.g., change in temperature, salinity, etc.) and produce a bloom. Fish, mussels, clams, crayfish, and gilled amphibians are killed by the toxins but most aquatic insects and higher organisms do not appear to be directly impacted. Treatments have been developed for hatcheries and small ponds but are unsuitable for large waterbodies. TPWD has instituted a cooperative effort with universities, state agencies, river authorities, and others to address this problem. Monitoring and event investigations have been initiated. Workshops with experts have been held to determine information needs and gaps. Research is being funded to address those needs. It is desired for management options to be developed for large waterbodies.

Keywords: toxic alga, fish kills, golden alga, harmful algal blooms

Abstract Number: 100690

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Oral Presentation

Contributed Presentation

Delayed mortality and movements of paddlefish *Polyodon spathula* released as bycatch in the lower Tennessee River.

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Paddlefish *Polyodon spathula* in Kentucky Lake, TN-KY, are managed to maintain a commercially valuable fishery. Minimum size limits enacted in 2002 (864 mm eye-fork-length [EFL]) and again in 2005 (914 mm EFL) sought to protect paddlefish from growth and recruitment overfishing. All paddlefish shorter than the minimum length are released as bycatch. The bycatch of sublegal paddlefish in the commercial gill net fishery represented 60% of the total catch between 2003 and 2005. Forcing fishers to release small fish will not reduce fishing mortality unless those fish survive. Thus, the objective of this ongoing study is to model the mortality of paddlefish released as bycatch as a function of water temperature and net soak time. Data are also being collected to investigate the immediate post-release behavior of released paddlefish. To meet project objectives, radio transmitters are externally attached to paddlefish captured in commercial gill nets. Tagged fish are subsequently tracked for several weeks or until their fate can be determined with reasonable certainty. Previous estimates of initial mortality (i.e., fish dead in the nets) ranged from 7 to 86%, depending on water temperature and, to a lesser extent, soak time. Preliminary sampling indicates delayed mortality ranges from 4 to 37%. The cumulative negative impacts of initial and delayed mortality could limit the effectiveness of a management strategy that assumes that most released fish survive.

Keywords: delayed mortality, paddlefish, bycatch

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Contributed Presentation

The Effect of the Introduction of Tilapia on the Fish Population in a Closed System Reservoir in Northern Arkansas.

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Nile tilapia have been stocked as a forage species annually since 2001 in Lake Hogue, a 101-ha., closed-system public fishing reservoir in northeastern Arkansas. Electrofishing and rotenone sampling data was used to identify fish population trend changes that occurred from 1997 through 2003. Otolith examinations demonstrated that no improvement in growth rates occurred among largemouth bass. Insignificant

changes were detected in largemouth bass population size structure over the study period although relative weights of almost all sizes of bass were improved. Bluegill relative weights also showed some improvement. Spring electrofishing results suggested that the population size structure for bluegill increased while fall sampling records showed that a decrease was observed in the quality of the bluegill fishery. Available prey to predator ratios improved for young, intermediate and adult predators following tilapia stocking. Sampling failed to demonstrate recruitment of young tilapia into the lake's fish population. Tilapia introductions did not produce any major changes in the largemouth bass population but may have indirectly contributed to an improvement in the forage fish populations.

Keywords: Nile tilapia electrofishing rotenone size structure trend changes predators forage fi

Abstract Number: 100698

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Oral Presentation

Contributed Presentation

THE INFLUENCE OF BEAVER IMPOUNDMENTS ON THE DYNAMICS OF MERCURY ACCUMULATION IN SOUTHEASTERN STREAM FISHES

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Although beaver ponds do not persist indefinitely, they can have long lasting effects on biogeochemistry of southeastern stream habitats, therefore potentially impacting the availability of some contaminants such as mercury (Hg). The anoxic, low pH, and high dissolved organic carbon (DOC) waters of beaver impoundments may promote mercury methylation and thus movement of Hg into aquatic food webs. To examine this possibility, fishes from beaver impoundments on the U.S. Department of Energy's Savannah River Site, in south-central South Carolina were collected using hoop nets and standard minnow traps during June and July of 2005 and analyzed for total Hg concentration. Project goals were to: 1) provide baseline data on Hg accumulation within the bodies of fishes collected from five beaver impoundments, 2) determine any trends in Hg concentrations in fishes of different trophic categories, 3) compare Hg levels of fishes collected during drought conditions in 2001 with those collected during current wet conditions, and 4) determine if fishes from an industrially-impacted beaver impoundment differed in Hg concentrations from those collected in un-impacted impoundments. Our analyses suggest that variations in Hg concentrations in fishes were limited, trophic position effects were not consistent, Hg levels were significantly higher in fishes collected in 2005 than those collected in

2001, and fishes from industrially-impacted impoundments were not significantly different in Hg concentrations than those fishes from un-impacted impoundments.

Keywords: beaver impoundments southeastern streams mercury fishes

Abstract Number: 100699

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Oral Presentation

Contributed Presentation

Does early life exposure impact survival of hatchery red drum?

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It has been demonstrated that hatchery-reared fish experience significantly higher rates of mortality compared to their wild counterparts. Many times this discrepancy can be linked back to the hatchery environment which is often void of many or all natural stimuli (e.g. prey types, predators, complex habitat). In this study, we evaluated how exposure to complex habitats (*Spartina* spp.) and predators (pinfish, *Lagodon rhomboides*) during the early juvenile stage may influence the development of survival skills in hatchery red drum, *Sciaenops ocellatus*. At the end of the exposure period, individuals were run through a series of high-speed video trials used to quantified differences in prey-capture performance and anti-predator response. Preliminary trials indicated that prey-capture performance was significantly different between the rearing groups. Information gathered from these trials can be used to gauge the effectiveness of red drum stocking initiatives and provide critical feedback to hatchery and fishery managers.

Keywords: red drum, stock enhancement, survival skills, hatchery

Abstract Number: 100700

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Oral Presentation

Contributed Presentation

Effects of Water Level Variation on Wetland/Littoral Plants and their Associated Faunal Assemblages, with Implications for Water Management and Biota of Lake Okeechobee

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We summarized published literature regarding the effects of water level variation on subtropical wetland and littoral plants, as well as the fish and other biota supported by those plant communities. The objective of this study was to enhance the information base that supports the CERP (Comprehensive Everglades Restoration Plan) hydrologic restoration goals for Lake Okeechobee. The review indicated: (1) there is solid literature regarding effects of water level variation on aquatic plants, good local information regarding subsequent effects on wading birds, apple snails, snail kites, waterfowl, information on selected species of fish, and some information regarding alligators; (2) there is very little information regarding amphibians and reptiles other than alligators; and (3) future research should focus on fish community, amphibian, and reptile responses to changes in water level. Based on the studies reviewed and knowledge of anticipated changes in water level regime under CERP, if Lake Okeechobee lake stage varies between 3.7 and 4.6 m msl in most years, shoreline areas can be expected to develop diverse and widespread stands of emergent and submerged aquatic vegetation. If these changes occur, the literature suggests that largemouth bass recruitment and abundance would increase due to enhanced habitat structure and food resources, as well as positive responses for alligator, wading bird, and snail kite nesting success. Effects of water level and littoral plant changes on *Lepomis* spp. and black crappie populations, which also support very important fisheries at Lake Okeechobee, are not well known and warrant further investigation.

Keywords: Lake Okeechobee littoral zone Comprehensive Everglades Restoration Plan (CERP) literature review

Abstract Number: 100701

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Oral Presentation

Contributed Presentation

Evaluation of a Nonlethal Technique for Determining Gender of Freshwater Mussels

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Most North American freshwater mussel species are not sexually dimorphic. During the brooding period, gravid females can be identified by inspection of the marsupial gills; however, non-gravid females cannot be differentiated from males in species lacking sexual dimorphism. The ability to differentiate males from females throughout the year could have significant implications for mussel conservation and research. Our objective was to test the accuracy and nonlethality of a method to determine gender of live individuals. A syringe was used to extract about 0.2 mL of

gonadal fluid from 67 *Elliptio dilatata* and 65 *Actinonaias ligamentina*. The fluid was microscopically examined for developing gametes. Because gametes were difficult to see, a staining method was developed for rapid identification of gametes in the gonadal fluid. We sacrificed (25 *E. dilatata* and 18 *A. ligamentina*) individuals identified as males and females, and examined histological sections of their gonads. There was agreement (100% in *E. dilatata* and 89% in *A. ligamentina*) in gender assigned from examination of gonadal fluid and histological sections. The effect of our invasive procedure on survival of mussels was ascertained by comparing the survival of the test group animals with that of a control group. After 12 mo, survival was similar between test and control groups for both species ($P > 0.27$; Fisher's Exact Test).

Keywords: Mussels Gender Nonlethal Gonadal-fluid

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Oral Presentation

Contributed Presentation

Texas Abandoned Crab Trap Removal Program

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Each February since 2002, the Texas Parks and Wildlife Department has conducted a volunteer-based abandoned crab trap removal program in Texas coastal waters. During these events, more than 12,700 volunteer man-hours were expended to remove a total of 18,008 abandoned crab traps. Most, 70%, were removed from the Galveston and San Antonio Bay systems, 6,762 and 5,855 traps respectively. Of the traps removed, 1,251 traps were examined to determine contents and condition. The examined traps contained 2,392 organisms representing 30 species. The most abundant species found were blue crab, *Callinectes sapidus*, and stone crab, *Menippe adina*, 62% and 19% respectively. Sheepshead, *Archosargus probatocephalus*, was the most abundant vertebrate species found and represented 7% of all organisms observed. The strong support for the program from volunteers and the resource benefits of removing these unsightly and wasteful artifacts of the commercial crab fishery justifies continuation of the Texas Abandoned Crab Trap Removal Program well into the future.

Keywords: Texas blue crab trap removal

Abstract Number: 100705

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Oral Presentation

Contributed Presentation

The Arroyo Colorado Revisited: An Ecological Survey of the Arroyo Colorado, Texas 2001-2003

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The lower Arroyo Colorado, flowing 40 km from the Port of Harlingen to the lower Laguna Madre in south Texas, is one of the few mesohaline systems associated with the lower Laguna Madre, and provides essential nursery habitat for many estuarine species. Bag seine and otter trawl samples and hydrological data were collected during 2001-2003 to characterize species composition, abundance, and seasonal distribution. Over 23,000 vertebrates and nearly 16,000 invertebrates in 120 species were collected. The dominant species collected was white shrimp, *Litopenaeus setiferus*, (25%); followed by gulf menhaden, *Brevoortia patronus*, (13%); spot, *Leiostomus xanthurus*, (10%); Atlantic croaker, *Micropogonias undulatus*, (7%); and pinfish, *Lagodon rhomboides*, (7%). Species distributions and multivariate analysis of assemblage composition showed few consistent longitudinal patterns. Seasonal changes in species richness and diversity were noted with the highest richness in September through January and the lowest from June through August. Of particular interest was a change in species composition when compared to an earlier study completed along the same stretch of the Arroyo Colorado between 1966 and 1969 (Bryan 1971). Analysis of hydrological data showed vertical and longitudinal stratification of the water column for temperature, dissolved oxygen, and salinity. Most notable was the seasonal lack of dissolved oxygen on the bottom along the length of the Arroyo Colorado above the 10 km point.

Keywords: Richness abundance diversity seasonal Arroyo Colorado

Abstract Number: 100707

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Oral Presentation

Contributed Presentation

Impact of Tournaments on the Largemouth Bass Population at Sam Rayburn Reservoir

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Concerns regarding black bass *Micropterus* spp. tournament-related impacts have escalated during the last 40 years, due to increased tournament frequency. However, few studies have empirically estimated effects of tournaments on black bass populations. An estimated 52% of Sam Rayburn Reservoir anglers participate in tournaments and the annual number of events likely exceeds 300. In 2003, we tagged 6,021 largemouth bass *M. salmoides* to estimate the annual proportion of the population caught and harvested by tournament anglers. Tag returns were obtained via creel sampling to avoid non-reporting uncertainty, adjusted for recruitment and tag loss, and expanded to estimate total annual tagged fish catch and harvest. We conducted simulations to evaluate impacts of tournament mortality using rates of 10, 30, and 50% and compared those estimates to non-tournament harvest and catch-and-release mortality (simulated at 5, 10, and 15%) to assess specific contributions to annual angling mortality. From 3,447 angler interviews, creel clerks identified 40 tagged fish caught by anglers during the interview day (27 immediately released, 6 harvested by non-tournament anglers, and 7 harvested by tournament anglers). Total tag return estimates resulted in 1,620 fish immediately released (27% of population), 372 harvested by non-tournament anglers (6% of population), and 274 harvested by tournament anglers (5% of population). Tournament mortality and catch-and-release mortality each comprised a total of 1 to 6% of the population losses across all simulations. Tournament mortality comprised 6 to 28% of total angling mortality, whereas catch-and-release mortality contributed 10 to 31%. We conclude that tournament-related impacts on the largemouth bass population at Sam Rayburn Reservoir are low. Although we estimated no size-selective harvest from tournament anglers, size-selective tournament mortality could alter size structure by reducing large fish numbers.

Keywords: Sam Rayburn, largemouth bass, tournaments, tournament mortality, catch-and-release mortality

Abstract Number: 100719

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Oral Presentation

Contributed Presentation

THE INTRODUCTION HISTORY OF NATURALIZED LARGEMOUTH BASS MICROPTERUS SALMOIDES (LACEPEDE, 1902) IN KENYA AND ITS POTENTIAL FOR AQUACULTURE THROUGH INDUCED SPAWNING.

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Throughout the world alien fishes have been introduced to watersheds with little or no follow up to assess their long term effect. Largemouth bass (LMB), a fresh water fish native to North America, has been introduced to many parts of the world among them Kenya. This study aimed at documenting the introduction history of LMB in Kenya, its (LMB) response to induced spawning in tropical fishponds and some

aspects of its biology. In this study search on the existing literature was conducted, government archives examined, discussion and interviews held with community and letters sent to various fisheries stations. In Lake Naivasha LMB brooders were fished out by hook and line. The obtained fish were acclimatised, by being placed in a wire cage at one of the landing beaches for 7 days. The fish were subjected to different hormonal and environmental conditions while feeding them in an attempt to induce them to spawn. It was established that the idea to bring LMB to Kenya (Lake Naivasha) was raised in 1910 by the late U.S President Theodore Roosevelt. LMB was introduced to L. Naivasha and other small water bodies (SWBs') in 1928. The fish did not respond to any of the hormones used. However the fish spawned when it was subjected to environmental manipulation. The fish health continued to improve steadily during the 335 days they were reared in the ponds. There was no significant difference ($P < 0.05$) in the condition factor (Cf) between this and the natural stocks.

Keywords: Largemouth bass, Lake Naivasha, Sagana, Induced spawning and Introduction history.

Abstract Number: 100714

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Oral Presentation

Contributed Presentation

When The Rio Grande Ceased to Flow: Effects of Rio Grande Mouth Closure on Estuarine Dependent Species

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From February 2001 to November 2002, the Rio Grande ceased to flow to the Gulf of Mexico due to drought, noxious aquatic vegetation and international water management practices. This 21 month closure of the river mouth was interrupted by a 3 month period when its confluence with the Gulf of Mexico was temporarily re-established by a man made ditch. During the mouth closure, the former tidal (estuarine) portion of the river was sampled using bag seines and otter trawls to detect changes in relative abundance and species composition of aquatic organisms. Comparisons were made to data collected in the same area from 1992-97 when the river mouth was open. During the closure of the river mouth, striped mullet *Mugil cephalus*, gulf menhaden *Brevoortia patronus*, white shrimp *Litopenaeus setiferus*, and Atlantic croaker *Micropogonias undulatus* utilization decreased and estuarine habitat utilization by other organisms such as blue crab *Callinectes sapidus* and common snook *Centropomus undecimalis* was altered. Results of this study demonstrate impacts that occur with the loss of estuarine habitat due to low freshwater inflows.

Keywords: Rio Grande inflow estuary drought

Abstract Number: 100720

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Oral Presentation

Contributed Presentation

Testing the validity of Cating's (1953) method for age determination of American shad using scales.

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Cating's method of using scales to age American shad (*Alosa sapidissima*) has been the standard for more than 50 years. However, the only validation of this method is for ages 4-6 in the Connecticut River. To test the method for these – and older – age classes in another river, we obtained scales from 52 known-age fish from two Pennsylvania rivers and had 13 experienced biologists estimate ages using Cating's method. Each biologist read the scale impressions twice, and these readings were then assessed in terms of precision, accuracy, and bias. Percent agreement between estimates for the same scale set (precision) ranged from 50.0 to 76.5 %. Percent agreement between estimated age and known age (accuracy) was highest for ages 3-6 (33.7-48.5%), markedly lower for age-7 (12.1%), and lowest for age-8 fish (3.9%). Ages of the youngest fish were often overestimated, and those of the oldest fish were typically underestimated (bias). Therefore, Cating's method is not applicable to American shad in these Pennsylvania rivers. In fact, this scale-ageing method has never been validated across all ages for any American shad stock. Thus, we recommend against using age-based techniques to assess stocks of American shad until further age-validation studies have been completed.

Keywords: Age growth validation American shad anadromous fish stock assessment

Abstract Number: 100723

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Oral Presentation

Contributed Presentation

SEASONAL VARIATIONS IN FISH ASSEMBLAGES OF INTERMITTENT STREAMS IN THREE NATIONAL PARKS

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Intermittent streams in the southeastern United States experience significant differences in temperature, as well as changes in physical parameters due to seasonal fluctuations. It has been generally thought that fish assemblage patterns change as a direct result of these seasonal variations. This study was designed to determine the effects of variable flow regimes on fish species composition, diversity, and abundance. Six small streams with intermittent flows in three national parks (Chickamauga and Chattanooga National Military Park, Fort Donelson National Battlefield, and Abraham Lincoln Birthplace National Historic Site) were sampled May-June for the summer trials, October-November for the fall trials, and will be sampled February-March 2006 for the spring trials. All trials were conducted when water levels and flows were at normal seasonal stages. Fish populations were determined by electrofishing a 100 m stretch at each site. Physical parameters including temperature, dissolved oxygen, conductivity, pH, and flow rate were also measured at each site. The most abundant species for both summer and fall samples were *Semotilus atromaculatus*, *Camptostoma anomalum*, and *Rhinichthys atratulus*. During the summer sample, the three species accounted for 33% of the total population, while they accounted for 50% of the total population during the winter sample. Preliminary results indicate that fish assemblage patterns do change as a direct result of the seasonal variations.

Keywords: intermittent streams, fish assemblage, flow regimes, seasonal variation, National Parks

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Oral Presentation

Contributed Presentation

Comparisons of population structure in western Gulf of Mexico species of menhadens: a genetic perspective.

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The North American species of the genus *Brevoortia* support large commercial fisheries on the Atlantic and Gulf coasts. Historically, the industry supported by these species has comprised as much as 40% of all commercial landings in the U.S., with the Gulf menhaden (*B. patronus*) supporting the largest single fishery by weight, in North America. Two species of menhaden are found in the western Gulf of Mexico, the Gulf menhaden being the main target of the reduction fishery, and a congeneric Clupeid, the finescale menhaden (*B. gunteri*), which makes up <1% of commercial landings. We examined the population structure of both species using genetic techniques. Specifically, we used mtDNA sequencing and microsatellite DNA markers to examine patterns of genetic variation of putative "stock" structure in both species, and to examine the possibility of hybridization between these species. Furthermore,

we used the genetic variability within each species to estimate relative effective population sizes, and compared these estimates to anecdotal evidence of census size variation between species. Finally, we compared patterns of variation in western Gulf menhadens with similar patterns in two additional species of menhadens from the eastern Gulf and Atlantic, respectively. Genetic evidence support the assertions that 1) Gulf menhaden compose a single large, interbreeding population in the Gulf of Mexico, 2) finescale menhaden exist in smaller and less variable populations, 3) pre- or post-mating boundaries exist which limit or preclude hybridization between the species and 4) similar patterns of genetic variation exist in menhadens from the eastern Gulf and Atlantic.

Keywords: menhaden mtDNA microsatellite genetics Gulf of Mexico

Abstract Number: 100728

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Oral Presentation

Contributed Presentation

Spawning Stock Composition and Migratory Characteristics of Adult Atlantic Sturgeon in the Altamaha River, Georgia

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The Atlantic sturgeon, *Acipenser oxyrinchus*, once spawned in most major rivers along the Atlantic coast of North America. In Georgia, the largest population is found in the Altamaha River where a major commercial fishery for the species operated until 1996 when a Federal ban closed all US fisheries. Although historic catch records suggest the Altamaha population was once among the largest in US waters, little is known about the historical or current status of this population. The objectives of this study were to: 1) estimate annual run size, 2) determine age structure and annual mortality of the adult population, and 3) describe seasonal movements and to identify potential spawning habitats using GIS. Using both drift and bottom-set gill nets, we captured 213 adults in the tidal waters of the Altamaha River from March through May of 2004 and 2005, yielding a Schnabel population estimate of 353 and 542, respectively. Age-data from captured fish showed that the modal age of spawning adults was 9 years. From catch curves we estimated annual mortality rates of 17% in 2004 and 21% in 2005. Seasonal movements of radio-tagged adults, suggest that spawning may occur much further upstream than previously thought (> 215 rkm) and that both spring and fall spawning may occur in this system. Although the oldest fish captured was much younger (age-19) than the known maximum age of Atlantic sturgeon in other rivers, the Altamaha population appears to be recovering based on the preponderance of young adults in the annual spawning run.

Keywords: Atlantic sturgeon, Anadromous fishes, migratory behavior, mortality, age structure

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Oral Presentation

Contributed Presentation

Creating a Morone Hybrid Fishery in a High Flow-Through Reservoir in Oklahoma: Comparison of Two Morone Hybrids.

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The hybrid striped bass is a popular sport fish among Oklahoma anglers. However, due to the high flow-through rates of many Oklahoma reservoirs, hybrid striped bass fisheries are difficult to establish given the propensity of the hybrids to emigrate from these reservoirs. In an attempt to establish a hybrid fishery in a high flow-through reservoir, Kaw Lake was stocked at 5 fish per acre with 80,000 common cross hybrids (male *Morone chrysops* x female *Morone saxatilis*) as well as 80,000 reciprocal cross hybrids (male *Morone saxatilis* x female *Morone chrysops*). The objective of this study is to determine if either the common cross or the reciprocal cross of hybrid striped bass survive and remain in a high flow-through reservoir in Oklahoma, and if either cross can create a viable sport fishery. The initial stocking was done in June 2005. Weekly seine samples following the stocking yielded 120 total hybrids. Of the 120 fish collected, 97 (80.8%) were reciprocal cross hybrids and 23 (19.2%) were common cross hybrids. Fall gillnet sampling produced 6 hybrids (0.336 fish per net night). Results and analysis from the first year of the project will be discussed in depth.

Keywords: Morone saxatilis chrysops hybrid striped bass Oklahoma

Abstract Number: 100732

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Oral Presentation

Contributed Presentation

Evolution of Texas Parks and Wildlife Department's Approach to Managing Cynoscion nebulosus (spotted seatrout) Populations Following Freeze Events

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Polar air masses which push deep into south Texas and cause mass mortality of marine organisms in Texas' shallow bays have a long and destructive history that dates back to the early 1500's. Prior to 1940, news accounts provide insight in to severity of freezes and their effect on fishery resources. From 1940 to the mid 1970's state biologists documented the effects of freeze events on marine resources; however information was generally limited to their effects on commercial landings. When the 1983 freeze occurred, Coastal Fisheries Division of Texas Parks and Wildlife Department had standardized monitoring programs in place to record trends in relative abundance and harvest of marine resources. With these programs and the adoption of a standardized approach to estimate the number of animals killed during freeze events, Coastal Fisheries was able to assess freeze mortality, recommend regulatory changes, and chronicle the recovery of fish populations. These measures were used to expedite the recovery of the spotted seatrout population following the 1983 and 1989 freeze induced mortalities. In contrast to these reactive measures which were aimed towards assisting recovery of impacted populations, new regulations adopted after the Christmas 2004 cold front are intended to reduce fishing mortality prior to and during freeze events. This marked the beginning of an ongoing proactive approach to reduce impacts of cold weather events on Texas marine resources.

Keywords: seatrout freeze management

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Oral Presentation

Contributed Presentation

Movement, behavior and home ranges of tournament displaced black bass in Lake Martin, Alabama.

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Anglers fishing in black bass tournaments often displace fish great distances from their site of capture. It is unclear what effect tournament displacement has on movement and behavior of fish once they are released. Largemouth bass *Micropterus salmoides* and spotted bass *M. punctulatus* were implanted with radio transmitters to simulate the effect of tournament displacement on movement and behavior in Lake Martin (16,188 hectares), Alabama. Ten largemouth bass and 9 spotted bass were tagged and transported to a popular tournament processing site 9-19 km from their capture locations and 10 largemouth and 10 spotted bass were tagged and released at their capture location to serve as control fish. Displaced largemouth bass and spotted bass traveled farther from their release site than non-displaced fish ($t=-2.37$, $P<0.05$; $t=-3.58$, $P<0.05$). After initially moving away from the release site displaced largemouth bass set up home ranges 9.1 to 12.7 km from their release site. Ninety-five percent kernel home ranges averaged 254 and 98 ha for non-

displaced and displaced largemouth bass, respectively and was not statistically different ($t=0.43$, $P>0.10$) . Non-displaced spotted bass ranges averaged 59 ha; insufficient observations of displaced spotted bass prevented estimating 95% kernel home ranges. Average depth inhabited by spotted bass was shallower for displaced fish than for non-displaced fish ($t=3.85$, $P<0.01$). No differences in depth were observed for largemouth bass. Displacement of largemouth and spotted bass altered their movement patterns for up to 90 days after release as migration from the tournament release site occurred.

Keywords: black bass telemetry displacement

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Oral Presentation

Contributed Presentation

A Test of the Impact of Hydrilla Introduction on Biodiversity in Florida Lakes

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The addition of exotic species to ecosystems often has been associated with the decline in species richness and diversity of native flora and/or fauna. Hydrilla *Hydrilla verticillata* is native to Asia and was first observed in the United States, specifically in Florida in the late 1950s. Since then, hydrilla has spread across the U.S. resulting in a multitude of problems for water-related recreation and navigation. Although accused of adversely affecting freshwater biota, few studies have compared biodiversity of lakes with hydrilla to those without. We compared species richness and diversity of fish, aquatic birds, and aquatic plants for lakes with and without hydrilla from a sample of 45 Florida lakes. Species richness for fishes, aquatic birds, and plants were significantly greater ($p<0.1$) in lakes with hydrilla present ($N=12$) than at lakes without hydrilla ($N=33$). However, lakes with hydrilla present were also significantly greater in surface area and when lakes of similar size were compared, species richness of fishes did not differ although richness for aquatic birds and plants was still greater for lakes with hydrilla. Results indicate that species richness and diversity of fish, aquatic birds, and aquatic plants may not be adversely affected by occurrence of hydrilla for Florida lakes.

Keywords: hydrilla biodiversity exotic species

Abstract Number: 100743

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Oral Presentation

Contributed Presentation

Relation between floodplain lake fish communities and river connectivity in the lower White River, AR

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The goal of our research was to provide an understanding of how river-floodplain linkages affect fish communities in floodplain lakes. Our study was conducted within the White River National Wildlife Refuge, AR. We sampled 41 floodplain lake fish communities with boat electrofishing, gill nets, and mini-fyke nets. Nearly 41,000 fish comprising 72 species and 18 families were collected. Average richness was 31 species/lake (ranged from 13 to 42 species) and average Shannon diversity was 1.65 (ranged from 0.00 to 2.73). Canonical correspondence analysis was used to evaluate relationships between species, families, and reproductive mode relative abundances with lake physical/environmental and hydrological variables. Length/width ratio, water temperature, type of connection (prior to overbank flooding or overbank flooding), and average start date of connection were found to be important influences on fish communities. Lakes with a greater length/width ratio, surface area, and average depth tended to be connected by sloughs prior to overbank flooding. Start date of flooding tended to increase as distance to the river increased. Three general lake types and associated fish communities were evident. Type 1 lakes had higher length/width ratio, larger surface area, higher average depth, and connected prior to overbank flooding. Type 3 lakes had lower length/width ratio, lower surface area, lower average depth, and connected via overbank flooding. Type 2 lakes were intermediate with moderate length/width ratio, surface area, average depth, and connected just prior to overbank flooding.

Keywords: river, floodplain lakes, CCA

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Oral Presentation

Contributed Presentation

Spatiotemporal variation in fish assemblage structure based on functional groups and species composition

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Stream ecosystems across the world are dynamic and complex. Biogeographic and historical constraints cause many of these systems to be unique and create difficulty

in predicting compositional changes in fish assemblages. However, each system appears to be comprised of similar functional groupings despite phylogenetic differences. Hence, the objectives of this study were (1) to compare assemblage structure of stream fishes from a taxonomic and functional perspective among rivers and seasons, and (2) to determine whether certain variables that structure taxonomic assemblages (e.g., temperature, current velocity, water depth, substrate, stream width) can be used to predict functional diversity. I surveyed fish assemblages from three tributaries of the Colorado River in Texas (Pedernales River, San Saba River, and South Llano River) across all four seasons and from this data created functional and taxonomic data sets. Fish assemblages within each river were more similar to assemblages from the same river than assemblages from different rivers, regardless of season, from both taxonomic and functional perspectives. However, abiotic variables were better predictors for functional diversity than taxonomic diversity. Such a finding can be very useful for management agencies that are bestowed with the task of helping to maintain freshwater ecosystems.

Keywords: functional groupings, spatiotemporal variation, assemblage structure, predictability

Abstract Number: 100746

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Oral Presentation

Contributed Presentation

Nest site selection and nest success of smallmouth bass in Baron Fork Creek, Oklahoma

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Smallmouth bass populations in eastern Oklahoma are more genetically divergent and have higher mortality rates than other populations throughout their native range. We documented the nesting chronology, nest site selection, and nest success of smallmouth bass in an upstream (4th order) and downstream (5th order) reach of Baron Fork Creek, Oklahoma. Males started nesting in mid-April when water temperatures reached 16.9°C upstream, and in late-April when temperatures reached 16.2°C downstream. Streamflows were low, and decreased throughout the spawning period. Larger males nested first upstream, as observed in other populations, but not downstream. Upstream, 62 of 153 nests developed to swim-up stage. Downstream, 31 of 73 nests developed to swim-up. Nesting densities upstream (147 / km) and downstream (100 / km) were both higher than any densities previously reported. Males selected nest sites with intermediate water depths, low water velocity, and near cover, behavior that is typical of male

smallmouth bass. Documented nest failures resulted from human disturbance, angling, and longear sunfish predation. Logistic exposure models showed that water velocity at the nest was negatively related and length of the guarding male was positively related to nest success upstream. Male length and number of degree days were both positively related to nest success downstream. Our results, and those of other studies, suggest that biological factors dominate in determining nest success during benign (stable, low flow) streamflow conditions, whereas nest failures attributed to substrate mobility or nest abandonment dominate when harsh (spring floods) streamflow conditions coincide with the spawning season.

Keywords: Resource selection function, Logistic exposure, reproduction, stream habitat, predation, streamflow

Abstract Number: 100748

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Oral Presentation

Contributed Presentation

Evaluating fisheries benefits of restored oyster reefs along an environmental gradient

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Oyster reefs have long been recognized for supporting a valuable commercial fishery based on the extraction of oysters from the reef matrix. This fact, combined with recent recognition of the many ecological services oyster reefs provide to estuarine ecosystems, has resulted in increased efforts to restore and/or enhance the spatial extent of oyster reefs. As part of a large-scale restoration effort in Mobile Bay, AL, we designed a field project to address the following question. How does the design of a habitat influence the relative value of the ecosystem services it provides and how does this relationship change over environmental gradients? A field survey consisting of gill net sampling and oyster quadrats was designed to evaluate fish use and oyster abundance based on reef elevation, water quality, and location. All three sites from the field survey showed fish utilization to be higher in the control nets; however, fish assemblages were different when comparing control and reef catches. Catches in control nets had large numbers of clupeids, ariids, and sciaenids, while in reef nets numbers of fish from those families dropped, especially in the numbers of clupeids and ariids. In addition, oyster abundance was site dependent and there was a trend for oyster numbers to increase with higher reef elevation. Therefore, while the restoration effort did not lead to enhancement of numbers of fish in the restored reef areas, the fish assemblages were different between the control and reef areas, which may be of importance in future restoration efforts.

Keywords: fish oyster restoration

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Oral Presentation

Contributed Presentation

Combined Nitrogen and Phosphorus Fertilization for Controlling Golden alga *Prymnesium parvum* in Fish Culture Ponds.

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Prymnesium parvum has caused significant fish kills at Texas hatcheries since 2001. Copper sulfate and ammonium sulfate can control *P. parvum* but they provide short-term relief and have undesirable side effects. Copper sulfate can kill desirable algae and invertebrates, and ammonium sulfate can be toxic to fish. Because dominance of the phytoplankton community and toxin production by *P. parvum* appears to be nutrient-related, we evaluated two fertilization regimens of nitrogen (N) and phosphorus (P) for their efficacy in controlling *P. parvum* populations and toxin production. The experiment was conducted with three treatments (30P:300N and 60P:300N three times weekly and no fertilization) in limnocorrals at the Texas Parks and Wildlife Department's Dundee fish hatchery. In unfertilized treatments *P. parvum* cell densities and toxicity persisted throughout the 40 d experiment. In both fertilized treatments *P. parvum* cell densities and toxicity declined below detectable levels within two weeks and remained undetectable during the duration of the study.

Keywords: toxic alga, fish kills, harmful algal blooms, golden alga, fertilization

Abstract Number: 100752

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Oral Presentation

Contributed Presentation

Species Composition and Annual, Seasonal, and Spatial Variability of Fish and Macroinvertebrate Assemblages in the Texas Surf Zone.

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The Texas Parks and Wildlife Department's Coastal Fisheries Division has monitored the relative abundance of marine organisms since 1975 using a standardized, fishery-independent sampling program. Long-term trend data based on these types of sampling programs are necessary to effectively manage marine resources. From 1988 through 1995, beach seine and bag seine samples were collected from May through November from seven Gulf beach areas along the Texas coast as part of the marine resource monitoring program. The purpose of the surf zone monitoring project was to augment existing knowledge of the life histories of organisms using the surf zone, to develop a more comprehensive understanding of seasonal, annual, and spatial variation in Texas' surf-zone fish and macroinvertebrate assemblages, to determine if the abundance or distribution of these organisms are related to measured environmental variables, and to identify any management implications. Over eight years of sampling along Texas beaches, a total of 36,107 vertebrates and 4,941 invertebrates were collected in beach seines, and a total of 203,249 vertebrates and 28,876 invertebrates were collected in bag seines. The overall composition of the catch as well as annual, seasonal, and spatial variation in the abundance of organisms was examined, and management implications for selected species were explored.

Keywords: surf zone, beach, beach seines, Texas

Abstract Number: 100756

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Oral Presentation

Contributed Presentation

Development of bioenergetic model for zebrafish and application in toxicology research

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Bioenergetic models are a potentially important tool in ecotoxicological studies by providing a null model to make comparisons of growth, consumption, and respiration. Zebrafish *Danio rerio* is a common fish species used in ecotoxicological studies, yet there has not been a model fit for zebrafish. Thus, we fit a bioenergetics model with observed consumption, growth, and respiration across a temperature range of 18-30° C. The model's fit was evaluated with a 60-d laboratory validation at 28° C. We applied the zebrafish model as a null model in a toxicological study of Hexahydro-1,3,5-trinitro-1,3,5-triazine, a cyclonitramine commonly known as RDX (royal demolition explosive). RDX is a high energetic compound used mainly for the production of munitions and has been reported in water bodies around the world but information on its toxicity to aquatic organisms is scarce. We observed diminished growth and survival for zebrafish at high concentrations (10 ppm). Contrary to a priori expectations, we found no difference (P=0.75) in specific respiration between control and RDX-exposed zebrafish at low concentrations of RDX (1 ppm).

Keywords: Bioenergetics; zebrafish; toxicology

Abstract Number: 100758

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Oral Presentation

Contributed Presentation

Spatial variation in biochemical condition and growth of newly settled southern flounder

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Several flatfish species including southern flounder recruit to estuaries during early life and identifying habitats and sites which serve as nurseries is critical to conservation and management efforts. Here, biochemical condition and growth measurements were used to determine the quality of settlement sites used by southern flounder in the Galveston Bay estuary. Beam trawl collections were conducted in three major sections of the Estuary (East Bay, West Bay, Galveston Bay), and three sites were sampled from each bay (3 bays x 3 sites = 9). Within each sampling site, replicate beam trawl collections were taken in three habitats: 1) marsh edge 2) intermediate zone (10-20m from marsh interface; ~1m depth) and 3) bay zone (typically >100m from marsh interface; depth > 1 m). Catch data indicated that newly settled southern flounder were present throughout the Galveston Bay Estuary, but densities were significantly greater in East Bay (0.0313m⁻²) than West Bay (0.0034m⁻²) and Galveston Bay (0.0071m⁻²). Habitat-specific variation in density was not found. Spatial variation in nutritional condition (RNA:DNA) and recent growth were negligible, suggesting that early life survival and recruitment success of

southern flounder in the Galveston Bay Estuary may favorable regardless of settlement site.

Keywords: Southern flounder, biochemical condition, growth, RNA:DNA, habitat, distribution

Abstract Number: 100764

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Oral Presentation

Contributed Presentation

Prey Item Investigations for Sturgeon in Three South Carolina River Systems; Preliminary Results.

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The amphidromous shortnose sturgeon (*Acipenser brevirostrum*) and the anadromous Atlantic sturgeon (*Acipenser oxyrinchus*) coexist in many major rivers along the Atlantic coast of North America. In South Carolina, they occur in most coastal rivers and a dam locked population exists in a lake system. Diet information for these species has been well documented for the northern part of their range, but is lacking in southern river systems. Recently, a non-lethal method for examining diet items (gastric lavage) has been developed and refined for use with sturgeons. This is important due to the endangered status of shortnose sturgeon and the candidate status of the Atlantic sturgeon. A study is currently underway to determine the diet composition for shortnose and Atlantic sturgeon in three South Carolina river systems (the Savannah and Edisto Rivers and Lake Marion). To date a total of 41 shortnose sturgeon and 253 Atlantic sturgeon have been captured. Of these, 39 shortnose sturgeon and 243 Atlantic sturgeon underwent the gastric lavage procedure. Analysis data to date indicates that shortnose sturgeon feed chiefly on amphipods (71%) in rivers and mayfly larvae (95%) in lake environments. In contrast, riverine Atlantic sturgeon diets consist primarily of benthic polychaete worms (93%). Results to date suggest that at least in southern rivers sub-adult and adult shortnose sturgeon and sub-adult Atlantic sturgeon do not compete for food resources even though both species are often collected together.

Keywords: Shortnose sturgeon Atlantic sturgeon gastric lavage South Carolina

Abstract Number: 100765

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Oral Presentation

Contributed Presentation

Cold in the Tropics?: Implications of Winter on Growth and Survival of Age-0 Florida Largemouth Bass

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Florida's climate changes from sub-tropical to temperate with increasing latitude, which may strongly influence age-0 largemouth bass *Micropterus salmoides* growth and survival. We sampled the 2003 and 2004 largemouth bass year classes quarterly at 6 lakes in south, central, and north Florida (N=2 lakes per region). Hatching dates and mean daily growth were evaluated using otoliths and hatching periods (i.e., early, middle, late) were assigned based on lake hatching distributions. Instantaneous mortality was estimated for hatching periods using absolute changes in abundance between sampling periods. Initial age-0 largemouth bass hatch dates and hatch duration were inversely related to latitude because hatching started earliest and continued over a longer period at the south region relative to central and north regions during both years. Early hatched fish at south lakes exhibited slow growth and high mortality relative to later hatched fish and fish at other regions, likely due to episodic cool (15-16 °C) water temperatures in January and February when early hatched fish were present at south lakes. Age-0 largemouth bass at the north lakes exhibited rapid growth that nearly compensated for later hatching, resulting in age-1 size distributions that were similar across lakes and regions. Weather patterns influenced growth and survival of age-0 largemouth bass in Florida during both years, indicating that optimal stocking strategies will vary with year and latitude.

Keywords: largemouth bass growth survival Florida

Abstract Number: 100774

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Oral Presentation

Contributed Presentation

The impact of large schools of migratory cownose rays on local shellfish populations: density dependent predation and source-sink dynamics.

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Historically, the harvest of bay scallops, *Argopecten irradians*, provided an important fishery resource in the central areas of North Carolina sounds and bays. However, in recent years, landings of bay scallops have decreased. In many areas, harvest has decreased dramatically as a result of predation by cownose rays, *Rhinoptera bonasus*

. Thousands of cownose rays visit North Carolina sounds from late August to October during their southern migration from Chesapeake Bay to warmer waters and again from April to May on the northern, return migration. Because the timing of the late summer migration of cownose rays corresponds to the start of bay scallop spawning, bay scallops consumed by cownose rays probably do not contribute recruits to the following year's stock. Our surveys of bay scallops in seagrass beds throughout the North Carolina outer banks during late summer of 2002 - 2004 demonstrate that extremely high mortality occurs over a 2 week period in areas where populations of bay scallops are most dense. The near 100% mortality of bay scallops occurs prior to spawning, thus creating sink populations. Our sampling of large mobile predators coupled with experimental manipulations provides convincing evidence that the high mortality of bay scallops in late summer is caused by cownose rays. Further, our data suggest that cownose rays are choosing seagrass beds with high densities of bay scallops to feed. Given the apparent increase in cownose ray populations, future efforts to restore the bay scallop fishery must include plans to manage around cownose ray predation.

Keywords: Elasmobranch rays foraging predator-prey

Abstract Number: 100776

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Oral Presentation

Contributed Presentation

Efficacy of Oxytetracycline Marking Fingerling Palmetto Bass in Hard Water

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An oxytetracycline (OTC) marking study was performed to determine an OTC concentration that would successfully mark palmetto bass (M white bass *Morone chrysops* x F striped bass *M. saxatilis*) in hard hatchery water (500 mg CaCO₃/L). Comparisons between juvenile palmetto bass immersed for 6 h in concentrations of 500 and 700 mg/L of OTC mixed with hard water from Dundee State Fish Hatchery were examined to determine if differences existed in marking mortality, mark intensity, and mark identification after 14 and 344 d. Sagittal otoliths were examined for the 14 d portion of the study and lapillus otoliths were examined for the 344 d portion. Examination of the lapilli for OTC marks after 344 d was chosen over sagittae because of the time saved in otolith preparation and ease of mark identification. No significant marking mortality was noted but identification of the OTC mark in sagittal otoliths 14 d post-immersion was poor for both OTC concentrations. The 700 mg/L OTC concentration yielded better results than the 500 mg/L treatment when examining lapilli for identifiable marks and mark intensity 344 d post-immersion. It is recommended that juvenile palmetto bass OTC marked in hard water (500 mg CaCO₃/L) be immersed in 700 mg/L of OTC for 6 h and that lapillus otoliths be used for OTC identification.

Keywords: palmetto bass oxytetracycline otoliths

Abstract Number: 100778

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Oral Presentation

Contributed Presentation

Using Acoustic Telemetry to Estimate Fishing and Natural Mortality of Common Snook in Sarasota Bay, Florida

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Abstract. - The common snook *Centropomus undecimalis* is a popular, saltwater gamefish found in southern Florida that has been actively managed by the state management agencies to prevent overexploitation since the 1950's. Despite increasingly restrictive management regulations, the status of the population and the effectiveness of these regulations remain uncertain. Most fisheries management activities are focused on regulating fishing mortality (F), thus, an important aspect of population assessments is an accurate estimate of F to provide insight into the magnitude of fishing mortality relative to total mortality (Z) and natural mortality (M). We used telemetry methods to estimate Z, F, and M for adult common snook in Sarasota Bay, Florida. The "fates" of each fish were determined through a combination of active tracking and observations from a series of remote, autonomous receivers. These relocations were evaluated using a suite of *a priori* assumptions to determine whether an animal was live or dead. These fates were then converted to mortality rates using known-fate type models in the program SURVIV. For the period from October 2004 through September 2005 our models estimated a range of Z values (0.78 – 0.84) and a range of F values (0.29 – 0.6) depending on how assignments of natural mortality related to red tide events were made. Few observations of natural mortality have, thus far, precluded us from making estimates of M.

Keywords: Mortality Acoustic Telemetry Snook

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Contributed Presentation

Effects of the Probiotic, Liquid Live Micro-Organisms System, on Sludge, Water Quality and Koi Carp Production in Hatchery Ponds

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Turbidity and sludge in hatchery ponds can adversely impact water quality and fish production. To reduce turbidity, hatchery managers use chemical coagulants, chopped hay, or cottonseed meal. However, the turbidity-causing substances removed from the water column sink to pond bottoms as sludge which at pond draining can severely pollute receiving water bodies. For hatcheries to operate within effluent discharge limits total suspended solids (TSS), total settleable solids, total ammonia nitrogen, pH and carbonaceous biochemical oxygen demand (CBOD) must be effectively managed. We tested the effects of the probiotic, Liquid Live Micro-Organisms System (LLMO), on sludge accumulation, selected water quality variables, and koi carp production in plastic-lined ponds for 148 d. The results revealed no significant differences in sludge accumulation, water quality variables (turbidity, Secchi disk transparency, CBOD, chlorophyll a, TSS, and pH) and koi carp production between ponds treated with the LLMO and untreated control ponds.

Keywords: Sludge, water quality, probiotics, Liquid Live Micro-Organisms, bacteria, effluent, koi carp

Abstract Number: 100777

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Oral Presentation

Contributed Presentation

Variations in Fish Abundance Through Time in Small Western Kentucky Streams

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Routine monitoring at five small streams in western Kentucky have shown significant variations in the abundance of fishes over a five year period. Our data show that there are significant differences between years in populations of common species. Similarly we found that while species richness remains relatively constant through time the actual species present varies greatly from year to year. We compared habitat indices and benthic populations to the fish populations but found little relationship.

Keywords: stream fish abundance Kentucky streams fish populations variations in populations

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Oral Presentation

Contributed Presentation

Experience as a Hutton Junior Fisheries Biologist

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The American Fisheries Society (AFS) Hutton Junior Fisheries Biology summer internship program offers an opportunity for high school students to acquire collegiate level internship experience working with professional biologists. The San Antonio River Authority (SARA) was involved in the Hutton program in the summers of 2004 and 2005, with Michael Gonzales, SARA Environmental Services Department Manager, serving as mentor. I gained a wide range of experiences with fish and macroinvertebrate sampling, habitat and water quality monitoring, and data collection associated with SARA monitoring programs and special projects within the San Antonio River drainage. In the summer of 2004, I assisted with a contracted project for the National Parks Service. Objective of this study was to determine occurrence and abundance of fishes within the San Antonio Missions National Historical Park. In the summer 2005, I was involved with monitoring activities associated with the State of Texas Clean Rivers Program. The application of scientific techniques provided me with useful knowledge about the fisheries profession. Perhaps one of the most beneficial aspects of the AFS Hutton Junior Fisheries Biology Program is the connections a student can develop with professional biologists and other members of the Texas Chapter AFS. Overall, I feel that this internship experience has prepared me for college and a career in fisheries.

Keywords:

Abstract Number: 100785

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Oral Presentation

Contributed Presentation

Changes in Reservoir Morphometrics and Fish Communities as a Result of Extensive Sedimentation in Lake Texoma, Oklahoma

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Lake Texoma is a 36,000 ha reservoir located in southern Oklahoma and northern Texas, and was completed in 1944. The upstream end of the reservoir is experiencing significant sedimentation and accretion, resulting in isolation of coves and a reduction of reservoir surface area. We focused on one of the two major tributaries to the reservoir, the Washita River arm, where we determined (1) the amount of reservoir surface area lost to accretion, (2) changes in morphometrics in areas of high sedimentation, and (3) the impacts of these processes on fish community structure. We used GIS technology to address changes in surface area, standard limnological measurements to address morphometrics, and experimental gill nets samples analyzed via ordination techniques and similarity indices to characterize the fish community. Much of the surface area of the reservoir has experienced accretion above the water level, shoreline length has increased, and localized shoreline development values increased, then decreased over time. Numerous areas of the reservoir have lost connectivity to the main body of water, resulting in habitat fragmentation. With these changes, the fish community has become fragmented, the relative abundance of pelagic game species may be reduced, and the relative abundance of littoral species may be increasing. Fish community response appears to be correlated with the extent and duration of isolation of the reservoir fragments sampled. These changes will likely impact the quality of the sport fishery and the local economy in this area.

Keywords: sedimentation fragmentation morphometrics reservoir GIS ordination

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Oral Presentation

Contributed Presentation

Some evidence for anadromy in the black drum (*Pogonias Cromis*) populations in Baffin Bay, Texas

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The Laguna Madre of Texas is a large hypersaline lagoon, sustaining the largest stock of black drum (*Pogonias cromis*) in their range. In Baffin Bay, little is known of their life history characteristics. There, black drum are known to migrate several kilometers up creeks after heavy rain events. There is also some evidence suggesting bimodal spawning. The objectives are to determine black drum reproductive condition in creeks and determine the seasonal reproductive condition

of black drum in the bay. In September 2003, eight females and two males were obtained from Los Olmos Creek after heavy rains and examined histologically. Water salinity was estimated at 0 ppt. Of fish collected from creeks, one male displayed diffuse spermatozoa, while females exhibited final and mid-maturation oocyte stages suggesting spawning activity in the creek. To determine reproductive seasonality, fish were collected monthly from commercial fishermen. Standard lengths, body weight, and gonad weight were recorded, and samples of the gonads were collected for histological examination. Black drum were collected from November 2004 to November 2005. Approximately 25 fish were collected from the bay each month. Bimodal spawning activity was observed peaking in spring, with a smaller peak in fall. The smaller peak coincides with the rainiest month in South Texas. Since even modest rainfall events would reduce the salinity in creeks more than in larger bodies of water, black drum might have adapted an anadromous strategy to place vulnerable eggs and larvae with limited osmoregulatory ability in a more favorable environment.

Keywords: black drum *Pogonias cromis* reproduction seasonality anadromous

Abstract Number: 100796

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Oral Presentation

Contributed Presentation

Recruitment, spatial distribution, and fine-scale movement patterns of red drum (*Sciaenops ocellatus*) through major and shallow passes in Texas

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Information on geographical recruitment patterns of marine fish populations is critical to understanding their ecology. This is problematic for estuarine-dependent species because of large adult migrations and larval dispersal. For example, red drum (*Sciaenops ocellatus*) are an estuarine-dependent fish that use seagrasses as nursery habitat, and it is unknown how far recruitment occurs from the inlet. Packery Channel is a natural tidal inlet in Corpus Christi Bay that has been closed since the 1930's and recently opened creating a direct link for marine fishes and crustaceans that spawn in the Gulf of Mexico and use the estuary as nursery habitat. The purpose of this research is to determine the distance that red drum disperse from an inlet before settling into a seagrass meadow and to examine the effects of a new inlet on red drum recruitment. We also assessed fine-scale movement patterns of newly settled wild and hatchery-reared red drum using mark and recapture techniques. Our results suggest that juvenile red drum have relatively large movement patterns within seagrass meadows. Although red drum have large movement patterns within a seagrass meadow they do not disperse far from the inlet before settling. The greatest densities of red drum were found near the inlet with significantly decreasing densities at farther distances. These results suggest that the opening of Packery

Channel will increase recruitment in an area that previously exhibited low densities of red drum and that remote seagrass meadows surrounding Packery Channel may now become an important nursery area for this species.

Keywords: red drum, recruitment dynamics, fine-scale movement

Abstract Number: 100799

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Oral Presentation

Contributed Presentation

Impacts of a New Tidal Inlet on Estuarine Nekton: The Opening of Packery Channel in Corpus Christi, Texas

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In the Gulf of Mexico the vast majority of commercially important species are estuarine-dependent with larvae migrating through tidal inlets where they use estuaries as "nursery" grounds. Access to high quality habitats in estuarine areas via tidal inlets is critical for reproduction, growth, survival, and sustainability of these populations. Packery Channel, a natural tidal inlet, has been closed since the 1930's due to sedimentation. The US Army Corps of Engineers recently dredged and permanently reopened this inlet to allow water exchange from the Gulf of Mexico into the Laguna Madre near Corpus Christi Bay, Texas. We established seven zones at varying distances from Packery Channel to assess the impact of this new inlet on estuarine nekton. Within each zone we selected two sampling sites in seagrass meadows dominated by *Halodule wrightii* and collected triplicate nekton samples (10 m²) twice per season using an epibenthic sled. Sampling took place one-year prior to the opening of Packery Channel and will continue one-year after. Using red drum (*Sciaenops ocellatus*) as a model species for fall recruitment, we found distinct differences in their densities post-channel opening. However, red drum densities were not as great as those found near natural inlets. Despite these differences in density patterns between natural and dredged inlets, these results suggest that the Packery Channel may have important implications to fisheries along the Texas coast by allowing newly recruiting nekton access to the extensive seagrass meadows of the Laguna Madre.

Keywords: Packery Channel inlets red drum recruitment

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Oral Presentation

Contributed Presentation

A Synoptic Survey for Non-Indigenous Ichthyofauna In Selected Tidal Bayous of Galveston Bay

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A synoptic survey was conducted between April 2004 and February 2005 on three tidal bayous of Galveston Bay to assess the presence of non-indigenous species. Active and passive sampling gears were used to collect finfish species within these waterbodies on a quarterly basis. Six non-indigenous species were collected: snow plecos *Pterygoplichthys anisitsi* (n = 167), grass carp *Ctenopharyngodon idella* (n = 18), blue tilapia *Oreochromis aurea* (n = 16), Nile tilapia *O. niloticus* (n = 14), Rio Grande cichlid *Cichlasoma cyanoguttatum* (n = 13) and common goldfish *Carassius auratus* (n = 2). Plots of gonadosomatic indices (GSI) for female *P. anisitsi* showed elevated values, indicative of spawning activity, during the spring sampling period while spawning activity for male *P. anisitsi* was less discernable with GSI data appearing slightly bimodal, with peaks during the summer and winter. Genetic analysis suggests either the putative tilapia species were of hybrid origin or hybridization among the tilapia species is occurring while the lack of variation in grass carp suggests they are from a single lineage, possibly resulting from either a single introduction event or multiple releases of the same stock.

Keywords: non-indigenous plecos *Pterygoplichthys anisitsi* grass carp *Ctenopharyngodon idella* blue tilapia *Oreo*

Abstract Number: 100809

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Oral Presentation

Contributed Presentation

Dynamic surplus production models for analyzing the Texas commercial blue crab (*Callinectes sapidus*) fishery

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The blue crab fishery is the third largest commercial saltwater fishery in Texas, accounting for approximately 10 % of total annual landings and generating around

11.7 million dollars into local economies. Commercial landings have declined from a high of 11.7 million pounds reached in 1987 to a 35-year low of 4 million pounds in 2004; catch-per-fisherman dropped from 38,000 lbs/year to 18,000/year over the same period. Fishery-independent bay trawl data revealed similar declines in catch-per-hour and mean carapace width, signaling increasing levels of mortality. These data were analyzed using a dynamic surplus production model in an attempt to determine a more favorable harvest strategy with a view of increasing and sustaining future yields. Preliminary results suggest that an annual sustainable yield of 7-million pounds is possible if yields are capped and populations allowed to recuperate. Current and future management measures such as effort and license limitation are also discussed.

Keywords: Dynamic Surplus Production models Blue Crab Fishery

Abstract Number: 100810

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Oral Presentation

Contributed Presentation

Dissimilarity of a Blanco River Reservoir Fish Assemblage from Other Riverine Sites

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Main stem dams impact fish assemblages upstream and downstream of the modified areas. In general, decreased flow and pooled areas cause a shift from fluvial specialists to lentic species and increased taxa richness because of habitat diversification and subsequent stocking of game and forage species within the newly constructed impoundment. The purpose of this study was to determine fish occurrence and habitat changes in the Blanco River (Guadalupe drainage) relative to flow alterations caused by multiple low-head dams constructed in the 1950s. Analysis of similarities was used to test for differences among impounded and non-impounded sites. Our results show that the reservoir assemblage is significantly different from non-impounded sites and is the most unique among main stem sites. Additionally, the reservoir is dominated by lentic species and has few endemic forms. In contrast, sites relatively near to and distant from impoundments did not differ. Although fish assemblage changes were related to low-head dams, the extent of impact was limited.

Keywords:

Abstract Number: 100811

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Contributed Presentation

REPLACEMENT OF FISH MEAL WITH POULTRY BY-PRODUCT MEAL AS A PROTEIN SOURCE IN SUNSHINE BASS, MORONE CHRYSOPS X MORONE SAXATILIS, DIETS

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Sunshine bass *Morone chrysops* x *M. saxatilis* has become an important fish for aquaculture in the United States. As with many cultured species, feed often accounts for 40-60% of total production costs. Sunshine bass requires a high protein diet (35-45%), a relatively expensive feed. Currently, fish meal (FM) is the primary source of protein in commercial sunshine bass diets, though several sources of protein, including poultry by-product meal (PBM), are available at lower costs. The use of PBM has been demonstrated to either partially or totally replace FM in diets for certain species of fish. The current study was designed to evaluate the feasibility of either partially or totally replacing FM with PBM in sunshine bass diets. To evaluate the replacement of FM with PBM, 400 phase II sunshine bass (mean weight 5.6 g) were stocked into each of twelve 0.04-hectare earthen ponds. The ponds were randomly assigned one of four diets formulated to be isonitrogenous (37% protein) and isocaloric with various percentages of PBM (0, 16.5, 33.0, and 49.3% of total protein) partially or totally replacing FM (0, 33, 67, and 100% of FM protein content). Fish were cultured for 246 days. Results indicate that complete replacement of FM with PBM is feasible in grow-out diets for sunshine bass grown in earthen ponds. The total replacement of FM with PBM yielded no significant differences ($p < 0.05$) in production, dress-out, or body composition. Economic analysis indicates that replacement of FM with PBM may result in reduced revenue over feed costs.

Keywords: fish culture hybrid striped bass nutrition

Abstract Number: 100812

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Oral Presentation

Contributed Presentation

Lake Sturgeon Reintroduction in the Coosa River System

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Lake sturgeon *Acipenser fulvescens* were abundant in the Coosa River of northwestern Georgia until they were extirpated due to habitat degradation and exploitation in the mid-1900s. Recent conservation and protection measures have greatly improved lake sturgeon habitat in the Coosa, prompting new efforts to restore the species in this system. In fall 2002, the Georgia Department of Natural Resources initiated a long-term lake sturgeon reintroduction program with the release of over 1,000 8-14cm fingerlings. The primary objective of our study was to evaluate post-stocking reintroduction success by monitoring survival, growth, and seasonal habitat use. Beginning in fall 2003, we used both gill and trammel nets to capture age-1 and older juvenile lake sturgeon in both riverine and reservoir habitats of the Coosa River system. We also compared seasonal movements of naturalized juveniles (caught at least 1 year post-stocking) to that of naïve fish (tagged and released directly from the hatchery). From October 2004 through November 2005 we captured 151 individual lake sturgeon juveniles measuring 335-695 mm TL. Age and growth of these fish showed that stocked cohorts fully recruited to our gear at approximately 18 months of age after reaching 350 mm TL. Radio tracking of naïve and naturalized fish revealed that mortality of naïve juveniles was 90% after 12 months compared to 0% for wild fish over the same period. Our findings suggest that a new lake sturgeon population is gradually emerging; however, mortality of stocked fish may be high during their first few months after release.

Keywords: lake sturgeon reintroduction telemetry coosa river georgia

Abstract Number: 100813

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Oral Presentation

Contributed Presentation

Theoretical Model for Prey Size of Largemouth Bass

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A linear relationship is generally observed between the length of largemouth bass, *Micropterus salmoides* (Lacepède), and the length of prey they can consume. However, one should instead expect an allometric relationship, in which the maximum size of prey increases relatively more rapidly than does the largemouth bass length. We have constructed a theoretical model based on: (1) this allometric relationship; (2) the speed with which largemouth bass capture prey; and (3) the escape ability of prey fish. This model predicts a linear relationship between length of largemouth bass and length of prey. We test the model using published data sets.

Keywords: Largemouth bass prey length consume

Abstract Number: 100814

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Oral Presentation

Contributed Presentation

The effect of temperature and forage fish abundance on reservoir striped bass distribution

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Habitat selection may give particular insight into how individuals approach trade-offs present in the environment when habitat conditions are substantially less than ideal. Such is the case for many southern populations of reservoir striped bass (*Morone saxatilis*) that experience summer stratification events in which hypoxia limits the habitat available to fish, forcing them into marginal thermal habitat while potentially isolating them from the depths or regions of the reservoir that contain the highest forage fish densities. To evaluate the relative influence of forage fish abundance and temperature on reservoir striped bass habitat selection, this study examines the distribution of striped bass tagged with internal sonic transmitters in Badin Lake, a eutrophic reservoir in the central piedmont region of North Carolina. Fish locations were compared to information on water column temperatures, dissolved oxygen constraints, and forage fish abundance interpolated across the entire reservoir using geostatistical techniques, in the summers of two consecutive years that displayed substantially differing severity of stratification and associated thermal conditions. While both environmental factors appear to have an effect on striped bass distribution, neither temperature nor forage fish abundance fully explains the pattern of striped bass relocations, suggesting that a more integrated index of habitat quality is necessary.

Keywords: striped bass reservoir habitat selection forage fish temperature geostatistics

Abstract Number: 100815

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Oral Presentation

Contributed Presentation

Can Barley Straw and the Probiotic, Liquid Live Micro-Organism System, Control *Prymnesium parvum* and improve water quality for fish production?

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The ichthyotoxic microalga *Prymnesium parvum* has caused extensive fish kills in many parts of the world. Since 2001, *P. parvum* has been implicated in major fish kills in 13 U.S.A states. Chemicals can control *P. parvum* in hatchery ponds and small impoundments. However, chemical treatments are not feasible for large reservoirs because they are expensive, effective for a few days and may cause adverse ecological impacts. Barley straw and the Liquid Live Micro-Organisms System (LLMO) are natural products demonstrated to exert relatively long-term control on algal populations with potential to improve water quality. They are inexpensive and nontoxic to aquatic organisms or humans. However, their effects on *P. parvum* are unknown. We investigated the effects of these two products on *P. parvum* density, toxin production, ichthyotoxicity, and water quality (total nitrogen, total phosphorus, pH, and chlorophyll *a*) in hatchery ponds for 140 d. Barley straw or LLMO had no significant effects on *P. parvum* density, toxin levels and ichthyotoxicity. Similarly, they had no significant impacts on water quality.

Keywords: Golden alga, *Prymnesium parvum*, water quality, nutrients, ichthyotoxicity, probiotic, bacteri

Abstract Number: 100817

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Oral Presentation

Contributed Presentation

Differences in Population Metrics Between Bluegill and Redear Sunfish: Implications for the Effectiveness of Harvest Restrictions

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Bluegill *Lepomis macrochirus* and redear sunfish *L. microlophus* were collected and aged from three reservoirs in Georgia and Alabama in 2003-2004 to describe population metrics and investigate the potential of harvest restrictions to maintain or improve size structure of these populations. Redear sunfish grew faster and lived longer than bluegills in all three reservoirs, and estimated natural mortality was greater for bluegill than redear sunfish; however, total annual mortality was similar between species in two of three reservoirs. Population dynamic models did not predict any significant benefits to bluegill size structure and yield from minimum length and/or bag restrictions. In contrast, redear sunfish populations showed

significant increases to size structure with a minimal decline in yield with various harvest restriction scenarios in each study reservoir. Likely, harvest restrictions for bluegill will not positively affect size structure without an unacceptable decline in yield, due to higher mortality and slower growth. However, our results indicated that harvest restrictions may have greater potential in managing redear sunfish populations. For redear sunfish, yield was not drastically affected by minimum length limits, but number of larger, preferred-length (> 230 mm) fish could increase over an order of magnitude in moderate to highly exploitative fisheries with harvest restrictions. Finally, results of this study have demonstrated that the common practice of managing sunfish as a homogenous group may not be appropriate, particularly if the fishery is composed of a diverse array of sunfish species that are targeted by anglers.

Keywords: length restrictions, reservoirs, FAST modeling

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Oral Presentation

Contributed Presentation

EVALUATING EFFECTS OF SIZE-SELECTIVE HARVEST ON GROWTH PARAMETER ESTIMATES

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Fish growth parameters from the von Bertalanffy model (e.g., Brody growth coefficient, asymptotic length) are used to estimate natural mortality and fishery yield. However, exploited fish populations often have biased growth parameters due to selective removal of fast-growing individuals. Evaluating these biases is problematic because it requires data on unfished populations, which rarely exist. We evaluated bias in growth parameters of gizzard shad *Dorosoma cepedianum* following commercial gillnet harvest from the Harris Chain of Lakes, Florida. Gizzard shad growth was estimated via experimental gillnets immediately before and after harvest at a fished lake and at two unfished control lakes. We used likelihood ratio tests to evaluate bias in growth parameters for pre- and post-harvest growth models at the fished lake versus the unfished lakes, and we assessed effects of biased growth parameters on natural mortality and yield estimates. Asymptotic length (L_{inf}) decreased by 31.7 mm after harvest at the fished lake ($P = 0.08$) but the growth coefficient (K) and time at zero length (t_0) did not differ between time periods. Time at zero length (t_0) decreased by 0.26 yr ($P = 0.01$) at an unfished control lake whereas parameter estimates did not differ between time periods at a second unfished lake. Biases in growth parameters at the fished lake did not substantially influence yield and natural mortality estimates. However, variation in growth parameters at the unfished control lake indicated that biases due to sampling error or seasonal effects on fish selectivity may have overshadowed biases due to shad harvest.

Keywords:

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Oral Presentation

Contributed Presentation

Managing freshwater inflows to estuaries: an application of the DermoWatch Program

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DermoWatch (www.dermowatch.org) is a web-based community for the monitoring and management of the lethal oyster parasite, *Perkinsus marinus* (= *Dermocystidium marinum*). Dermo disease is more prevalent in larger oysters (*Crassostrea virginica*) in warmer, saltier waters. Online services are provided to oyster growers, resource managers and scientists. Data displays include station information, water temperature and salinity, and percent infection and disease intensity of sub-market and market-sized oysters. Adult oysters are sessile indicators of mesohaline environments. They are constrained on the freshwater side of their range by reproductive and osmotic failure, and constrained on their seaward side by predation and parasitism. The parasite *P. marinus* is less tolerant of low salinity than are oysters, and host and parasite provide a good integrator of salinity conditions. Resource managers can thus use DermoWatch to better manage freshwater inflows into estuaries. Freshwater inflows might be adjusted to maintain low disease levels in the central part of the estuary. This prevents wholesale mortalities due to parasites (and predators), and insures that oysters are optimally abundant across the salinity gradient.

Keywords: Freshwater oysters disease

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Oral Presentation

Contributed Presentation

The Expansion of Giant Salvinia (*Salvinia molesta*) on Toledo Bend Reservoir, Texas

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ABSTRACT Mild winters and high water levels throughout the spring and summer of 2004 resulted in a record expansion of giant salvinia (*Salvinia molesta*) throughout Toledo Bend Reservoir. By May of 2005, aerial surveys estimated 5000 acres of giant salvinia reservoir-wide. Since its discovery on the reservoir in 1998, isolated infestations had been held in check by aggressive herbicide treatments conducted by Texas Parks & Wildlife Department and the Louisiana Department of Wildlife and Fisheries. An extended drawdown of the reservoir by the Sabine River Authority in 2000 resulted in a marked reduction of infestations, but failed to eliminate the threat. The expansion of giant salvinia on Toledo Bend Reservoir in 2004 poses a serious threat to neighboring water bodies. Giant salvinia is easily transported overland to new locations by boat trailers and personal watercraft. Due to the plant's overwhelming rate of growth and magnitude of areas covered, herbicide treatments on Toledo Bend Reservoir proved ineffective in 2004. Large-scale introductions of a bio-control agent in the form of the giant salvinia weevil (*Cyrtobagous salviniae*) on the Texas portion of the reservoir began in July of 2004. It is hoped the establishment of the giant salvinia weevil will provide a long-term management tool for the control of giant salvinia in the future.

Keywords: Toledo Bend Giant salvinia *Salvinia molesta* *Cyrtobagous salviniae*

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Oral Presentation

Contributed Presentation

Largemouth bass population characteristics in the lower 11 pools of the Arkansas River

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Following completion of the McClellan-Kerr Navigation System in 1973, the Arkansas River's fisheries have been exposed to many of the same impacts as other river

systems, such as sedimentation, altered hydrology, and loss of off-channel or backwater habitats. A 380-mm (15-in) minimum length limit was implemented on largemouth bass in 1998. However, recent concerns have been expressed suggesting the quality of the largemouth bass population in the Arkansas portion of the river has been diminishing. Historical fisheries data for the river are scarce and not representative of the entire river. Thus, the primary objective of this study was to provide detailed characterization of the largemouth bass populations in the lower 11 pools (500 km) of the Arkansas River. Population age structures were skewed towards younger fish with very few individuals older than age 3. Population size structures, expressed as proportional stock density (PSD), were greatest in the lower pools of the river. PSD values averaged 57 (\pm 4) and 45 (\pm 8) in the lower and upper pools, respectively, with Lake Dardanelle averaging 47 (\pm 5). Similarly, relative stock densities using 380-mm total length averaged 20 (\pm 4) and 18 (\pm 6) in the lower and upper pools, respectively, with Lake Dardanelle averaging 14 (\pm 4). Bass condition was generally good throughout the river, though a slight inverse relationship existed with river mile. Results of this study do not suggest that the quality of largemouth bass populations in the lower Arkansas River is poor.

Keywords: largemouth bass large rivers stock assessment

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Oral Presentation

Contributed Presentation

Reproduction and Habitat Use of Paddlefish in Ozark Lake, Arkansas River Arkansas

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The effects of proposed channel modifications on paddlefish reproduction and habitat use in the Arkansas River, Arkansas are unknown. Data regarding these aspects of paddlefish ecology are needed to enable managers to develop an appropriate management plan. The purpose of this study was to identify paddlefish spawning areas and determine seasonal habitat use. We implanted 50 adult paddlefish in Ozark Lake with ultrasonic transmitters and made 565 relocations from January 2004 to December 2005. Telemetered fish migrated a median distance of 32.7 km in the spring when water temperatures ranged from 10-16 °C. Adults staged for the spawn in the tailwater of J.W. Trimble Dam in 2004 and in 2005. We verified reproduction by capturing 23 prolarvae in the upper reach of Ozark Lake at water temperatures between 17-19 °C. Telemetered fish frequently moved between bayous in the summer, however tributary-mouths were the most dominant habitat type selected for in each season and comprised 55.6 % of all relocations. Water depths that fish occupied were 6.7 ± 2.0 m (mean \pm SD) and did not differ between seasons. Mean

water velocities fish utilized were significantly different between summer-fall and winter-spring seasons, 29.8 and 61.7 cm/s, respectively. Given the proposed channel modifications for Ozark Lake, paddlefish will likely retain access to adequate spawning habitat. However paddlefish use habitat near the Mulberry River confluence year-round, therefore channel modifications between river-kilometer 435.3 and 439.3 may alter important population characteristics pertinent to a successful management plan.

Keywords: Paddlefish reproduction habitat

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Oral Presentation

Contributed Presentation

Oyster reef as essential habitat for finfishes and invertebrates

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Biogenic reefs formed by dense aggregation of the eastern oyster *Crassostrea virginica* are a dominant feature in many estuarine systems along the Atlantic and Gulf of Mexico. Oyster reefs are complex in their structural nature and may provide critical habitat for several species of fishes and invertebrates, but few studies have quantitatively assessed the use of oyster reefs by fisheries species in the Gulf of Mexico. Limited assessment of nekton using this habitat type has primarily been due to inefficiency of conventional gear to adequately sample oyster reefs. We have developed an effective technique for quantitatively sampling oyster reefs using an enclosure sampling approach. During 2000 and 2001 oyster reef, marsh *Spartina alterniflora*, and nonvegetated bottom habitat types were sampled on a seasonal basis in Galveston Bay, Texas. We found higher densities of nekton using oyster reef and marsh than over nonvegetated bottom, and species composition varied considerably among habitat types and season. These results suggest that identifying and quantifying the habitat role of oyster reefs, particularly in relation to other habitat types, is critical to implementing effective management and protection measures for Essential Fish Habitat.

Keywords: Oyster Reef, Habitat, Fisheries Habiata

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Oral Presentation

Contributed Presentation

Movements and Habitat Preferences of the Juvenile Lake Sturgeon (*Acipenser fulvescens*) in the Upper Tennessee River System, USA

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The lake sturgeon reintroduction program is a multi-agency partnership working to reintroduce the lake sturgeon (*Acipenser fulvescens*) to the Upper Tennessee River system. The initial reintroduction occurred in 2000, and over 20,000 juveniles have been released to date. Attempts to determine survival of stocked fish have been marginally successful. This could be attributed to the fact that the lake sturgeon is highly migratory or that sampling locations were chosen without sufficient knowledge of habitat preferences. The objective of this project is to identify seasonal habitat preferences of reintroduced juvenile lake sturgeon in the Upper Tennessee River System. Twenty fingerlings were surgically implanted with radio-transmitters and released into the French Broad River in east Tennessee in October 2004. Movements were tracked by boat using a radio telemetry receiver and loop antennae for the life of the transmitter batteries, approximately 90 days. Waypoint locations were taken using a Garmin GPS unit. Water temperature and depth were recorded for each waypoint. The waypoint locations will be mapped using the ARCMAP program. This information will be used to determine movement patterns and areas of preferred habitat. Further analysis of preferred habitats will be conducted to determine water quality and substrate characteristics.

Keywords: Telemetry, Lake Sturgeon, movements, habitat preferences

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Oral Presentation

Contributed Presentation

Use of stocked red drum to address fishery issues: the South Carolina model

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Impacts of hatchery fish on wild populations are often characterized as to their potential negative effects. However, hatchery produced animals can also be used to address issues important to fishery management and ultimately benefit the wild population. This is especially true when a large number of replicates with specific characteristics (e.g. size) are needed to produce statistically valid results. In SC, this approach has been utilized to further knowledge of the overfished red drum

population. Hatchery produced fish have been used in experiments to: document long term retention of commonly used tags (in some cases as low as 10% after only 12 months); identify non-reporting level of tagged fish by anglers (approximately 40%); characterize seasonal variation in tag-induced and hooking mortality (0 % to high, depending on size and season). These types of data increase accuracy of mark recapture models and make reasonable estimates of population size possible. Further, by releasing fish at various life stages and monitoring recapture rates, researchers are obtaining insights into recruitment dynamics. For example, the large population component (>70%) comprised of hatchery fish released one year earlier at approximately 25 mm TL, indicates that the population bottleneck may occur at an earlier life stage. Experimental releases of genetically identifiable larvae are currently being conducted to test this hypothesis.

Keywords: red drum, stocking

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Oral Presentation

Contributed Presentation

Marine Fisheries and Ecosystem-Based Management: Is the National Coastal Assessment the link?

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For many years marine fishery scientists have been recommending a move toward a multi-species approach to fisheries management. More recently there has been a call for an ecosystem-based approach to the management of fisheries and for the management of ecosystems in general. As we assess the current management strategies used in the natural resources, they appear, in general, to be either issue or resource oriented, with little cross-cutting coordination or collaboration. For the past six years the National Coastal Assessment (NCA) has been collecting data and assessing the health of the nation's bays, estuaries and in some cases, continental shelf waters. This program collects water, sediment, benthos and fish data that allows for, in a limited way, cross resource analysis and assessment. Is the NCA program leading the way toward ecosystem-based monitoring and management of fisheries and other natural and human resources?

Keywords: marine fisheries, ecosystem-based management, National Coastal Assessment, bays, estuaries, continen

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Oral Presentation

Contributed Presentation

Distribution of exotic fish species in the Clear Lake Watershed, Texas: potential mechanisms of dispersal in coastal streams.

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During September 2004 through October 2005 we conducted surveys in selected first and second order tributaries of the Clear Lake watershed in Galveston Bay, Texas. Fish community data were collected using a backpack electroshocking gear and seines. In addition, limited trawling and gillnetting was conducted in one of the larger bayous. Results of these surveys and comparisons with past data suggest that native "exotics" such as the Rio Grande Cichlid, Cichlasoma cyanoguttatum, have invaded and extended their range within the watershed, and have become dominant in some waterbodies. In addition, other exotic species including, tilapia Oreochromis niloticus and suckermouth catfish Pterygoplichthys spp. were collected in Armand Bayou. Possible sources include ongoing introductions by tropical fish hobbyists and downstream invasion through low salinity bay systems. The probability is high for widespread invasion of these species into other portions of southeastern Texas and Louisiana coastal streams, due to their tolerance to low salinity water.

Keywords: Pterygoplichthys Cichlasoma Oreochromis exotic Galveston

Abstract Number: 100849

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Oral Presentation

Contributed Presentation

MERCURY CONCENTRATIONS IN FISH FROM CADDO LAKE, TEXAS

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We compared mercury concentrations in largemouth bass (*Micropterus salmoides*) to mercury concentrations in other game fish from Caddo Lake, Texas and determined how habitat type, trophic position, growth rate, and genetics were related to mercury concentration in largemouth bass. Largemouth bass and freshwater drum (*Aplodinotus grunniens*) had the highest concentrations of mercury and white bass (*Morone chrysops*) and channel catfish (*Ictalurus punctatus*) had lower concentrations of mercury. Largemouth bass from different habitats exhibited different mercury – total length relationships with individuals from shallow, vegetation-dominated habitats having higher concentrations of mercury than individuals from open-lake habitats. The trophic position of largemouth bass (measured with ^{15}N) was not statistically different between the two habitat types. Growth rate of largemouth bass was higher in the open-lake habitats than the shallow, vegetation-dominated habitats. Largemouth bass did not exhibit significant population genetic substructure between the two habitats. Largemouth bass growth rates between the two habitats were not related to differential occurrence of Florida subspecies largemouth bass (*Micropterus salmoides floridanus*). We suggest that when a lake may be contaminated with mercury, game fish in the lake should be collected from multiple habitats when assigning fish consumption advisories.

Keywords: Caddo Lake, mercury, largemouth bass

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Oral Presentation

Contributed Presentation

A preliminary Ecopath-Ecosim model of a North Carolina reservoir foodweb: challenges, insights, and future directions.

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As new species continue to be introduced into reservoir ecosystems, researchers are challenged to manage foodwebs of increasing complexity. To better understand and manage reservoirs in North Carolina, we described the trophic linkages of a 'typical' North Carolina reservoir using the Ecopath with Ecosim (EwE) modeling package. First, using the Ecopath mass-balance approach, we created a snapshot of the reservoir foodweb. We then employed the time-dynamic simulation tool Ecosim to project the future effects of selected ecosystem perturbations - such as increased harvest of a sportfish species or a change in the stocking rate of striped bass - on

the rest of the reservoir community. We discuss the challenges of parameterizing a model of a southern US reservoir ecosystem. Finally, we consider additional issues in North Carolina fishery management that may be addressed with EwE, and what additional data would be needed to improve this model for use in managing the state's reservoirs.

Keywords: Reservoir foodweb modeling ecosystem Ecopath Ecosim management

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Oral Presentation

Contributed Presentation

CATCH AND RELEASE IN SOUTH CAROLINA'S RED DRUM RECREATIONAL FISHERY

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Red drum (*Sciaenops ocellatus*) is a recreationally important finfish species throughout the southeast. In South Carolina a two fish per angler per day bag limit and 15-24 inch TL size slot have been in effect since 2001. These regulations contribute to the 80% catch and release rate within the state. However, an accurate assessment of hooking mortality has yet to be established. To this end, over 1,400 South Carolina anglers were surveyed to identify their red drum fishing habits, including hook and bait types used when fishing for red drum. It was found that most South Carolina anglers use j-hooks and natural bait to fish for red drum. A study of short-term (48 h) catch-and-release mortality was then conducted in two phases. Sub-adult red drum were caught in shallow water using typical recreational tackle and the three most common hook types, J-hooks, non-offset circle hooks, and offset circle hooks. Adult red drum were caught using bottom longlines rigged with alternating J-hooks and non-offset circle hooks. In both cases, the use of non-offset circle hooks resulted in the lowest overall gut hooking and mortality rates. J-hooks resulted in the highest rate of gut hooking, and offset circle hooks in the highest mortality rate. These results will be used to educate anglers about gear choices that can result in a lower catch and release mortality within the South Carolina red drum population.

Keywords: "red drum" "anglers" "catch-and-release"

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Oral Presentation

Contributed Presentation

EPIBENTHIC SURVEY OF LARVAL BLACK DRUM HABITAT IN THE BAFFIN BAY SYSTEM

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The Laguna Madre of Texas and Mexico is the world's largest hypersaline lagoon system, and it sustains the largest stock of black drum (*Pogonias cromis*) in the world. Despite their recreational and commercial importance, relatively little is known of their life history characteristics, particularly in the Laguna Madre. Living in hypersaline waters, ion and water regulation must impose a great energetic demand on these fish particularly for egg and larval stages with limited regulatory abilities. These early stages will likely perish if not in the proper environment. The nursery habitat utilized by newly settled black drum larvae in the Laguna Madre has not been well described. An epibenthic plankton survey has been conducted over a variety of substrates in the Laguna Salada and Cayo del Grullo areas of Baffin bay. A weighted sled, fitted with a 500µm mesh cone net, was used to collect triplicate plankton samples from seven different sites in the Baffin Bay system bimonthly, between May of 2004 and March of 2005. Grass, mud and sand substrates were targeted. These samples are being analyzed to determine relative densities of black drum larvae over these different substrates throughout the sampling period, in an effort to identify the preferred nursery habitat of black drum in Laguna Madre.

Keywords: black drum pogonias cromis baffin bay

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Oral Presentation

Contributed Presentation

Radiation-Induced Germline Mutations in Japanese Medaka

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Japanese medaka (*Oryzias latipes*) were exposed to different doses of ionizing radiation to determine the lowest doses that activate germline mutations. Nine highly variable microsatellite loci (mutation rates of 10^{-2}) identified in previous studies were examined. Study goals included: 1) to evaluate the frequency of germline mutations in medaka when exposed to known amounts of radiation, 2) to construct a dose-response curve for these relationships, and 3) to detect the lowest dose at which germline effects can be observed. Prior to the exposure, medaka pairs were bred, and hatchlings were collected to serve as controls for microsatellite analyses. The same medaka breeding pairs were exposed later to four doses of acute ionizing radiation (0.1, 0.5, 2.5, and 5 Gy) and then allowed to breed again. The DNA was extracted from the parents and all hatchlings produced before and after the exposure, and the microsatellite loci were amplified using polymerase chain reactions (PCR). PCR products were run on Model 3730 Sequencer, and genotyping was performed using Genemapper software. The mutation frequencies were calculated for each locus and compared among all treatments and controls. The expected results should show an increase in germline mutation rates with an increase in radiation dose rate. Preliminary results suggest that there are elevated mutation rates in hatchlings of adult medaka exposed to the medium radiation dose. Establishing the lowest dose, at which the germline mutations are significantly elevated, will be important in determining whether germline mutations can be induced by environmentally relevant radiation doses.

Keywords: environmentally relevant radiation mutation medaka fish hatchlings

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Oral Presentation

Contributed Presentation

Habitat Use Patterns Of Newly-Settled Spotted Seatrout, *Cynoscion nebulosus*, In Three Texas Bays.

Neahr, T.A. and Stunz, G.W.

Estuaries are one of the most notably productive marine ecosystems, supporting diverse populations of flora and fauna. Numerous ecologically and economically important fish species use estuaries during some phase of their life cycle. Despite the recognition of the importance of estuarine habitat, there are considerable gaps in knowledge concerning the specific spatial patterns of habitat use within estuaries for many important fishery species including the spotted seatrout (*Cynoscion nebulosus*), but their occurrence among different habitat types is unknown. The purpose of this study was to examine the habitat use patterns of newly-settled spotted seatrout in three Texas Coastal Bend bays. Newly-settled trout were sampled using an epibenthic sled from three different habitat types: seagrass, non-vegetated bottom, and marsh edge. We found significantly higher densities of spotted seatrout in seagrass beds compared to other habitat types. Using experimental mesocosms,

we conducted a series of habitat selection studies assessing selection for potential estuarine habitat types with hatchery-reared and wild-caught spotted seatrout. Both hatchery-reared and wild-caught mesocosm fish showed selection patterns for structured habitats (oyster reef, seagrass beds and marsh edge) over non-vegetated bottom, but selection among structured habitat types was not as significant. These results suggest that structured habitat types, particularly seagrasses, are important nursery habitat for juvenile spotted seatrout.

Keywords: Spotted Seatrout, habitat use patterns

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Oral Presentation

Contributed Presentation

Ecology of Inshore Lizardfish in the Northern Gulf of Mexico

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Inshore lizardfish, *Synodus foetens*, are among the most abundant benthic fishes in the northern Gulf of Mexico (Gulf). Little is known about their ecology despite the ecological significance their numbers imply. The goal of this study was to examine habitat-specific density, diet, and growth of inshore lizardfish in sand, shell rubble and hardbottom habitats on the north central Gulf shelf. Density estimates computed from quarterly trawl samples ($n = 113$) taken in 2004 and 2005 were significantly different among habitat types and sampling dates ($p < 0.01$); highest density occurred in mixed shell rubble and sand habitat. Diet, as determined by gut content analysis, consisted of mostly squids and fishes, and was not significantly different among habitat types or sampling dates. Gut content analysis and analysis of muscle stable isotope values ($d^{15}N$, $d^{13}C$, and $d^{34}S$; $n = 44$) indicated the importance of benthic fishes to lizardfish diet increased with fish size. Analysis of otolith microstructure yielded a maximum age of 5 years among samples ($n = 883$) collected and processed for age and growth analysis. Growth analysis from size-at-age data was not completed prior to abstract submission, but differences in growth among habitats will be tested and reported along with density and diet data. Overall, this work represents the first significant ecological study of inshore lizardfish in the northern Gulf. Perhaps similar attention should be paid to other poorly studied, but ecologically important, species if ecosystems management is to become more of a reality in US waters.

Keywords: Inshore lizardfish, *Synodus foetens*, otolith, diet, age, growth

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Oral Presentation

Contributed Presentation

Spotted Seatrout, *Cynoscion nebulosus*, Behavior at Spawning Aggregations in Charleston Harbor

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Spotted seatrout, *Cynoscion nebulosus* (Cuvier, 1830), is a species of great importance to the recreational fishery of South Carolina. Information on spawning site fidelity, residence times, and visitation rates of spotted seatrout is limited. To better understand the behavior of spotted seatrout twenty-six were surgically implanted with ultrasonic transmitters. They were then detected by acoustic receivers deployed at two spawning aggregation sites and surrounding areas throughout an entire spawning season. Each receiver recorded the presence/absence of tagged fishes within each receiver's proximity. Most tagged fish demonstrated a spawning site preference and often showed a fidelity to a non-spawning site when they were not engaged in spawning activities. Females typically began arriving at the spawning sites as males began to call at dusk with some fish arriving before the males began to call on a regular basis. Females also had a longer average visit duration than males to the spawning aggregations. These results will allow a better understanding of the behavioral ecology of spotted seatrout within spawning aggregations, and provide useful information for more biologically meaningful spotted seatrout fisheries management.

Keywords: "spotted seatrout" "ultrasonic telemetry" "spawning behavior" "Sciaenid" "*Cynoscion nebulosus*"

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Oral Presentation

Contributed Presentation

Population Status and Habitat Use of Shortnose Sturgeon in the Altamaha River, GA

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In the Southeastern U.S., populations of shortnose sturgeon (*Acipenser brevirostrum*) are known to be both genetically and ecologically distinct from their northern counterparts. Although few southern populations have been well studied,

previous research suggests that most populations have suffered continuous declines throughout the last century, despite 30 years of protection under the Endangered Species Act. In Georgia, the Altamaha River supports what is believed to be one of the largest remaining shortnose sturgeon populations south of the Chesapeake, however the current status and recent trends of this population are unknown. The objectives of this study were to: 1) estimate the current abundance of shortnose sturgeon in the Altamaha River and 2) located and describe active spawning sites. Using bottom-set entanglement gear, we conducted a mark-recapture population estimate of shortnose sturgeon in the Altamaha River from Oct, 2003, to August, 2005. During this period, we captured 888 individual shortnose sturgeon including 63 recaptures yielding a population estimate of 5910 (95% C.I. 4740 - 7848). We also used radio telemetry, to monitored movements of 12 individual adults throughout the spawning season. Based on movements of these fish we deployed several egg collection mats at several suspected spawning sites and in March, 2005 we recovered several shortnose sturgeon eggs from a site located at the confluence of the Ocmulgee and Ogeechee rivers. The results of this study show that the population is much larger than previously suspected and that spawning migrations extending well into the upper portion of the Altamaha watershed.

Keywords: shortnose sturgeon, population, telemetry

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Oral Presentation

Contributed Presentation

Depth and Substrate Modeling Using Geographic Information Systems On Aaron's Creek, West Virginia

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Aquatic habitat modeling and interpolation using Geographic Information Systems (GIS) is an emerging method of analysis being explored by fisheries biologists. The relative lack of GIS use in aquatic modeling is partly due to difficulty collecting underwater data. This experiment examines whether GIS can interpolate stream substrate and depth with a suitable level of accuracy for use in prediction and modeling of benthic habitat. Our work also examines potential to predict depth and substrate using less than five percent of the overall surface area of a stream reach. Three methods of interpolation were examined; ordinary kriging, inverse distance weighted and natural neighbor. Results show the complete reach can be successfully interpolated by taking 44 key data points of depth and substrate. This experiment used a 20 meter by eight point five meter stream reach, The 44 points represented one point nine four (1.94) percent of the reach area. An interpolation based on 88 random samples was also viable in predicting the substrate and depth over the stream reach but was less effective than the key point sample. Potential exists for successful use and development of this method of aquatic substrate prediction to

supersede traditional methods in terms of accuracy, time, ease of use, budget considerations and habitat mapping for a variety of benthic species. Aaron's Creek is a second order stream and this method of modeling should be evaluated to determine viability for other stream orders.

Keywords: GIS Substrate Interpolation Modeling

Abstract Number: 100869

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Oral Presentation

Contributed Presentation

Economic Growth and Fisheries Conservation: Theoretical and Empirical Considerations

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The size of an economy is a function of its population and per capita consumption. Because of the "trophic structure" of economies, economic growth is ultimately dependent upon the liquidation of natural capital (e.g., water, soils, minerals) which, prior to liquidation, comprises fish and wildlife habitats. Economic growth therefore ensues at the competitive exclusion of fish and other nonhuman species and may be classified as the limiting factor for fish in the aggregate. Strong empirical evidence supporting this theory is found in an accounting of fish species endangerment causes, which resembles a list of economic sectors that entail water allocation to various degrees. This is a challenge to fish conservation because the public, led by conventional economists and political leaders, prioritizes economic growth as a national goal. To address the limiting factor to fish conservation, fisheries professionals need to become versed in the rudiments of economic growth theory, macroeconomic policy, and the steady state economy as an alternative to economic growth. The steady state economy is characterized by stabilized population and per capita consumption within ecological carrying capacity. When the steady state economy reaches equilibrium with its containing ecosystem, fish species are conserved and biodiversity at large is maintained.

Keywords: economic growth, water allocation, fish conservation, biodiversity, macroeconomic policy, steady sta

Abstract Number: 100870

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Oral Presentation

Contributed Presentation

Habitat selection of juvenile robust redhorse in an experimental mesocosm: implications for developing sampling protocols.

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Robust Redhorse *Moxostoma robustum*, described originally by Edward Cope in 1870 from specimens collected from the Yadkin River, NC, apparently went unnoticed until 1991, when they were rediscovered in the lower Oconee River, Georgia. Despite extensive surveys and an ongoing, decade-long restoration program, wild-spawned juveniles 30 mm - 410 mm total length have not been collected. This project was designed to experimentally evaluate competing hypotheses (i.e., gear selectivity, habitat use, or actual abundance) that seek to explain the absence of juvenile robust redhorse from the catch. Two experimental mesocosms were used to determine if juvenile robust redhorse use available habitats in proportion to their availability. Pond-reared juveniles were exposed to four flow-based, habitat types (eddies = - 0.12 to -0.01 m/s, slow flow = 0.00 to 0.15 m/s, moderate flow = 0.16 to 0.32 m/s, and backwaters) in four, 10-day trials, with 16 pond-reared test fish used per trial, with replacement. Location data were recorded hourly during daytime hours for each fish in all trials and evaluated with a Log-Linear, Chi-square Model. In winter, the fish showed a preference ($p < 0.001$) for eddies and backwaters and avoided slow to moderate flows. In early spring the fish showed a preference ($p < 0.001$) for eddies and avoided the moderate flows. Although current field sampling for juvenile robust redhorse have not target the flows used by fish in this experiment, catch of wild-caught juveniles may be improved by targeting eddies near transitional areas with gear appropriate for such habitats.

Keywords: robust redhorse, habitat use, flow, endangered species, mesocosm, Catostomidae, suckers, Oconee Rive

Abstract Number: 100868

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Oral Presentation

Contributed Presentation

Otolith microchemistry discriminates between hatchery and stocked salmonines in the Little Red River, AR, tailwater system

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The Little Red River (LRR) tailwater supports a naturally-reproducing population of brown trout, providing a world-class fishery. However, the extent of natural reproduction by brook charr and rainbow trout is unknown, but assumed to be insignificant in comparison to hatchery plantings. In 2002, biologists and engineers constructed Collins Creek, an artificial tributary feeding the LRR, to provide additional angling opportunities. Soon thereafter, spawning adults and emergent fry of all three salmonine species were observed in Collins Creek, leading biologists to investigate the potential of this tributary to contribute wild rainbow trout and brook charr to otherwise hatchery-dominated populations in the tailwater. We attempted to distinguish hatchery-produced salmonines from those spawned in Collins Creek via otolith microchemistry. We used laser-ablation inductively coupled plasma-mass spectrometry to quantify concentrations of various cations in otoliths. We calculated ratios for each of 35 analytes to Ca43, and conducted multivariate analyses to identify elemental ratios with the most discriminatory power. Significant differences between hatchery and wild salmonines were found for eleven analyte ratios, but a 2-variable model containing only Na23 and Sr86 ratios was sufficient to distinguish the stocks with 100% success for both species. Otolith analysis of salmonines of questionable origin captured in the mainstem LRR suggests that brook charr produced in Collins Creek emigrate and recruit to the mainstem fishery, whereas rainbow trout are predominately hatchery in origin. However, these preliminary results are based on a small sample size, and more intensive study is needed to quantify relative contributions of hatchery and wild stocks.

Keywords: Otolith tailwater hatchery salmonines Arkansas reproduction

Abstract Number: 100871

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Oral Presentation

Contributed Presentation

A fine-scale study of temporal and spatial variability in habitat use by early life stages of estuarine fishes with a focus on red drum *Sciaenops ocellatus*

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While a large amount of work has been done to determine how abundances of fish larvae vary between distinct habitat types, relatively little work has focused on variability in habitat usage within fairly homogenous areas at small spatial and temporal scales. Accurate estimation of abundance and distribution of fish in seagrass beds is needed to clarify the relationship between planktonic supply,

settlement, and recruitment to juvenile populations of commercially and recreationally important species. 18,731 larval and early juvenile fish representing 32 species were collected from a south Texas seagrass meadow between 2 October and 20 November 2003. The community was numerically dominated by darter goby *Ctenogobius boleosoma* (43%), gulf pipefish *Syngnathus scovelli* (18%), red drum *Sciaenops ocellatus* (12%), and code goby *Gobiosoma robustum* (11%). ANOSIM analysis indicated significant variability in species similarity in both time and space. Samples that were collected near each other in time and space were more similar (Bray-Curtis) than sites that were spatially or temporally distant. To determine the degree to which similarities between sampling units were based on environmental variables, both biotic variables (seagrass blade length, blades per shoot, shoots per core) and abiotic variables (temperature, salinity, depth, dissolved oxygen) were considered in the BIO-ENV procedure. Seagrass blade length was the environmental variable that best explained sampling unit similarity, although the correlation was low. Seemingly homogenous habitats may support larval assemblages whose composition is considerably variable even at small temporal and spatial scales.

Keywords: settlement seagrass estuary assemblage recruitment larvae habitat

Abstract Number: 100872

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Oral Presentation

Contributed Presentation

Formation and Future Direction of the Southeast Aquatic Resources Partnership

Robinson, M.S.

The Southeast Aquatic Resources Partnership (SARP) was initiated in 2001 to address issues related to the management and conservation of aquatic resources in the southeastern United States. State and Federal natural resource agencies, regional fisheries councils and commissions, private conservation organizations, and other fisheries stakeholders from both the marine and freshwater areas of responsibility have come together with the following mission: *With partners, protect, conserve, and restore aquatic resources including habitats throughout the Southeast, for the continuing benefit, use, and enjoyment of the American people.* The partnership was formed with the realization that the individual members lack sufficient resources to effectively meet aquatic resource management and conservation challenges and must work cooperatively to attain common goals. Since 2001, SARP has been awarded more than \$700,000 in grants to promote and implement aquatic conservation in the southeast. Most recently, IAFWA awarded SARP a \$257,000 grant to develop the Southeast Aquatic Habitat Plan as the southeastern regional component of the National Fish Habitat Initiative. The SARP is comprised of representatives from: • 13 southeastern states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina,

Oklahoma, South Carolina, Tennessee and Texas; inland and marine divisions) • The U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Gulf States Marine Fisheries Commission (GSMFC), and the Gulf and South Atlantic Fishery Management councils (GMFMC and SAFMC). • All Southeastern Association of Fish and Wildlife Agencies (SEAFWA) states and non-governmental organizations, industry groups, and private sector interests are invited to participate.

Keywords: Partnership conservation habitat

Abstract Number: 100876

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Oral Presentation

Fisheries Applications of GIS

Partnering technology with customer service: Oklahoma Department of Wildlife Conservation's GIS map server system.

Summers Greg L.

Like most state fish and wildlife agencies, the Oklahoma Department of Wildlife Conservation (ODWC) has struggled with providing maps of public use areas and other wildlife related resources to anglers and hunters. Although every effort was made in the past to produce printed materials that were as accurate as possible, these publications quickly became obsolete. By using Geographic Information System (GIS) technology, the agency can now provide free, on-demand maps, through an internet map server, that can be updated instantaneously by ODWC personnel. The mapping system is available through the ODWC web site and public acceptance has been high.

Keywords: GIS mapserver

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Oral Presentation

Fisheries Applications of GIS

A GIS Based Empirical Approach for Modeling Biodiversity in the Alabama-Coosa-Tallapoosa (ACT) River Basin

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The Alabama-Coosa-Tallapoosa (ACT) River Basin, located in central Alabama and northwest Georgia, contains some of the highest levels of aquatic faunal diversity and endemism recorded in temperate freshwaters. To assess the biodiversity of fauna in this aquatic environment, a GIS database was constructed as part of the Southeastern Aquatic GAP (Gap Analysis Program). Objectives were to evaluate biological diversity of aquatic species and their habitats, and to identify gaps in the distribution and protection of these species and their habitats within the ACT basin. The basic land unit for model fitting and prediction were 12-digit U.S. Geological Survey (USGS) hydrologic units (mean size 7,800 ha), defined as subwatersheds. Our presentation will explain necessary requirements, including data acquisition, methodology, and data types. The database is required for building and testing empirical based predictive models for aquatic fauna distribution. Results provided will allow natural resource managers make more informative decisions in land and riverine management.

Keywords: GIS, Hydrologic Unit Code, HUC, fishes, empirical modeling

Abstract Number: 100847

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Oral Presentation

Fisheries Applications of GIS

Assessing the conservation status of Oklahoma's fishes: incorporating museum collections in a GIS

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Museum collections provide an important and unique source of information about the population status and trends of fishes. Museum collections provide a historical record – approximately 100 years of records exist in Oklahoma – that allows for the re-examination of specimens. However, these collections are not without potential sources of error and care must be used in the interpretation of status and trends in species status and distribution. We are currently establishing a digital atlas of Oklahoma fishes that incorporates geographic information with fish collections housed at Oklahoma State University and the University of Oklahoma. Historic fish collections were georeferenced following established protocols to include a confidence value that describes the relationship between the given geographic coordinates and the true location. This geodatabase allows us to examine changes in fish species' distribution, impacts of major anthropogenic disturbances, and the establishment and spread of non-native fishes. We will examine status and distribution of several genera and species while also discussing potential limitations provided by the database. Used correctly and conservatively, museum collections provide a useful and detailed record of spatiotemporal changes; however users must be cognoscente of potential failing of the database. Lastly, we will discuss the how future collections can be prioritized to minimize common limitations of museum collections.

Keywords: GIS Museum Distribution Impoundments *Macrhybopsis*

Abstract Number: 100717

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Oral Presentation

Fisheries Applications of GIS

A grid-based approach to mapping habitat in Texas reservoirs

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In 2004 the Inland Fisheries Division of the Texas Parks and Wildlife Department began a process to update the aquatic vegetation and habitat survey methodology in its procedures manual. Procedures and analysis tools were needed that were fast, efficient, objective, repeatable, and utilized the power of geographic information systems (GIS). An application was developed as an ArcView 3.x extension that allowed staff to assign up to three habitat features or plant species to customized grids that were overlaid on reservoir outlines or images. Grids currently range from 63 square meters to 1 hectare in size, depending on the type of survey being conducted. Grids extend beyond reservoir shorelines at conservation pool to enable surveys to be conducted during high water levels. This system is designed to be flexible to accommodate a range of tools or conditions. At the reservoir, staff can collect data on paper maps, using global positioning systems (GPS), or assign values directly to grids while surveying in the boat. Data not directly assigned to a grid at the reservoir can easily be assigned on a desktop computer in the office. Grid-based

data is stored in a relational database system for long-term change detection, but can also be dissolved to create polygons for mapping in the GIS. Time conducting the survey at the reservoir has remained essentially the same, but data processing and analysis time has been cut by up to 80 percent.

Keywords: GIS grid habitat mapping vegetation ArcView GPS procedures

Abstract Number: 100800

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Oral Presentation

Fisheries Applications of GIS

The Development of Segment-Level Watersheds in WV and the Benefits for Fisheries Management

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Many regional and local studies have used a watershed framework in combination with geographic information systems (GIS) to aid in water quality analyses and fisheries management. We have explored methods to extend the use of watershed based analyses and GIS in two ways: First by delineating watershed drainage areas for each stream segment and second, by nesting these segment level watersheds to enable scaled and cumulative analyses. The first process, delineation of stream segment-based watersheds, has been completed for the entire state of WV using the high resolution National Hydrography Dataset (NHD) stream data (1:24,000 map scale). For each stream segment, the corresponding drainage area was delineated, which allows analysis of landscape factors and direct impacts from mapped landscape features within each watershed. In addition, based on flow direction we have assembled a watershed network model using the segment-level watersheds. The watershed network model allows for assessment of cumulative impacts to individual stream segments, based on a segment's entire upstream area. Using automated GIS tools specifically developed to work with this data model, it is also possible to determine the approximate minimum distance from any stream segment to any feature of interest (such as polluting source or discharge) located upstream in the same stream system. The powerful new analytical capabilities provided by the development of this segment watershed network data model and associated tools enables further investigations of the relationships between instream water quality and stream biota with landscape factors such as land use, land cover, and disturbance.

Keywords: Watershed network model, GIS

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Oral Presentation

Fisheries Applications of GIS

Using GIS for Reservoir Creel Surveys and Mapping

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As a result of recent and intensive training in geographic information systems (GIS), powerful desktop computers, and more accurate global positioning systems (GPS), I developed some practical fisheries management applications with creel survey data and reservoir mapping using GIS. Visual analysis of bank fishing locations, fishing preferences, and angler catch at one West Texas reservoir, Lake Kirby, provided new perspectives into where anglers concentrated their seasonal fishing effort, location of "hot spots" for given species, and even the location of at least one major crappie spawning area, along with the timing and duration of the spawn. Using the spatial capabilities of GIS data, we hope to bring to the City of Abilene visual information on where the high-use areas are located at Lake Kirby and recommend potential sites for angler-use facilities and improvements. We will also use this data to inform less experienced anglers and new anglers to Abilene about good sites to fish for given fish species. In addition, angler use data will be useful with our habitat enhancement plan in selecting sites for habitat improvement and fish attractors. Contour maps were developed for five older reservoirs that previously had no elevation data available. These reservoirs ranged in size from 21 acres to 740 acres. Maps were constructed using a Garmin 188 sounder and a spatial analyst extension in ArcView 3.3. These maps will be an excellent product that we can provide to our anglers as a means to improve their fishing success or satisfaction. In addition, we could use the data to improve sample site selections and layer it with habitat and/or fish data to develop more intensive management applications and sampling designs.

Keywords: GIS creel fisheries management

Abstract Number: 100742

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Oral Presentation

Fisheries Applications of GIS

Identifying Essential Fish Habitats in the South Atlantic Bight Through GIS Analysis of Fishery-Independent Survey Data

Stephen, J.A. and Sedberry, G. R.

The reauthorization of the Magnuson-Stevens Fishery Act requires fishery managers to identify essential fish habitats (EFH) (areas necessary for spawning, feeding or growth to maturity). In addition, ecosystem-based management requires additional knowledge about hydrographic regimes, species associations and other factors affecting species distributions, diversity or spawning potential. There are several proposed sites for Marine Protected Areas (MPA) in the South Atlantic Bight (SAB), but the above information is needed before final designations. The goal of the Southeast Geographical Fishery-Independent Survey and Historical Database project (Sea-GeoFISH) was to consolidate over 30+ years of fishery-independent survey data from the SAB into a queryable database, that works in conjunction with GIS applications to create multiple maps of current and historical species abundances, biomass, diversity, and spawning locations. These visualizations will be available to managers through an interactive ArcIMS (Internet Mapping Server) website. This website currently contains information on 38 economic or ecologically important species and 14 different fishing gears. Information from the system has already identified spawning locations and areas of high abundance/biomass for species in the snapper-grouper complex. These tools and findings will help managers decide the best locations among the proposed areas.

Keywords: GIS South Atlantic Bight ArcIMS fisheries spawning snapper-grouper complex ecosystem-based

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Oral Presentation

Fisheries Applications of GIS

Linear referencing as tool for mapping freshwater mussel habitat.

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Linear referencing is an ArcGIS 9 tool used to relate one-dimensional line features to characteristics along these features and associate multiple attributes to any portion of these features. Linear referencing has traditionally been used in social applications such as monitoring of road quality, traffic volumes, or under ground pipelines, but it is also being used in environmental applications such as mapping rivers and related attributes including fish habitat and spawning grounds, fine sediments, and water temperatures. Linear referencing uses routes, such as rivers or river reaches, and route events, such as habitat types or sediment characteristics. Route events are stored in a geodatabase as attributes associated with the route or specific portion of the route. In this study we used linear referencing as a tool to assess freshwater mussel habitat across multiple spatial scales on the Kiamichi River, Oklahoma. We

referenced a 212 km region of the Kiamichi River and reaches of 1-40 km as routes, with channel units, water depth, and calculated bankfull flow characteristics as route events. Using the newly created geodatabases and spatial statistics, we examined associations between freshwater mussel occurrence and macrohabitat variables (geology, land use, and elevation), mesohabitat variables (channel units and depth), and microhabitat variables (substrate size and variability, width/depth ratio, and bankfull flow characteristics including calculated values of velocity, sheer stress, Manning's n , and Froude number). We are also evaluating changes in these geomorphic features and mussel occurrence above and below a major tributary impounded in 1983.

Keywords: Oklahoma GIS habitat mapping

Abstract Number: 100788

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Oral Presentation

Fisheries Applications of GIS

Longitudinal and local geomorphic effects on fish species composition in eastern Oklahoma streams

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Stream fish assemblages are structured by a multitude of biogeographical, physical and biological factors operating at different spatial scales. Our objective was to determine how geomorphology and stream habitat influenced fish species composition (presence-absence) at 107 stream sites in the Boston Mountains, Ouachita Mountains, and Ozark Highlands ecoregions in eastern Oklahoma. Stream sites were randomly selected using a geographic information system (GIS), and navigated to in the field using a global positioning system receiver. Watershed attributes were derived using a GIS, and reach variables were measured in the field. We used partial canonical correspondence analyses (pCCAs) to determine what geomorphic and stream habitat variables best explained the variability in fish species composition. Separate analyses were conducted for northeastern (Boston Mountains and Ozark Highlands) and southeastern (Ouachita Mountains) streams. Geomorphic variables representing stream size were most important in explaining variability in fish species composition in both northeastern and southeastern Oklahoma streams, and local channel morphology and substrate characteristics were secondarily important. Variables typically considered important as fish habitat (e.g., percent vegetation, large woody debris density) explained little variation in fish species

composition. Variance partitioning demonstrated that geomorphic variables explained twice as much variation in fish species composition, per variable, than did ecoregions in northeastern streams, and four times as much variation than did drainage basins in southeastern streams. Our results supported the hierarchical filter theory as applied to stream fishes, and are discussed relative to the River Continuum and Process Domains Concepts.

Keywords: RCC, fluvial geomorphology, community, assemblage, stream habitat, structure, habitat filter.

Abstract Number: 100804

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Oral Presentation

Fisheries Applications of GIS

Recent Trends in Fisheries GIS Applications

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Since the first published fisheries GIS paper in the mid-1980s, there has been a steady increase in the number and diversity of GIS applications in fisheries. I evaluated fisheries GIS studies to assess recent trends in GIS and spatial analyses. I reviewed 100 fisheries GIS studies published after 1999 in scientific journals and the Second International Symposium on GIS and Spatial Analyses in Fishery and Aquatic Sciences. I classified the articles using conceptual models of spatial analysis in fisheries and fisheries GIS. The majority of studies qualitatively analyzed single or multiple habitat and fish parameters with GIS. Fifty-nine percent of the studies used GIS overlay, buffer and interpolation analytical procedures on parameters such as habitat, land cover, sea surface temperature (SST), and catch per unit effort (CPUE). Twenty-one percent of the papers used GIS operations to visualize and map parameters such as bathymetry, habitat, fish movements, and fishing areas. Fourteen percent of the studies used quantitative analyses and spatial statistics, such as semivariograms and kriging, of habitat features (e.g., temperature, substrate) and fish abundance (CPUE, biomass density). Six percent of the studies used quantitative analyses and GIS operations to map and overlay catch per unit effort (CPUE), landing per unit effort (LPUE), abundance and biomass density. Fisheries GIS studies most often and nearly equally analyzed organisms and habitats, and least often analyzed people, or the human dimension. Distribution of fisheries GIS applications through the Internet and acquisition of environmental and fisheries data from sensors will likely increase in the future.

Keywords: geographic information systems, fisheries, marine, freshwater, spatial analyses

Abstract Number: 100822

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Oral Presentation

Instream flows

Aquifer-dependent fishes of central and western Texas

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We provide a review of the status of many of the important aquifer-dependent fishes found in Texas. These fishes occur both in the spring outlets that are directly dependent on aquifer levels to sustain their habitats and also in downstream rivers and streams that indirectly depend on ground water. Of paramount importance to these environments is their overall habitat stability, especially with respect to water chemistry and flows. Exploitation of limited resources, particularly groundwater pumping, has caused environmental degradation, extirpation and extinction of species and, ultimately, loss of habitat and ecosystems. Many of these fishes could serve well as biological indicators of the overall system integrity. The few remaining relatively intact faunas and unmodified localities need careful management if they are to be sustained.

Keywords: aquifer indicator-species habitat conservation

Abstract Number: 100667

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Oral Presentation

Instream flows

Use on stream studies to develop instream flow standards for Virginia

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Increasing demand in Virginia for water withdrawals has prompted a review and revision of existing instream flow standard setting tools for preliminary project evaluations. Revisions were based upon two Virginia instream flow incremental methodology studies which focused on coolwater species and a statewide *Micropterus dolomieu* study evaluating recruitment and flow correlations. Recommendations focused on species life stages requiring the most water during each of the critical periods. Seasonal variation is present to account for spawning requirements of *Hypentelium nigricans* and smallmouth bass. Summer flows focused

on northern hogsucker adults in small watersheds and *Moxostoma erythrurum* adults in large watersheds so that during wet years habitat was optimized for that species life stage. Divisions based upon drainage area were necessary due to the greater importance of summer flows in smaller streams. Additional flows are needed when juvenile *Alosa sapidissima* are present.

Month	<1000 sq mi	1K-5K sq mi	>5k sq mi	>5K with anadromous
Nov-Feb	70% exceedence	70	70	70
March	75	90	90	70
April	50	60	60	60
May	40	40	40	40
June	40	40	40	40
July	10	20	50	20
August	10	20	45	20
Sept	10	10	30	20
Oct.	15	15	40	20

When flows are lower than the exceedence values withdrawals are allowed but cumulative withdrawals should not exceed 10% habitat loss for the most flow dependent species. Frequently this was a 10% cumulative loss of instantaneous flows. This standard addresses the biology but not necessarily the other components of an instream flow program (hydrology, geomorphology, water quality and connectivity).

Keywords: Instream flow standards, smallmouth bass, northern hogsucker, redhorse sucker

Abstract Number: 100678

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Oral Presentation

Instream flows

Response of Oxbow Lake Biota to Hydrologic Exchanges with the Brazos River Channel

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Fishes and aquatic habitat variables were sampled between June 2003 and September 2004 to obtain information on the ecological dynamics associated with river channel–oxbow lake connectivity in relation to instream flows. Standardized fish samples were collected from oxbow and channel habitats using seines and gillnets, with data analyzed separately as catch per unit effort. Statistical ordination techniques revealed a strong gradient of fish assemblage structure that contrasted oxbow samples from river channel samples. A secondary gradient contrasted oxbows with different physicochemical attributes and connection frequencies. In contrast to the river channel, oxbow lakes contained high densities of white crappie (*Pomoxis annularis*), sunfishes (*Lepomis* spp.), and shads (*Dorosoma* spp.). A number of minnow species (e.g., *Hybognathus nuchalis*, *Macrhybopsis hyostoma*) appear to be fluvial specialists that were primarily collected from the river channel. For species common in oxbow lakes, density tended to decline following periods of peak flow, which indicates a net export of individuals from oxbows to the river channel during floods that connect these habitats. Consistent with this view were patterns of higher densities of these species in the river channel following periods of peak flow. Fluvial specialists appeared in oxbow lakes in low to moderate numbers during periods of peak flow, but these sub-populations generally did not persist more than a month or two. It is concluded that oxbow lakes of variable ages and geomorphological structures provide essential habitats that function to increase overall fish species diversity in the lower Brazos River.

Keywords: floodplain instream flow Texas hydrologic connectivity

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Oral Presentation

Instream flows

ENSO Impacts Translated to the Watershed Scale: Estuarine Salinity Patterns Along the Texas Gulf Coast - 1982 to 2004

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The importance of the El Niño-Southern Oscillation (ENSO) on regional-scale climate variability is well recognized, although the communication of this atmospheric signal onto the watershed and ultimately into estuarine salinity structure at the bay system level is less well known. The Texas coast, situated in a climatic gradient, is an ideal location to study ENSO influences on estuaries. The seven major estuaries found on the coast share similar physical properties, yet each one is maintained by a hydrologically isolated watershed. Inflow differences maintain estuaries spanning the range from positive, to neutral, to negative. Three monthly measures of ENSO indices (Niño 3.4 sea surface temperature anomaly, atmospheric Southern Oscillation sea level pressure anomaly, and Pacific Decadal Oscillation sea surface temperature anomaly) were related to estuarine-wide average salinity during the period 1982-

2004. Power spectrum analysis revealed that most of the variation in salinity is related primarily to five fundamental cycles (10.67, 5.33, 3.55, 1.94, and 1.02 years), and these periodicities closely correspond with frequencies related to the ENSO measures. The 1.94 year cycle is postulated to be related to the frequency of the Atlantic Oscillation, an 'ENSO-analog' operating in the Atlantic basin. Cross-correlation analysis showed the ENSO signal is translated almost immediately into the estuaries receiving the largest amounts of riverine inflow, and the signal is propagated across the state's climatic gradient over a calendar year. Despite having very different underlying salinity regimes, the seven estuaries of the Texas coast appear to be operating in near unison to the low frequency forcing signals of ENSO. Current water planning in Texas focuses much attention on maintaining estuarine salinity conditions at a monthly, bi-monthly, or seasonal scale. At this temporal resolution, water planning efforts may not adequately address the important ENSO-driven periodicities governing coastal estuarine salinity patterns.

Keywords: El Nino-Southern Oscillation, Salinity, Time Series, Fourier Analysis, Estuary, Texas Coast-USA

Abstract Number: 100744

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Oral Presentation

Instream flows

Ichthyoplankton recruitment to the delta nursery areas of Nueces Bay, Texas.

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Numerous commercially and recreationally important finfish species are considered estuarine-dependent in their early-life-history stages, and as such, they must find suitable nursery habitats. For species that spawn in areas distant from nursery areas, planktonic larvae face a variety of factors that can influence their dispersal. The objectives of this study are to quantify the seasonal recruitment of larval and juvenile fish and shrimp to the nursery areas of Nueces Bay, Texas, and to compare their distributions in relation to the discharge location of the Nueces River. Sampling, conducted biweekly during the spring of 2004, resulted in the collection of 38,218 larval and juvenile fish representing > 25 species from 20 families. Community structure of the ichthyoplankton was determined by non-metric multidimensional scaling (MDS) and rank-based analysis of similarity (ANOSIM). An unusually large 'freshet', or flood event that effectively replaced the volume of the back-bay with freshwater, greatly influenced the water quality parameters recorded during this study. Despite this flooding event, taxa still appeared to be seeking out the back-bay portions of the estuary. Community structure spatial and temporal patterns showed a great degree of overlap among stations, especially stations directly impacted by

the flood waters. The abundance and distribution of many taxa indicates that the back-bay and delta regions of Nueces Estuary are sought out as nursery habitats. While the freshet altered the abiotic character of the bay, it showed the current river discharge location does not appear to act as a recruitment barrier for taxa seeking nursery habitats.

Keywords: Ichthyoplankton, Nursery Area, Recruitment, Freshwater Inflow, Community Structure, Nueces Bay, Texas

Abstract Number: 100749

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Oral Presentation

Instream flows

Trends in spotted sunfish habitat utilization and their potential application in setting minimum flows and levels for Florida Rivers

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Spotted sunfish *Lepomis punctatus* is a common member of streamfish communities that occur throughout Florida and the southeastern U.S. Relationships of spotted sunfish abundance with streamflow and stage levels have recently been identified. Thus, the species may serve as an indicator species for flow and stage conditions, possibly providing insight for establishing Minimum Flows and Level (MFL) regulations for Florida rivers. We quantified microhabitat used by adult and juvenile spotted sunfish to predict how fluctuation in streamflow and stage may affect the availability of important spotted sunfish habitat at the Anclote, Manatee, and Little Manatee Rivers of the central Gulf Coast of Florida. Spotted sunfish were sampled using boat electrofishing gear and habitat parameters were measured within an interval defined by a one meter radius surrounding the location of each individual, from stream surface to substrate. We compared characteristics of microhabitat used by spotted sunfish versus characteristics of habitat intervals at randomly selected locations to identify habitat characteristics important to the species. Spotted sunfish utilized areas with structurally complex cover such as woody debris, snags, exposed roots, and aquatic macrophytes. Because these habitat types are located along stream margins, they are particularly susceptible to dewatering during low river stage, possibly explaining observed spotted sunfish population response to fluctuation in water level.

Keywords: spotted sunfish minimum flows and levels habitat utilization

Abstract Number: 100786

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Oral Presentation

Instream flows

Freshwater Inflow Needs of teh Matagorda Bay System

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Matagorda Bay is the second largest estuary on the Texas Gulf Coast covering approximately 352 square miles. The abundant production of finfish and shellfish make this bay system an important ecological resource and an economically significant commercial and sports fishery. Many factors contribute to this high natural productivity, but the most significant is an ample source of fresh water. To determine the freshwater inflow required to maintain bay productivity, the Lower Colorado River Authority (LCRA) entered into cooperative studies with the Texas Parks and Wildlife Department (TPWD), Texas Water Development Board (TWDB) and the Texas Commission on Environmental Quality (TCEQ). Two levels of inflow need, Target and Critical, were estimated for the estuary. Target inflows represent the monthly and seasonal inflows that optimize biomass while maintaining certain salinity, population density and nutrient inflow conditions. LCRA applied an existing TPWD and TWDB methodology, involving the synthesis of three components, to estimate Target freshwater inflow needs. First, statistical relationships were developed between freshwater inflows and key indicators of estuarine conditions. Second, monthly and seasonal freshwater inflows were calculated to optimize bay productivity subject to specific constraints at key estuarine locations. Third, estuarine-wide salinity conditions were evaluated to ensure conditions remain within desired limits. Critical inflow needs were determined by finding the minimum annual inflow needed to keep salinity near the mouths of the Colorado and Lavaca Rivers at levels required to maintain viable habitat under low flow conditions.

Keywords: Freshwater Inflow

Abstract Number: 100877

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Oral Presentation

Instream flows

Demand for Southeastern Oklahoma's Water: Will We Leave Enough in the Rivers for the Biota?

Fisher, W. L.*

There is increasing demand for surface and ground water in southeastern Oklahoma for water development and diversion projects to meet future urban water needs in Oklahoma and Texas. In 1999, the State of Oklahoma entered into a compact with the Choctaw and Chickasaw nations to develop water marketing proposals that would pipe surface waters from the Little and Kiamichi Rivers in southeastern Oklahoma to sell to Oklahoma City and north Dallas municipalities. The Oklahoma Legislature approved a 3-year moratorium on the water sale in 2002 and extended it an additional 5 years in 2004 until comprehensive hydrological studies could be completed. In 2002, central Oklahoma counties proposed to pump water from the Arbuckle-Simpson Aquifer in southeastern to meet their consumptive needs. One year later, the Oklahoma Legislature approved a 3-year moratorium on issuance of groundwater permits for municipalities outside of the counties the overlay the groundwater basin to complete comprehensive hydrologic studies. Water development projects create hydrologic alterations to a river that affect the magnitude and timing of natural river flows. These alterations modify both the structure and function of river ecosystems impacting the habitat and survival of aquatic organisms including fishes, invertebrates, and plants. A team of scientists from state and federal agencies and the comprehensive universities in Oklahoma has been conducting studies to evaluate the potential impacts of these water withdrawal projects on the biota and ecosystem flow requirements of several rivers in southeastern Oklahoma.

Keywords: Water Resources Development, Water Withdrawal, Ecosystem Flow Requirements, Fish, Mussels, Habitat

Abstract Number: 100836

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Oral Presentation

Instream flows

Predicting the effect of hydropeaking releases upon endemic warmwater streamfishes in a Virginia tailwater.

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Flow and temperature in the Smith River tailwater (southwest Virginia) are influenced by a hydroelectric peaking operation. Hypolimnetic releases support a naturalized brown trout (*Salmo trutta*) fishery, but also affect the distribution, and abundance of the downstream endemic warmwater ichthyofauna. With trophy trout lacking, managers and anglers desire changes that will positively affect trout growth. Spatially unifying endemic non-game species and the naturalized brown trout may enhance trout growth. Furthermore, the ability to predict the response of native stream fish to hydropeaking flows may allow for more informed decisions regarding flow management. We partitioned the native warmwater fish assemblage into guilds in terms of reproductive, feeding and habitat (depth and velocity) preferences.

Utilizing presence/absence and relative abundance analyses, we determined which environmental factors most influenced distributional patterns. We then applied these environmental factors as explanatory variables in a general linear model to predict the response upon the endemic fish assemblage. Concordant with previous research, temperature, yearly average peakflow, and tributary proximity appeared to most influence distribution and abundance of the endemic fish assemblage, regardless of guild membership. Abundances of endemic warmwater streamfishes increase with increasing temperature, decreasing yearly average peakflows and close proximity to a tributary junction. With minor changes to flow management in the Smith River tailwater, we found it is possible to improve the conditions for the endemic warmwater ichthyofaunal assemblage, while enhancing prey availability for brown trout.

Keywords: tailwater hydropeaking guilds flow management endemic streamfishes

Abstract Number: 100850

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Oral Presentation

Instream flows

Effect of river flows on growth patterns of redbreast sunfish in three coastal floodplain rivers in southeastern Georgia

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Redbreast sunfish, *Lepomis auritus*, were collected in the Ochoopee, Satilla, and St. Marys rivers in southeastern Georgia to describe growth patterns in relation to river flows. Otoliths were extracted from each fish and growth increments were estimated using an Image Analysis System. Increments for each growth year were compared to river flows during that year using regression analyses. Redbreast sunfish were relatively short-lived in all three rivers, reaching a maximum of age 7. Growth was slowest in the St. Marys River, next slowest in the Ochoopee River, and fastest in the Satilla River (Covariance, $P < 0.01$). Lifespan appeared to be similar between sexes; however, males grew faster than females in all three rivers (Covariance, $P < 0.05$). Growth of redbreast sunfish was faster in years with high river flows in all three rivers; however, flow appeared to be a more important determinant of growth in the Ochoopee River (partial $r^2 = 0.30$) than the other two rivers (partial $r^2 = 0.09-0.11$). Higher flows in rivers may benefit redbreast sunfish growth by inundating floodplains, leading to increased food supplies and faster growth.

Keywords: hydrology, otoliths, growth increments

Abstract Number: 100865

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Oral Presentation

Instream flows

***Cycleptus elongatus* life history studies on the lower Colorado River, TX as part of the LCRA/SAWS Water Project.**

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The lower Colorado River basin supports a diverse ecological community that relies heavily on the quality and quantity of water moving through the system. The LCRA-SAWS Water Project (LSWP) has the potential to alter the flow regime for the lower Colorado River. Therefore, the study team has initiated a series of studies specific to a State Threatened resident fish of the lower Colorado River (*Cycleptus elongatus* - blue sucker). The objective of these studies is to characterize the essential life history requirements (migration, spawning, and recruitment) of *Cycleptus elongatus* in the lower Colorado River, Texas. In the Fall 2004, 30 adult blue suckers were collected and implanted with radio tags for scientific purposes. So far, there has been an excellent survival rate for these fish and they continue to move up and down the lower Colorado River providing the study team with data on migration, habitat preferences, and spawning locations. During the Spring 2005 over 70% of the movement was upstream with fish swimming over 170 river miles to reach suitable spawning locations. Post-spawning movement was predominantly downstream with a high percentage of tagged *C. elongatus* returning to the very riffle complex in which they were originally tagged. The purpose of this presentation is to provide the technical details of the tagging effort and subsequent migration, spawning, and habitat preference results to date for this large riverine species.

Keywords: Blue sucker Instream flow Telemetry Colorado River

Abstract Number: 100878

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Oral Presentation

Instream flows

Colorado River Flow Relationships to Aquatic Habitat Study as part of the LCRA/SAWS Water Project.

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The lower Colorado River basin supports a diverse ecological community that relies heavily on the quality and quantity of water moving through the system. The wide range of variables and conditions associated with biological communities in the lower Colorado River presents complexity in understanding its ecological processes. The LCRA-SAWS Water Project (LSWP) has the potential to alter the flow regime for the lower Colorado River. Therefore, the study team has embarked on the development of a comprehensive ecologically based tool encompassing data from existing studies and field-gathered information that will provide prediction capabilities necessary to evaluate the full range of flows on ecological components of the lower Colorado River system. The objective of the study is to characterize the flow-habitat and flow-ecological relationships within the lower Colorado River and its riverine ecosystem from just downstream of Austin (i.e., Longhorn Dam) to Matagorda Bay to provide a means of assessing biological impacts/benefits of various flow regimes. The presentation will discuss the technical details associated with data collection activities and hydraulic and habitat model development to date.

Keywords: Instream flow Habitat modeling Colorado River

Abstract Number: 100879

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Oral Presentation

Instream flows

Development and effectiveness of the Biological Condition Gradient in a warm-water river with implications to instream flow assessments

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Biological Condition Gradient (BCG) is a conceptual model used within the Tiered Aquatic Life Use framework to describe biological responses related to anthropogenic stressors. The model can be used to predict the assemblage effect by an assortment of anthropogenic stressors (e.g., alterations to the hydrologic regime), but differs from other bioassessments by providing explicit goals for restoration efforts. Objectives of our study were to develop methodologies for constructing a BCG for a western gulf-slope river in Texas and to determine the effectiveness of the BCG in assessing fish assemblage changes related to anthropogenic stressors compared to that of more commonly used models such as EPA and regional Indices of Biotic

Integrity. To construct the BCG, the Brazos River drainage was divided into smaller regions based on distributional assessment of the historical and current fish assemblage. Once subdivisions were established (i.e., lower Brazos River main stem), historical records of fish occurrence and abundance were compiled and analyzed to assess gradual faunal shifts related to anthropogenic stressors. Hydrologic alterations (i.e., impoundments and dewatering) are the primary anthropogenic stressor in the Brazos River and other western gulf slope drainages; therefore, predictions of the BCG can be used as a conceptual framework for instream flow recommendations.

Keywords: Biological Condition Gradient, bioassessments

Abstract Number: 100881

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

AGE, GROWTH, AND REPRODUCTION OF THE RED SNAPPER, LUTJANUS CAMPECHANUS, FROM THE ATLANTIC WATERS OF THE SOUTHEASTERN U.S.

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Otoliths and gonadal tissue were taken from red snapper collected from fishery-independent and fishery-dependent sources between Cape Lookout, North Carolina and Key West, Florida during 1979–2000. The mean size of red snapper from fishery-dependent samples was 594 mm TL and ranged from 70–976 mm TL. Fish sampled with fishery-independent gear had a significantly smaller mean TL (426 mm, range = 121–866 mm) than fishery-dependent samples. The mean size of red snapper was significantly smaller in the 1980s when compared to the 1990s, regardless of gear type. Mean marginal increment analysis showed that opaque zone formation is annual with deposition occurring from June through August. The age range for fishery-independent samples was 1–22 yrs with a mean age of 3.1 yrs, and 1–45 yrs with a mean age of 4.2 yrs for fishery-dependent samples. Von Bertalanffy growth curves revealed that red snapper from commercial catches approach asymptotic size at around age 10, however, no asymptote is apparent for those fish sampled with fishery-independent gear. The overall sex ratio for red snapper was not significantly different from the expected 1:1, regardless of gear type. The smallest mature female was 287 mm TL and the largest immature female was 435 mm TL, with an estimate of length at 50% maturity (L_{50}) of 378 mm TL. The smallest mature male was 200 mm TL and the largest immature male was 378 mm TL, with an L_{50} for males of 223 mm TL. Histological examination of the gonads indicated that female red snapper were in spawning condition from May through October, with a peak between June and September. The gonadosomatic index (GSI) for females ranged from a low of 0.35 in November and December to a high of 2.67 in June. Males were found to be in spawning condition throughout the year.

Keywords: Lutjanidae, *Lutjanus campechanus*, age/growth, reproduction

Abstract Number: 100733

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Site fidelity, movement, and growth of red snapper in the North-central Gulf of Mexico

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Red snapper were captured and tagged ($n = 4,317$) at 14 experimental artificial reefs of two designs during quarterly research cruises off coastal Alabama, U.S.A., between January 1999 and October 2002. Fish were caught using hook-and-line, tagged with an internal anchor tag, measured, and released. Three hundred ninety two red snapper were recaptured during research cruises. Recreational and commercial fishers reported capturing an additional 219 red snapper (through December 2003). Annual site fidelity of tagged fish was estimated using nonlinear decay models. Due to the absence of hurricanes during our study, site fidelity was greater and movement rates were less than previously reported. Site fidelity varied by artificial reef design and 98 percent of red snapper with known recapture locations were caught off coastal Alabama. Growth rates were significantly greater for red snapper that did not move from the site of release. Fish density at artificial reefs did not affect growth rates, but growth rates did vary between artificial reef designs and locations.

Keywords: artificial reefs, red snapper, site fidelity, tag-recapture

Abstract Number: 100784

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Age and size-based estimates of fecundity and relative production for red snapper (*Lutjanus campechanus*) in U.S. Gulf of Mexico waters

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Duncan, M.S., and Collins, L.A., NMFS, Panama City Laboratory, Panama City, Florida

Red snapper reproductive and age samples were obtained during NMFS and Marine Fisheries Initiative (MARFIN) studies of reproduction. These combined efforts offered a relatively large sample size (n=563) of hydrated female red snapper for an age-based analysis of fecundity and maturation. This is one of the few examples of an age-based reproductive analysis for a fish species with a long multi-decadal life span (data range 2-34 yr). Typically, fecundity is related to length and extrapolated to age-based population assessments using growth functions. This approach implies that length and age are tightly coupled. The data for red snapper, however, suggests that intermediate aged fish may be more fecund than older animals, which prompted us to express fecundity as a function of age. Similar results are rare in the fish literature and have usually been interpreted as evidence for reproductive senescence among the oldest fish. Many studies show that the largest (and assumed oldest) fishes are by far the most fecund. Thus there have been calls to manage by conserving old fish or rebuilding age structure to increase proportions of old fish. Our findings suggest, however, there are cases where fecundity should be related to age directly and may provide exceptions to the management rule.

Keywords: Red snapper, Gulf of Mexico, Fecundity, Reproduction, Stock Assessment

Abstract Number: 100824

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Developing Indices of Larval Red Snapper (*Lutjanus campechanus*) Abundance for Use in Stock Assessments.

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Historically, plankton surveys have proven to be a cost effective way of monitoring the occurrence and abundance of the larvae of a wide diversity of marine fishes. Data from fishery-independent surveys have been used either alone or in conjunction with data on the adult life stage in population assessments. Larval indices in the form of mean abundance and/or frequency of occurrence generated from annual Southeast Area Monitoring and Assessment Program (SEAMAP) surveys in the Gulf of Mexico are incorporated in stock assessments for two highly valued FMP species in the southeastern U.S.; Atlantic bluefin tuna, *Thunnus thynnus*, and Gulf king

mackerel, *Scomberomorus cavalla*. Use of ichthyoplankton survey data in stock assessment for snapper species (family Lutjanidae) was problematic until recently when the larvae of at least some species could be identified. Standardized larval red snapper indices were constructed from the original survey dataset and presented for evaluation by the stock assessment panel. Various steps and procedures were taken to account for bias caused by (1) duplicate and/or multiple sampling at some SEAMAP systematic grid sites; (2) year to year variability in spatial coverage of the survey area; (3) diel changes in larval age/size composition abundance; and (4) inter-annual differences in age/size composition of larval catches.

Keywords: larval red snapper indices red Gulf of Mexico

Abstract Number: 100841

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

A Review of Gulf of Mexico Red Snapper Movement Studies: Implications for Population Structure

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Movement in Gulf of Mexico (Gulf) red snapper has been studied indirectly and directly with several different methods dating back many decades. Results and interpretations are varied, but a literature review of red snapper distribution and movement studies revealed several consistent patterns. Juvenile red snapper have been collected from a variety of habitat types, including mud, sand, and shell rubble habitats, but results analyzed across several studies indicated an ontogenetic shift to more complex shell rubble and eventually hardbottom habitats through the first two years of life. Results from traditional tagging studies suggested subadult red snapper displayed site fidelity to reef habitat but movement increased with fish size and many fish recapture 100s of km from release sites. Several authors suggested adult red snapper displayed high site fidelity, but direct estimates of annual site fidelity ranged from 25-50% yr⁻¹. Ultrasonic tagging experiments also confirmed potential low site fidelity as only a low percentage of study fish were tracked near release sites for more than a few months. Last, movement analysis based on otolith chemistry as a natural tag indicated extensive post-settlement movement in the western Gulf but little mixing between populations east and west of the Mississippi River. Overall, results of reviewed studies suggest juvenile red snapper show strong site attachment and limited home ranges, but as fish grow movement increases significantly, thus low adult site fidelity. Implications of movement results on age-specific habitat requirements, vulnerability to exploitation, and population structure will be discussed.

Keywords: red snapper, movement, population structure

Abstract Number: 100844

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Declining size at age among red snapper in the northern Gulf of Mexico off Louisiana, USA: Recovery or collapse?

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The commercial harvest of red snapper *Lutjanus campechanus* is among the most lucrative (> \$10 million in 2003) and most highly regulated (15 in (381 mm) total length (TL) minimum size, 2000 lb (909 kg) trip limit, 4.65 million lb (2.11 million kg) annual quota) fisheries in the GOM. From 1995 through 2004, we sampled 8,958 red snapper landed at commercial docks in Leeville and Cameron, LA for morphometric data and otoliths for age estimation. Despite the species' potential lifespan of more than 50 yr, the harvest is almost totally dominated by individuals of ages 2-6 yr. Since 1998 we have observed dramatic decreases in mean TL at age for red snapper of ages 4 yr (from 575 mm to 446 mm), 5 yr (from 659 to 496), and 6 yr (from 737 mm to 565mm); mean TL for 2 and 3 year old individuals have remained relatively stable. Density dependence theory tells us that within a population of fishes that is increasing in numbers, a decrease in resources (food, habitat, etc.) per individual might be manifested in a compensatory decrease in growth rate. Thus the declines in red snapper mean TL at age may be an expression of recovery of an overfished population. Conversely, the heavy commercial and recreational harvest of young red snapper, many of them at the very minimum length required for retention, may have resulted in an inadvertent selection for the survival of slow-growing individuals.

Keywords: Red snapper Density dependence Compensation Selection

Abstract Number: 100662

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Red snapper in the northern Gulf of Mexico: Age and size composition of the commercial harvest and mortality of regulatory discards.

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Accurate information on the age/size composition of the red snapper *Lutjanus campechanus* commercial harvest is necessary to monitor year class strength, conduct stock assessments, and document population recovery. Ages of red snappers sampled during 2001-2004 (N=2,867) ranged from 1 to 14 yr; the majority (96.6 %) were from 2 to 6 yr. Sampling efforts of 1995-1997 (N=2,083) and 1997-2000 (N=2,908) also exhibited similar age distributions, but with higher maximum ages of 48 yr and 39 yr, respectively. Modal total lengths (TL) for all three sampling efforts were in the range of 400-425 mm; however, the 2001-2004 sample population was considerably enriched at TL = 450 mm and substantially depauperate at TL = 500 mm. The heavy harvest sustained by younger age/size-classes, as well as the decrease in number of larger, older individuals in the most recent sampling effort, may be the portent of changes in the red snapper populations in the northern GOM. We investigated catch-and-release mortality of 4,839 red snapper regulatory discards (< 15 in (381 mm) TL) during 16 commercial fishing trips from 2001 to 2003. Among the discards 778 (16%) swam down vigorously, 714 (15%) swam down slowly, 1,765 (36%) were alive but could not swim down, and 1,582 (33%) were moribund or dead. Among 399 potential discards retained for age and length analyses, TL ranged from 248 to 380mm (10-15 inches); ages ranged from 1 to 4 yr with 2 yr olds dominating (86%). Discard mortality observed in this study is considerably higher than the current estimate (33%) used in red snapper stock assessment models.

Keywords: Red snapper Age distribution Size distribution Discard mortality

Abstract Number: 100661

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Diet and Prey Demand of Red Snapper (*Lutjanus campechanus*) on Alabama Artificial Reefs

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Red snapper *Lutjanus campechanus* is a highly exploited reef fish that is harvested in the Gulf of Mexico from both natural and artificial reefs. Following a near collapse, stocks began to recover in the 1990s; this recovery has been attributed in part to an increase in habitat in the form of artificial reefs. However, little is known about the role artificial reefs play in the trophic dynamics of the species. Toward this end, the seasonal and size-specific diet shifts of red snapper were examined through stomach content analysis of fish collected from artificial reefs in the north-central Gulf of Mexico off Alabama between May 1999-April 2000. Diet information was subsequently combined with data from the literature to obtain a first-order estimate of prey demand of the red snapper population on artificial reefs off Alabama. Results indicated that diet varied with season and with red snapper size, with the overall diet comprised primarily of demersal crustaceans, fish, and pelagic zooplankton. Annual prey demand of the red snapper population on Alabama artificial reefs was estimated to be over 19 million kg. Red snapper gained most of their nutrition from sand/mud and water-column associated organisms, not from organisms associated with the reef.

Keywords: red snapper, diet analysis, prey demand, artificial reefs, northern Gulf of Mexico,

Abstract Number: 100664

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Larval development of red snapper (*Lutjanus campechanus*) and the influence of temperature

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The extent of endogenous nutrient reserves available at the start of exogenous feeding may contribute to the high mortalities associated with larval culture of red snapper (*Lutjanus campechanus*). Yolk utilization, and development of morphological characteristics were observed and measured for red snapper larvae held at 28°C. Maximum standard length (L_s) and body depth were observed concurrently with yolk-sac exhaustion at 56 h post-fertilization (hpf). From that point L_s decreased. Larvae were reared at 26, 28 and 30°C in one study and at 24, 26 and 28°C in a second, and monitored for yolk volume, oil globule volume, and growth. Temperature had significant effects on hatching, larval development and survival. Eggs held at 24°C hatched approximately 14 h later than eggs held at 28°C. Survival to the onset of mouthpart articulation in the first trial declined with increasing temperature, 7.5 % at 30°C and 55.8 % at 26°C. In the second trial, survival was 82.4% at 26°C and 33.6 and 34.4% at 24 and 28°C, respectively. By the time mouthparts are functioning the oil globule has been drastically reduced with temperature affecting the degree of reduction. In the 26, 28 and 30°C trial, the

percentage of oil globule remaining at the time of functional mouthparts was 4.97, 3.20, and 1.35 % and in the 24, 26 and 28°C trial, 0.40, 10.1 and 1.57 % for the respective temperatures. Red snapper larval development and survival is greatly impacted by a few degree differences in temperature.

Keywords: Red snapper, larval development, temperature, yolk and oil globule utilization

Abstract Number: 100668

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Spawning of red snapper (*Lutjanus campechanus*) in response to hormonal induction or environmental control in a hatchery setting.

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Red snapper can be induced to spawn using exogenous hormones, or by environmental manipulation. Gravid red snapper females were collected off the Alabama coast from early May through August and induced spawned with HCG. On average, $55.8 \pm 17.33\%$ of the females ovulated. Most fish ovulated between 24 and 32 h post-injection. Fecundity varies by brood size and season. Smaller females have higher fecundities/kg than larger fish. Fish spawned in May gave less eggs/kg than fish spawned in June or July. Percent hatch averaged $42.13 \pm 3.44\%$ over the spawning season while the post-hatch survival decreased from 37.45% in May to 8.53% in July. Wild-caught adult red snapper can be held in confinement and natural spawning obtained when temperature and photoperiod are controlled. Adult snapper were stocked in 13.2 m³ tanks where photoperiod and temperatures were adjusted to follow the natural cycle of the coastal waters of Alabama. First spawning occurred on May 12, 2001 at 24.5 C and a 13'35" light cycle. Fish in four of the six tanks released eggs. One tank gave eggs on 23 days over an 85-day period however most spawns were not fertilized. As many as 120,000 eggs were collected/tank/day. In August 2001, brooders were re-stocked in three tanks. First spawns occurred at 26°C and a 13'57" light cycle. A total of 63 spawns were obtained over a 105 day period, with a mean egg production/tank of 4.2 million eggs. Mean fertilization rate, hatch rate and survival at 36-40 hph were 90.5%, 83% and 49% respectively.

Keywords: Red snapper, reproduction, fecundity, spawning, percent hatch

Abstract Number: 100669

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

The snapper fishery in the Gulf of Mexico, an historical perspective and management implications

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The Gulf of Mexico red snapper fishery is declared overfished, and overfishing is occurring. More stringent regulations, including reduced catch quotas and restrictions on the shrimp fishery to reduce bycatch of juvenile snappers are anticipated. However, with projected rebuilding, maximum sustainable yield (MSY) is estimated to be between twenty and thirty million pounds. This far exceeds what has ever been harvested from U.S. Gulf waters. In fact, the fishery began during the mid nineteenth century off the northeastern coast with harvests of only about two million pounds. At this rate, the stocks rapidly became depleted off, and the fleets moved further south and east to find new sources. Numerous exploratory cruises to the western Gulf in the late nineteenth century found minimal snapper, but high concentrations off Vera Cruz Mexico attracted fishers, and were the major source of snappers for more than a hundred years. The advent of petroleum structures in the mid twentieth century in the western Gulf and thousands of artificial reefs in the north central Gulf have markedly impacted the habitat dynamics of the Gulf, increasing ideal red snapper habitat in those areas. Currently the north central and western Gulf supports the majority of the U.S. harvest. Thus, the overfishing and overfished designations may be misleading, and the "rebuilding" may more accurately be described as realization of new harvest potentials due to increased habitat. Removal of artificial structures may decrease future harvest potential.

Keywords: red snapper overfishing historical landings

Abstract Number: 100674

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

The Fidelity of Red Snapper (*Lutjanus campechanus*) to Petroleum Platforms in the Northern Gulf of Mexico

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The habitat value of petroleum platforms for red snapper, *Lutjanus campechanus*, is poorly understood; however, it is widely recognized that the presence of platforms in the northern Gulf of Mexico (GOM) has affected the distribution of red snapper by the addition of hard substrate habitat. We evaluated the habitat value of petroleum platforms by monitoring the fidelity of red snapper to these structures with acoustic telemetry. In May 2003, 125 red snapper were captured with hook and line at several platforms in a 35-km² portion of the South Timbalier oil and gas lease blocks, 50 km south of Port Fourchon, LA. Following anaesthetization with MS-222, an individually coded acoustic pinger was surgically implanted into the peritoneal cavity of each specimen. After a short recovery period the red snapper were released at five platforms in the study area. Presences of individual snapper were recorded with omnidirectional acoustic receivers attached to eight platforms. Red snapper exhibited little movement among platforms in the study area; however, logistic regression showed a high initial fidelity to release location which subsequently decreased over time, thus site fidelity was found to be high in the short-term, but much lower in the long-term. This result differs from previous studies on red snapper fidelity that reported high fidelity over longer time spans. Knowledge of red snapper fidelity to petroleum platforms will lead to more effective management of this species by clarifying both the function of these structures as habitat and their importance to the GOM red snapper population.

Keywords: red snapper petroleum platforms fidelity acoustic telemetry

Abstract Number: 100675

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Population Structure and Historical Demography of Red Snapper (*Lutjanus campechanus*) from the northern Gulf of Mexico

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Allelic variation at 19 nuclear-encoded microsatellite loci and haplotype variation in a 590 bp protein-coding fragment of mtDNA was assayed among Gulf red snapper sampled from four cohorts at each of three offshore localities in the northern Gulf of Mexico. Significant heterogeneity in allele and genotype distributions among samples was detected at four microsatellites. Pairwise exact tests revealed that six of seven 'significant' comparisons involved temporal rather than spatial heterogeneity. For mtDNA, exact tests of genetic homogeneity among cohorts within localities and among localities were non-significant. Estimates of variance effective population size (microsatellites) ranged between ~1,000 and >75,000 and differed significantly

among localities, with the sample from the northcentral Gulf having significantly greater effective size than localities in the northeastern and northwestern Gulf. Estimates of female effective size (based on mtDNA) also indicated substantially larger effective size in the northcentral Gulf. The differences in variance effective size could reflect differences in number of individuals successfully reproducing and/or differences in patterns and intensity of migration, and are consistent with the hypothesis, supported by life-history data, that different 'demographic stocks' of red snapper occur in the northern Gulf. Nested-clade analysis of mtDNA variants provided evidence of different temporal episodes of range expansion and isolation by distance. The spatial distribution of red snapper in the northern Gulf thus appears to have a complex history that likely reflects glacial advance/retreat, habitat availability, and hydrology. These factors may partially restrict gene flow among present-day red snapper in the northern Gulf and give rise to a metapopulation structure with variable connectivity. This type of population structure may be difficult to detect with commonly used, selectively neutral genetic markers.

Keywords: red snapper, microsatellites, mtDNA, population genetics, effective size, demographic stocks

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Behavior and swimming performance of red snapper: Its application to shrimp trawl bycatch reduction.

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We investigated the behavior and swimming performance of red snapper, *Lutjanus campechanus* with the intent of applying this information toward developing an improved bycatch reduction device (BRD). Fish were trawled from artificial reefs just offshore of Pascagoula, Mississippi, transported to the lab at the University of Mississippi and held in 1300 liter, closed system aquaria. Fish were held under the temperature, salinity and photoperiod of the water and season from which they were collected. Using a Brett swim tunnel, we examined the influence of season, size and time of day on snapper critical swimming speed (Ucrit). A significant season and size effect on Ucrit was detected. Highest Ucrit was observed in summer and lowest in winter. Likewise, large fish swam significantly faster than small fish. An important observation was the fact that night swimming speeds were not significantly different from day swimming speeds. Behavioral tests in the laboratory under simulated trawling conditions revealed that the prototype Fish Box (Vortex Generating) BRD excluded approximately 80% of red snapper during daylight tests. However, less than 20% of snapper were excluded during night-time tests. Using infrared lights and cameras, we observed that snapper were very reluctant to explore areas in the BRD and appeared to be unable or unwilling to move into the escape opening,

despite the reversed flow generated in that area. When the BRD was artificially illuminated during night-time tests, over 90% of snapper were excluded from the BRD.

Keywords: red snapper, behavior, critical swimming speed, bycatch reduction, illumination

Abstract Number: 100688

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Reductions and Changes in Shrimp Trawl Fishing Effort in the Gulf of Mexico

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Shrimp trawl fishing effort in the Gulf of Mexico has declined dramatically in recent years due to a combination of economic factors and natural catastrophes. In 1990, shrimp fishing effort was in excess of 220,000 nominal days fished. In 2004, effort was less than 160,000 nominal days fished. Total effort has not been estimated for 2005. However, those vessels which fished in 2005 averaged trawling 33 to 40% fewer days than were fished on average in 2004. In 2005, hurricanes and continuing economic deterioration contributed to further reductions in the fishing fleet. Fewer than 3,000 vessels have applied for permits to fish EEZ waters in the Gulf. Historical and recent data suggest that a fundamental change in the fishing pattern has occurred in the Gulf shrimp fishery. However, this change has yet to be recognized in the effort estimation process. As a result, mid-shelf effort is systematically overestimated whereas nearshore and offshore effort is underestimated. These changes will significantly reduce red snapper bycatch because red snapper are most abundant in the mid-shelf area.

Keywords: Shrimp fishery, fishing effort, bycatch, red snapper

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Red Snapper Bycatch in the Gulf of Mexico Shrimp Fishery: A Review

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Historically, the magnitude and age composition of juvenile red snapper bycatch in the Gulf of Mexico shrimp fishery has been a highly contentious issue. Goodyear (1995) estimated total red snapper bycatch in the Gulf shrimp fishery during 1982 to 1992 consisted of 310.7 million juvenile red snapper (~28 million/yr) of which 56% were age-1 fish and 44% were age-0 fish. In contrast, Gallaway et al. (1998) estimated total bycatch for the same period was 198.1 million fish (18 million/yr) of which only 35% were age-1 fish and 65% were age-0 fish. Nichols (2005) provides the most recent bycatch estimates and his new approach has resolved the contention regarding bycatch estimation. During 1999-2003, bycatch averaged ~22.1 million fish per year of which 28% were age-1 fish and 72% were age-0 fish. Bycatch has declined dramatically since 1990 when some 60 million juvenile red snapper were taken in shrimp trawls. In contrast, total red snapper bycatch levels in 2001, 2002, and 2003 were about 24, 22, and 9 million fish, respectively. Red snapper CPUE in the shrimp fishery is high between the 10- and 30-fathom depth contours and low inshore and offshore of this zone. Reductions in total effort and an ongoing shift in fishing effort from mid-shelf zones to inshore and offshore habitats should greatly reduce red snapper bycatch in future years.

Keywords: Shrimp fishery, fishing effort, bycatch, red snapper

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Rebuilding Red Snapper: Future Challenges Confronting Fishery Managers and Ongoing Management Activities

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The Gulf of Mexico red snapper stock was first determined to be overfished in the late 1980s and subsequent stock assessments have concluded the stock remains overfished. Amendment 1 to the Reef Fish Fishery Management Plan established the first rebuilding plan for red snapper in 1990, setting a target of rebuilding red snapper by 2000. Changes in scientific advice and new information on red snapper biology resulted in several revisions to the rebuilding plan. The most recent revision was approved in 2004 and set a goal of rebuilding red snapper by 2032. Despite the recent implementation of this plan, additional management restrictions are necessary to rebuild red snapper by 2032. Managers are now confronted with several challenges to successfully rebuild red snapper, including addressing the large amounts of bycatch in the shrimp fishery and high rates of discard mortality in the directed fishery. The Gulf of Mexico Fishery Management Council and NOAA's

National Marine Fisheries Service are currently developing or have recently implemented several management measures intended to address bycatch and rebuild red snapper. These measures include an individual fishing quota program for the commercial red snapper fishery, elimination or reduction of size limits, modifications to bycatch reduction device certification criteria, license limitation, and reductions in total allowable catch. Social and economic considerations in both the directed fishery and shrimp fishery and the long-duration of the rebuilding plan further complicate management and stock rebuilding.

Keywords: red snapper, fishery management, bycatch, rebuilding plan

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Red Snapper (*Lutjanus campechanus*) Young-of-the-Year in the Texas Territorial Sea

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Between 1985 and 2004, Texas Parks & Wildlife conducted 18,482 trawls in the Texas Territorial Sea, extending from the beach out to 16.7 km (9 nm), and including statistical zones 17 – 21. Samples were selected using a stratified random sampling methodology and were collected monthly. Red snapper (*Lutjanus campechanus*) catches are discussed here. Mean total length (TL) was 91 mm (± 0.35 SE, $n = 5,799$), making all red snapper collected young-of-the-year. Coast wide mean CPUE was 1.9 (± 0.10 SE), although catches were minimal along the northern Texas coast with only 14.8 % of red snapper collected in statistical zones 17 through 19. Zones 20 and 21 dominated red snapper catches with 39.6 % and 45.6 % of total catch, respectively. Mean CPUE was higher during fall (4.9 ± 0.34 SE) than in any other season and higher in September (7.1 ± 0.69 SE) than in any other month. Although there was statistical significance in the linear relationship between CPUE and salinity, water temperature, and dissolved oxygen ($p < 0.0001$), little variation around the mean was explained ($r^2 < 0.01$). Annual variability in CPUE may be associated with changes in shrimping effort. Recent CPUE increases (2000 – 2004) may have resulted from shrimping effort reduction caused by economic factors such as increased fuel prices, decreased market prices, and competition from foreign imports, and/or regulatory management measures such as the nearshore seasonal shrimping closure off the southern Texas coast, and BRD requirements instituted in 1998, which reduced red snapper bycatch.

Keywords: CPUE Distribution Seasonality Annual variability Environmental parameters

Abstract Number: 100727

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Distinguishing Wild From Hatchery Produced Juvenile Red Snapper with Otolith Chemistry

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Stock enhancement has been proposed as a means to rebuild Gulf of Mexico red snapper populations. Most enhancement programs employ some tagging or mass marking methodology to estimate the contribution of hatchery fish to wild populations. We tested whether red snapper otolith elemental concentrations and C and O stable isotope values could be used as a natural tag to distinguish wild from hatchery produced juveniles. We obtained otolith samples from 60 hatchery reared fish and 146 wild fish collected over the continental shelf from northwest Florida to Texas. One sagitta from each fish was ground to a fine powder and analyzed with isotope ratio-mass spectrometry (IR-MS) to test for differences in C and O stable isotope delta values between hatchery and wild fish. The second sagitta was cleaned, dissolved in ultrapure nitric acid, and analyzed with sector field-inductively coupled plasma-mass spectrometry (SF-ICP-MS) to test for differences in otolith elemental (Ca, Ba, Mg, Mn, Sr, and Pb) concentrations. Results from IR-MS and SF-ICP-MS analyses indicated significant differences existed in otolith elemental and stable isotope signatures between hatchery and wild juveniles (MANOVA: Pillai's Trace; $p < 0.001$). Results from jackknifed classification accuracies from discriminant function analysis indicated hatchery fish could be distinguished from wild fish with 100% accuracy based on otolith elemental and stable isotope signatures. These results suggest otolith chemistry may be employed as an effective natural tag for mass marking future stockings of red snapper or other marine finfish to estimate hatchery contribution to wild populations.

Keywords: red snapper, hatchery, otolith chemistry

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

A History of Red Snapper Management in the Gulf of Mexico

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The red snapper fishery has been in existence in the Gulf of Mexico since the mid-1800s. However, management of this species did not occur until more than a century afterward. Federal management of the fisheries in the Gulf of Mexico began in 1976 with the passage of the Magnuson-Stevens Fishery Conservation and Management Act and the establishment of the Gulf of Mexico Fishery Management Council (Council). One of the first fishery management plans (FMPs) developed by the Council was the Reef Fish FMP. This FMP was implemented in November 1984 and established the first red snapper size and bag limits. In 1988, the stock was determined to be overfished. Since then, the fishery has been managed to stay within total allowable catch levels in order to rebuild the stock. Management methods have included size limits, bag limits, season closures, trip limits, and license limitation programs. The success of these methods has been limited; in part due to high levels of juvenile red snapper mortality associated with shrimp trawling, high rates of discard mortality from the directed fishery, and socioeconomic requirements of the directed fisheries to maintain some minimal level of harvest

Keywords: red snapper, management history, Gulf of Mexico

Abstract Number: 100741

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

An assessment of the red snapper (*Lutjanus campechanus*) fishery in the U.S. Gulf of Mexico using a spatially-explicit age-structured assessment model

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Red snapper (*Lutjanus campechanus*) have been fished in the Gulf of Mexico since before the Civil War. The size and efficiency of the commercial fleet increased greatly during the 1960s, but without a corresponding increase in catch, suggesting that red snapper populations throughout the Gulf of Mexico were by that time fully-exploited and perhaps even overfished. Nevertheless, most assessments of red snapper in the Gulf of Mexico have been based on data collected since the 1980s owing to a combination of gaps in the catch data and limitations of the models employed. The lack of contrast in the more recent data makes it difficult to develop meaningful estimates of stock status, particularly in relation to abundance-based reference points such as the equilibrium spawning biomass at maximum sustainable yield. This paper presents a flexible age-structured model that includes information dating back

to the inception of the fishery. The results suggest that the populations of red snapper in the U.S. Gulf of Mexico are well below the levels corresponding to a spawning potential ratio of 30%. They also suggest the stock will not to recover to that level in the foreseeable future without substantial reductions in both the catch of adults by the directed fleets and the bycatch of juveniles by the offshore shrimp fishery. The population east of the Mississippi river appears to be much smaller than the population west of the Mississippi, but is increasing at a faster rate under existing regulations.

Keywords: red snapper, assessment, statistical catch-at-age model

Abstract Number: 100759

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Reconstructing the commercial landings of red snapper (*Lutjanus campechanus*) in the Gulf of Mexico from 1872 to 1962

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Statistics on the commercial landings of red snapper (*Lutjanus campechanus*) in the United States have been recorded by the National Marine Fisheries Service (NMFS) and its predecessors as far back as 1880. However, there are many gaps in the historical record: Censuses were conducted sporadically prior to 1949 and the water body where the catch was taken was not consistently recorded until 1963. Past assessments of the status of red snapper in the Gulf of Mexico have avoided these problems by using only data collected after the early 1960s. Unfortunately, there are indications the stock may have already been depressed by this time and the resulting lack of contrast in the data has made it difficult to estimate important benchmarks such as the maximum sustainable yield. For this reason, the participants of several SEDAR (SouthEast Data and Assessment Review) workshops strongly recommended reconstructing the catches as far back as possible using whatever auxiliary information might be available. This paper details a first attempt at such a reconstruction using clues hidden in several historical references.

Keywords: red snapper, landings, historical accounts

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Habitat Effects on Juvenile Red Snapper Density and Growth in the North Central Gulf of Mexico

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Bycatch reduction devices have been required in the north central and western Gulf of Mexico since 1998 but the program has failed to reduce bycatch to levels necessary for red snapper stock recovery. An alternate solution to the bycatch problem may be establishing no trawl zones in areas with high juvenile red snapper production potential. Before no-trawl zones are considered, habitat requirements of juvenile red snapper must be known better [i.e., what constitutes juvenile essential fish habitat (EFH)]. This study was conducted to estimate the effects of habitat on juvenile red snapper density and growth in areas that historically supported high (n=1; shell rubble habitat type), median (n=2; 1 shell rubble and 1 sand habitat type) and low (n=1; mud habitat type) juvenile densities as estimated from NMFS Fall Groundfish Survey (1991-2000) trawl samples. Contemporary habitat utilization patterns were examined with trawl sampling in summer through fall 2001 and 2002. Overall, juvenile density was highest in shell rubble habitat. However, high numbers of newly settled fish also were captured in mud habitat in 2002. Growth rates were significantly different among habitats in 2001 (ANCOVA; $p = 0.049$) but not 2002 (ANCOVA; $p = 0.308$), with shell rubble habitats consistently producing high growth rates. Therefore, we conclude shell rubble habitat had the highest production potential for juvenile red snapper in the two years of our study. Future research should focus on variability of habitat-specific production potential among red snapper year classes, as well as mapping the spatial extent of habitat types.

Keywords: Essential Fish Habitat (EFH), Red Snapper, Production Potential, Bycatch, Growth, Density

Abstract Number: 100766

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Video estimates of juvenile and adult red snapper and associated fish assemblages on sand, shell, and natural reef habitats in the northcentral Gulf of Mexico

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Video estimation of the relative abundances of fishes is a non-invasive method commonly used to assess fish densities. This technique can be used to characterize habitat use patterns either of fish assemblages or of a particular species of interest. The objectives of this study were to quantify relative abundances of red snapper, *Lutjanus campechanus*, and to characterize the associated fish assemblages over different habitat types using video methodology. Fishes were enumerated over sand, shell, and natural hard bottom reef habitat types in the northcentral Gulf of Mexico (GOM) off Alabama on quarterly cruises over a two-year period with a stationary underwater video camera array. Red snapper showed both significantly higher abundances and significantly larger sizes over the reef habitat. However, no seasonal effects were observed, indicating temporal abundance patterns were consistent among seasons. Fish assemblages differed over habitat types, with significant differences between reef and shell assemblages. Efforts to identify the single species that most contributed to these differences indicated that the red snapper accounted for 59% of the overall similarity within the reef fish assemblage and 20% of the total dissimilarity between the shell and reef fish assemblages. This study highlights the usefulness of applying video techniques to identify the importance of sand, shell, and reef habitat types to different life stages of red snapper and to the different fish assemblages occupying these distinct habitat types in the northcentral GOM.

Keywords: red snapper, habitat, underwater video, fish assemblage

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

The Performance of the "Gulf Fisheye" Bycatch Reduction Device in the United States Gulf of Mexico Shrimp Fishery

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Bycatch reduction devices (BRDs) have been required in the Gulf of Mexico shrimp fishery since 1998. The Gulf Fisheye BRD and the Jones/Davis BRD were certified for use in the GOM shrimp fishery based on criteria for the reduction of red snapper *Lutjanus campechanus* bycatch achieved during the cooperative industry/government research effort from 1992 to 1997. In 1998 an intensive monitoring effort provided data on the effectiveness of mandatory use of these devices. The 1998 study indicated that there were performance problems with the fisheye BRD in some configurations, and the regulations were amended modifying the allowable placement of the fisheye to improve performance. Monitoring of the performance of BRDs in the fishery was continued through an observer program from 2001 to 2003. Analysis of observer data indicates that the fisheye BRD performance

has not improved but rather is much worse. The total finfish reduction estimate was 16.5%, and F reduction for red snapper was 11.7%. The shrimp reduction was 2.0%. Observers found that the majority of fisheye installations were noncompliant with federal regulations. However, analysis of data indicates that BRD performance was poor in both legal and illegal installations. Several changes in fishing gear characteristics and practices in the fishery may be reducing fisheye performance. Results were highly variable over the range of vessels and gear configurations, but poor performance is most likely due to changes in fishing practices to minimize shrimp loss.

Keywords: Trawl Snapper Bycatch Fisheye

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

A comparison of red snapper abundance between artificial reefs with and without epibenthic communities.

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Copper-based paint was used to prevent the development of epibenthic organisms on artificial habitats. Red snapper *Lutjanus campechanus* abundance was compared between habitats with (n = 20) and without (n = 20) epibenthic communities over a 12 month period. Experimental reefs were built during June 2003 in the northern Gulf of Mexico. Diver visual surveys were used to estimate abundance of fish and epibenthic communities in the fall (4-5 October 2003), winter (21 November - 8 December 2003), and spring (5-20 May 2004). Percent cover of epibenthic communities were significantly greater on unpainted compared to painted habitats. Red snapper preferred habitats with epibenthic communities. Also, they showed significantly larger sizes on unpainted compared to painted habitats. This study showed that epibenthic communities affected the recruitment of juvenile red snapper to artificial reefs in the northern Gulf of Mexico. Thus, the attraction of fishes to reef structures was not just in response to shelter, but also potential food resources.

Keywords: artificial reefs

Abstract Number: 100791

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Analysis of the relationship between shrimp and juvenile red snapper distributions on large temporal and spatial scales

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Closed areas are often relatively short-term restrictions of specific gear types in specific sensitive areas used by fishery managers to reduce overfishing, to rebuild stocks, or to achieve other management goals. The use of closed areas to reduce red snapper bycatch in the Gulf of Mexico shrimp trawl fisheries has never been seriously investigated as a management tool because of the assumption that bycatch of red snapper is a random event that cannot be avoided by fishermen. We used GIS analysis of SEAMAP data to investigate whether there are locations where shrimp and juvenile red snapper overlap consistently in space and time, which would indicate the potential for closed areas to reduce red snapper bycatch. We also investigated areas with high abundances of shrimp and low abundances of red snapper to show areas where fishermen are likely to catch shrimp with less red snapper bycatch. Finally, we have tried to correlate the areas of highest and lowest overlap with environmental parameters such as temperature, dissolved oxygen, and sediment type to better predict under what conditions shrimp and juvenile red snapper might be expected to overlap.

Keywords: shrimp trawl bycatch, red snapper, GIS analysis, closed areas

Abstract Number: 100793

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Movements of red snapper tagged off Texas

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Over the last three years, we have tagged over 6,000 red snapper (*Lutjanus campechanus*) off Texas. Fish under the sixteen inch (40.6 cm) recreational size limit were tagged from party boats and charter boats out of Port Isabel, Port Aransas, Freeport, and Galveston. Most fish were tagged off oil platforms, artificial reefs, and natural structures in water greater than 100 feet, and most were tagged from May through August. Only about 2% of tagged fish have been recaptured. Time at large of recaptured fish ranged from 2 to 564 days. Fish were recaptured by both recreational and commercial fishermen. Most fish were recaptured from the Port Aransas and Port Isabel areas. Most recaptured red snapper exhibited localized

movements and many fish were recaptured at the same platform or structure where they were initially tagged.

Keywords: red snapper, Texas, movements, mark and recapture

Abstract Number: 100794

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Survival, movement, and residency of hatchery-reared red snapper, *Lutjanus campechanus* on artificial reefs in the northern Gulf of Mexico.

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The movements, survival, and residency of age-0 red snapper, *Lutjanus campechanus*, were examined on artificial reefs in the Gulf of Mexico. Hatchery-reared fish were marked with visible implant fluorescent elastomer (VIE) marks and either Alizarin red S (ARS) or Oxytetracycline dihydrate (OTC) dye. One week after stocking, 21% remained on original reefs, while 38% moved to surrounding reefs. After one month, 5% remained on original reefs and 18% on surrounding reefs. After seven months, 4% remained on original reefs and 7% on surrounding reefs. The experiment was replicated with larger reefs and increased numbers of fish. One month after stocking large reefs, 2% remained on original reefs and 9% on surrounding reefs. After eight months, 0.4% remained on original reefs and 2.2% on surrounding reefs. In the laboratory, age-0 VIE marked fish had lower survival than controls, and ARS marked fish had lower survival than OTC and controls. No significant differences were detected in survival between VIE marked age-2 fish and controls, or among age-0 fish marked with one of the two chemicals plus a VIE mark compared to fish with just a VIE mark, and controls. No significant mark effect on growth was detected for any of the treatments in the laboratory. This study showed short distance movements (24 to 57 m) of age-0 red snapper among artificial reefs and an even distribution among stocked and unstocked reefs.

Keywords: Red snapper movement survival residency artificial reefs hatchery-reared

Abstract Number: 100795

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Potential changes in age structure of red snapper from 1977-2004 due to fishing pressure along the US Atlantic coast

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A subsample of red snapper otoliths were aged from a collection taken in Atlantic waters off the coast of the United States between the years 1977-2004. Three hundred otoliths were analyzed from the years 1982-1984, and another three hundred from 2002-2004. Observed lengths ranged from 212 – 905 mm total length (TL) in the early 80s, and ranged from 468 – 956 mm TL in the sample collected 20 years later. Only fork lengths (FL) were recorded for fish from 2002-2004 so FL was converted to TL using the formula, $TL = -3.21 + 1.08 (FL)$. Ages for these time periods were observed as 1 - 27 years old and 2 – 51 years olds. The change in size limit for red snapper in 1992 to 20 inches (508 mm) has truncated the age structure available from fishery dependent samples. Total lengths were back-calculated by replacing the otolith radius with the radial measurement to each opaque zone using the body proportionality hypothesis on a linear model. The back-calculated lengths, at ages present in both data sets, will be compared. This will allow a better comparison of size at age since the most recent samples don't include the smaller sized fish.

Keywords: aging otolith back-calculation

Abstract Number: 100821

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Patterns of habitat use by juvenile red snapper, *Lutjanus campechanus*, on natural banks in the northwestern Gulf of Mexico.

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Trawl surveys were conducted to measure patterns of habitat use by newly settled red snapper *Lutjanus campechanus* at three bathymetric highs, or banks, on the inner continental shelf of Texas. Digital side-scan sonar and multibeam bathymetric data were used to define inshore mud, shell-ridge, and offshore mud habitats for Freeport Rocks, Heald Bank, and Sabine Bank. Monthly surveys were conducted using an otter trawl from July-September of 2003 and 2004 during the settlement period for red snapper. Peak recruitment occurred July-August on all three banks. Red snapper densities were significantly influenced by date, bank, and habitat.

Freeport Rocks had markedly higher densities of red snapper than the other two banks; however, no habitat effect was detected. Conversely, densities of red snapper at Heald and Sabine Banks were affected by habitat, with densities on offshore mud habitat significantly higher than shell-ridge or inshore mud habitats. Otolith microstructure analysis was used to estimate age, hatch date distributions, and growth. In addition, recent growth (based on increment widths near the otolith margin) was used to assess the relative quality of settlement sites inhabited by red snapper.

Keywords: juvenile red snapper, recruitment, nursery habitat, otolith daily ageing, northwestern Gulf of Mexico

Abstract Number: 100825

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Variation in the age structure and year-class strength of red snapper (*Lutjanus campechanus*) in the Gulf of Mexico by region and fishing sector.

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A total of 29,927 red snapper otoliths were selected for aging from the commercial and recreational fishery from 1991 to 2002. Ages ranged from 1 to 57 years. The commercial long-line fishery selected the oldest individuals with fish first fully recruited to the fishery by age 5, (mean= 7.8 years) and 22% of individuals 10 years or older. The recreational fishery selected the youngest fish with fish entering the fishery at age 3 and 90% of individuals 2 to 4 years (mean= 3.2 years) and 0.3% of fish 10 years or older. The commercial hand-line fishery selected for slightly older fish with 78% from 3 to 5 years of age (mean= 4.1 years) and 1% of individuals 10 years or older. Red snapper collected from the western Gulf of Mexico were significantly older than those from the east for all three fishing sectors (ANOVA, Commercial long-line and Recreational $p < 0.001$; Commercial hand-line $p = 0.02$). An index of relative year-class strength calculated from the commercial and recreational hand-line fisheries indicated strong year classes were present in 1989 and 1995. This pattern was evident individually in the commercial and recreational hand-line fisheries with Pearson correlation indicating a significant relationship ($p < 0.001$) in year-class structure between sectors. The eastern and western Gulf of Mexico indices also indicated a regional correlation in year-class structure (Pearson correlation= 0.67, $p = 0.032$).

Keywords: red snapper otoliths year-class

Abstract Number: 100827

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

A Time Series of Observations on Red Snapper Larvae: SEAMAP Surveys, 1982-2003

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Since 1982 the Southeast Area Monitoring and Assessment Program (SEAMAP) has supported collection and analysis of ichthyoplankton samples with the goal of producing a long-term database on the early life stages of fishes in the U.S. waters of the Gulf of Mexico. Over 12,000 snapper larvae from SEAMAP surveys were identified to the lowest taxon possible. Larvae identifiable as red snapper (*Lutjanus campechanus*) ranged in body length from 2.4 to 19.2 mm (mean = 5.12, median = 4.60) in bongo net samples; and 2.7 to 24.0 mm (mean = 4.37, median = 4.00) in neuston net samples. Over 95 % of larvae were ≤ 8.3 mm in bongo samples and ≤ 5.6 mm in neuston samples. Larvae first appeared in May and were present in samples through November. Months of highest occurrence and abundance were July and September when larvae were taken in 12.7 % and 11.0 % of bongo samples; and 7.6 % and 8.4 % of neuston samples. Mean abundance in those months was 1.18 and 0.82 larvae per 10 m² for bongo samples; and 0.36 and 0.36 larvae per 10 min for neuston samples. By November per cent occurrence was ≤ 0.2 % and mean abundance was < 0.01 larvae in samples from either gear. Larvae were captured throughout the survey area but were consistently observed in greatest abundance at stations on the mid continental shelf west of the Mississippi River, especially off western Louisiana and central Texas.

Keywords: red snapper, larvae, SEAMAP surveys, occurrence, abundance, distribution

Abstract Number: 100832

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Estimating the effect of angler gear on recovery of tagged red snapper on artificial reefs within Alabama Coastal waters

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Approximately 1,200 square miles of offshore waters are included in the artificial reef general permit areas of Alabama, making this the largest artificial reef program in the U.S. The large concentration of artificial reefs and recreational fishing effort provide an excellent opportunity to examine questions associated with red snapper biology and fisheries management. Our past surveys have documented substantial numbers of red snapper less than the 16 inch recreational size limit in the artificial reef area. Given the high abundance of these sub legal red snapper and the popularity of the artificial area to recreational anglers, there is concern that catch and release mortality may be significant. In April 2003, we modified the methodology of our periodic hook and line surveys of reefs to include capture by both conventional J hooks as well as circle hooks. For all subsequent surveys, we fished artificial reefs with both gear types using similar effort (number of fishers and soak time). All captured snappers, groupers and triggerfish were tagged from predetermined artificial reefs in the survey zone and released. The condition of each fish upon reentry into the water column was noted on a scale of 0-5 with higher numbers representing poor condition. The majority of tagged fish were recovered by recreational anglers within Alabama coastal waters. Recapture rate and recovery location were used to estimate growth, survival and movements during time at large.

Keywords: red snapper, hook and line mortality, j hook, circle hook, artificial reef, recreational fisheries

Abstract Number: 100851

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Demographic differences in northern Gulf of Mexico red snapper *Lutjanus campechanus* reproductive maturation: implications for the unit stock hypothesis

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Over decades of exploitation, size-selective fishing mortality has resulted in the removal of the largest, most fecund females and decreased the age- and/or size-at-maturity in a number of fish populations worldwide. Red snapper has been fished for over a century and became a managed species in the Gulf of Mexico (GOM) in the 1990s after perceptions of a declining population size surfaced. However, red snapper management plans are based on minimal data regarding the reproductive output of the species, and size and age at sexual maturation is not certain. To provide information on the size and age of female red snapper at the onset of

reproductive maturity, specimens were collected during the spawning season in 1999, 2000, and 2001 from the GOM off Alabama and Louisiana and were examined for evidence of spawning activity. Progression of oocyte maturation to vitellogenesis was used to define and identify sexually mature females. The smallest mature red snapper was 267 mm FL and was two years old. The smallest with hydrated oocytes, indicative of imminent spawning, or postovulatory follicles, indicative of recent spawning, were 285 mm and 297 mm FL respectively, and both were two years old. Red snapper off Alabama reached maturation at smaller sizes and younger ages than those off Louisiana. Growth rates did not differ between the regions. Such changes in maturation schedules may document an important stock response to reductions in population size.

Keywords: red snapper maturation demographics

Abstract Number: 100854

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Habitat Associations of Juvenile Red Snapper and Penaeid Shrimps in the North Central Gulf of Mexico

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Juvenile red snapper and penaeid shrimp densities were examined on the north central Gulf of Mexico (Gulf) shelf to estimate if juvenile red snapper preferred habitat that was similar or dissimilar to habitat important for shrimp. First we mapped areas with side scan sonar that historically supported high, median, and low juvenile snapper density estimated from NMFS Fall Groundfish Survey trawl samples collected in 1991-2000. Habitat type inferred from side scan mosaics was groundtruthed with box core sediment samples. Benthic fish and invertebrate communities then were sampled with trawls at 20 0.4 km² sites evenly divided among mud, sand, sand-shell rubble, and shell rubble habitat types. Sampling trips were conducted approximately monthly during summer and fall 2001 and 2002. Trawl sampling (n = 148) was conducted primarily during daylight hours, but 13 trawl samples also were conducted at night in fall 2002 for comparison to daytime samples. Both red snapper and shrimp densities were significantly different among habitats and sampling dates (ANOVA; $p < 0.01$), with red snapper density being greatest in sand-shell rubble and shell rubble habitats and shrimp being most dense in mud habitat. Density estimates were correlated between day and night samples for both snapper and shrimp. However, shrimp density estimates were an order of magnitude greater at night than during the day, reflecting the nocturnal nature of shrimp. Results from this study indicate juvenile red snapper and shrimp prefer different habitat types. Further study, including mapping the spatial extent of

different habitat types, may provide data required to delineate no-trawl refugia to minimize bycatch and habitat degradation.

Keywords: red snapper, bycatch, shrimp, habitat

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Red Snapper Foraging Dynamics on Alabama Artificial Reefs

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Red snapper, *Lutjanus campechanus*, in the Gulf of Mexico are heavily exploited and are considered "severely overfished." The state of Alabama has one of the nation's largest artificial reef programs, and it is estimated that there are between 8,000-20,000 artificial reefs in the 3508 km² Alabama artificial reef permit zone. However, little regard has been given to the effects of reef placement, and how the fish populations the reefs support may interact. In this study, models were used to simulate consumption requirements for red snapper on a typical artificial reef and to examine variability in reef spacing and its effects on the spatial dynamics of foraging. To accomplish this goal we used bioenergetics, Ecopath with Ecosim and Ecospace, fuzzy logic theory. Combined results from these models indicate that when artificial reefs are spaced more closely than about 1 km², foraging halos around the reefs may begin to overlap, making the foraging environment less than optimal. Theses modeling results are consistent with empirical studies of red snapper which indicate that both growth rate and site fidelity decrease as reef proximity increases.

Keywords: red snapper, artificial reefs

Abstract Number: 100862

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Oral Presentation

Red Snapper Fisheries Ecology in the US Gulf of Me

Release mortality in Gulf of Mexico red snapper: Physiological consequences of catastrophic decompression

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Gulf of Mexico red snapper populations have slowly declined over several decades prompting strict state and federal regulations (size limits, bag limits, and season closures). Consequently, approximately 52% of all red snapper caught are released, but with no substantial increase in population numbers. Release mortality, associated with catastrophic decompression (CD) may be the cause. Red snapper were acclimated to pressures simulating depths of 0, 30, 50, and 110m, typical of their distribution in the Gulf of Mexico, and decompressed at rates paralleling retrieval from depth by recreational anglers. The SB expansion pattern is predictable, first occupying ventral, mid-ventral, and finally the most rostral region of the abdominal cavity. Upon decompression from 110m, the SB expanded such that only 20% of the body cavity (opposed to approximately 56%) was available for internal organs. According to X-ray images and necropsy data, expansion patterns correlated with specific organ systems and certain injuries. We suggest a suite of clearly identifiable injuries associated with CD that result in considerable physiological damage to fish and increase in number and severity with retrieval from deeper depths. Catch-and-release fishing is not likely a viable management strategy for red snapper. A better approach may be based solely on bag limits, where fewer fish that are unlikely to survive would be released. The red snapper is one of the most sought after species in the Gulf of Mexico; use of physiological data to develop sustainable management practices may eliminate ineffective mitigative practices and identify a critical source of mortality.

Keywords: red snapper, catastrophic decompression, CD, catastrophic decompression syndrome, CDS, release mortality

Abstract Number: 100875

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Oral Presentation

Trophy Fish Management

Factors Related to Angler Catch of Trophy Largemouth Bass in Texas Reservoirs

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We used angler catch reports of largemouth bass *Micropterus salmoides* from Texas Parks and Wildlife Department angler recognition programs to determine if catch occurrence of trophy fish (≥ 5.9 kg) was greater in reservoirs stocked with fingerling Florida largemouth bass *M. s. floridanus* (FLMB) than in non-stocked reservoirs. We also compared trophy fish catch occurrence between reservoirs having the standard 356-mm minimum length harvest limit to reservoirs having a more restrictive length limit, and evaluated the relation of catch occurrence to

reservoir age, surface area, shoreline development index (SDI), latitude, longitude, FLMB stocking frequency and density. Catch occurrence of trophy fish was significantly greater in FLMB-stocked reservoirs (29%) than in non-stocked reservoirs (4%). Probability of trophy largemouth bass catch occurrence in FLMB-stocked reservoirs increased with reservoir SDI, decreased with reservoir age, and was greater for reservoirs managed with special harvest regulations (high minimum length, protective slot, and no harvest restrictions) than for reservoirs managed with the statewide standard minimum size. Our study indicated that introduction of FLMB into Texas reservoirs yielded greater trophy largemouth bass potential and suggested that differences in trophy potential among FLMB-stocked reservoirs are likely more a function of differing reservoir habitat than differences in FLMB stocking frequency and density.

Keywords: trophy largemouth bass Texas stocking reservoir

Abstract Number: 100663

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Oral Presentation

Trophy Fish Management

Managing the Texas spotted seatrout, *Cynoscion nebulosus*, fishery for larger fish.

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Texas began implementing coastwide regulations on the spotted seatrout, *Cynoscion nebulosus*, fishery in 1978. Between 1980 and 1990, regulatory measures were adopted to assist spotted seatrout populations recover from the combined effects of overfishing and three catastrophic cold induced fish kills. These early management measures resulted in the spotted seatrout population being 50% greater than that observed in the early 1980's. In spite of the increase in spotted seatrout numbers, Texas Parks and Wildlife Department (TPWD) received numerous comments, between 1999 and 2001, concerning the apparent decrease in the abundance of larger spotted seatrout and increase in the number of undersized fish in the population. TPWD was presented the opportunity to improve the trophy component of the spotted seatrout fishery by fine tuning existing regulations in response to a sociological component, rather than a biological need, of the fishery. The resulting regulations, adopted by the TPWD Commission in 2003, were a proactive approach to reduce spotted seatrout landings, increase the proportion of large fish in the population and distribute the harvest of large spotted seatrout among more anglers.

Keywords: seatrout trophy management

Abstract Number: 100721

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Oral Presentation

Trophy Fish Management

Using a voluntary survey to improve knowledge of trophy largemouth bass catches in Lake Fork Reservoir, Texas

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Lake Fork Reservoir is an established trophy largemouth bass *Micropterus salmoides* fishery and has been managed under a protective slot limit since 1989. The fact that Lake Fork has produced 34 of the 50 biggest largemouth bass in Texas draws anglers from a broad geographic area and the trophy fishery provides a significant source of revenue for the local economy. Despite intensive sampling using standard procedures, fisheries managers in Texas have very little information on catches of trophy bass. We sought to characterize the Lake Fork trophy bass fishery using voluntary reporting of trophy fish catches. Initiated in March 2003, this ongoing survey targets bass weighing ≥ 7 lbs and/or measuring ≥ 24 inches. Initially developed to provide recreational anglers with information on trophy bass catches, and to promote the bass fishery on Lake Fork, the trophy bass survey contains valuable information for managers. As of October 2005, we obtained information on over 4,900 trophy largemouth bass. We examined whether mean weight and body condition (W_r) varied as a function of year, season, moon phase, or time of day when the fish was caught. Preliminary analyses suggest mean weight and body condition of trophy bass caught during winter (December – February) were significantly higher than during all other seasons, while trophy bass mean weight and body condition during summer (June – August) were significantly lower than during all other seasons. Additionally, more trophy bass were caught per day during full moon periods than other moon phases, but this was only significant during fall months. The number of trophy bass reported during a sampling quarter was positively correlated with directed angler effort as estimated by access creel surveys; however, the number of trophy bass caught per hour of effort was higher during the winter than during other seasons. Using trophy bass survey data in conjunction with angler access creel surveys, we conclude that the slot limit on Lake Fork is effectively sustaining the trophy bass fishery.

Keywords: trophy fish management, largemouth bass, Lake Fork Reservoir, trophy fish survey

Abstract Number: 100722

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Oral Presentation

Trophy Fish Management

ShareLunker Program

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The ShareLunker program (SL) is an angler recognition program which documents the catch of trophy largemouth bass (> 5.9 kg) from Texas waters. The objective of the program is to encourage anglers to loan largemouth bass weighing at least 5.9 kg to Texas Parks and Wildlife for public relations/education purposes, research, and spawning. Since the program's inception in 1986 through April 2005, a total of 375 anglers have provided 391 fish to the program. The SL program has been instrumental in illustrating the importance of catch and release fishing in the development of trophy largemouth bass fisheries. Data from the program have been used to evaluate Florida largemouth bass stocking success, evaluate effects of restrictive harvest regulations, and to identify reservoir characteristics which produce trophy fisheries. Fish donated to the program have been incorporated into hatchery brood stock in a manner that maximizes effective population size of the brood stock. Additionally, genetic markers thought to be associated with quantitative traits (i.e., amplified fragment length polymorphisms) are being evaluated for their use in a selective breeding program.

Keywords: Key words: trophy fisheries, breeding program, largemouth bass, catch and release fishing

Abstract Number: 100755

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Oral Presentation

Trophy Fish Management

Admixture and Ancestry of Trophy Bass

Lutz-Carrillo, D. J.*

Taxonomic identity at the population and individual level is made more difficult by introgressive hybridization and commonly requires invasive sampling techniques. In order to estimate the genetic composition and ancestry of valuable trophy bass without mortality we used microsatellite DNA variation to evaluate 37 trophy bass (defined here as ≥ 5.90 kg) donated to the Texas Parks and Wildlife Department (TPWD) between 2004 and 2005. Based on comparative analyses at eleven polymorphic loci, in five Florida largemouth bass *Micropterus salmoides floridanus* (*N*

= 175) and eight northern largemouth bass *M. s. salmoides* ($N = 249$) populations, allele frequencies indicated that all trophy fish had a majority of Florida largemouth bass influence with ancestry genetically similar to populations sampled in western Florida. Twenty-four fish were direct descendents of Florida largemouth bass as either remnants or direct descendants from introductions, and thirteen were admixed with northern largemouth bass. All admixed individuals were later generation hybrids (non- F_1 s) providing no evidence of heterosis or outbreeding depression with respect to size in select environments.

Keywords: microsatellite bass admixture hybrid Florida introgression trophy

Abstract Number: 100762

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Oral Presentation

Trophy Fish Management

Relationship between Fishery Quality and Angler Catches of Trophy Fishes

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Biologists have used descriptive characteristics of trophy fishes (e.g., maximum size) to infer information about population dynamics. That is, biologists generally assume that population characteristics are related to the production of large, trophy fish. We tested this assumption by comparing angler catches of large fishes with population characteristics determined during routine monitoring of fish populations for bluegill (spring trapnets), largemouth bass (spring electrofishing) and walleye (fall gillnets). We hypothesized that numbers and maximum size of fishes captured by anglers (and reported in the Nebraska Master Anglers database) would be: 1) positively related to population abundance (catch per unit effort [CPUE] multiplied by lake area) if trophy fish production is related to "number of tickets in the lottery," 2) positively related to fish density (CPUE) and size structure (traditional stock density indices) if trophy fish production is related to "average" fish production, and 3) negatively related to fish density (CPUE) if production of trophy fish is related to density-dependent growth. We found, in general, positive correlations of angler catches of trophy fish with fish density and size structure, although responses varied among species. Trophy fish generally are inadequately sampled by standard fishery sampling gears; however, our data suggest that fishery quality, as measured with standard fishery sampling gears, does relate to angler catches of these large fishes.

Keywords: fishery quality, trophy fish, angler data

Abstract Number: 100763

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Oral Presentation

Trophy Fish Management

Potential use of North American fishery agency record-fish lists in identifying patterns in trophy fish occurrence

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We examined web pages for all 50 US state and 13 Canadian provincial fishery management agencies. Web pages for all 50 US states included lists of state record specimens; only three of 13 provincial web pages included such information. Among US state agencies, 49 agencies posted record lengths or weights of freshwater fishes and 21 posted records for saltwater fishes. Although capture information varied among states, most presented the date and location of capture. These records allow testing of a number of simple hypotheses of importance to trophy fish management. For example, whether maximum size is related to latitude or growing season length. We will discuss these and other potential uses of web pages for study of trophy fishes.

Keywords: trophy fish research fishery management maximum size

Abstract Number: 100769

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Oral Presentation

Trophy Fish Management

The science of trophy fish management

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ments around the world. Creating and managing fisheries for trophy-sized fishes represents an emerging challenge for fishery managers. However, there is relatively

little scientific information available on which to base management of these valuable fishery resources. In large part, this is due to the rarity of these large fishes. Consequently, standard sampling methods collect so few large individuals that geographic and temporal patterns in abundance are difficult to detect. Nonetheless, a review of the literature on trophy fishes revealed a number of geographic, bioenergetic, ecological and human dimensions related factors that affect the occurrence of trophy fishes. Unsurprisingly, within species, there is greater trophy potential at lower latitudes. Forage availability and quality influences production of trophy fishes, which may explain a general relationship between water body size and maximum fish size. Regulations, angling effort and mortality, and climatic events, including El Niño, also affect catches of trophy fishes. From these and other observations, we developed a general conceptual model for guidance of research and management of trophy fishes.

Keywords: trophy fish management maximum size

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Oral Presentation

Trophy Fish Management

Symposium wrap-up: The role of science in trophy fish management

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The presentations included within this symposium include case histories, descriptions and analyses of existing sources of information on occurrence and size of trophy fishes, and initial attempts to develop conceptual and mathematical models that might be useful in the study and management of trophy fishes. This paper will synthesize these presentations and offer comments on: (1) our current state of knowledge of trophy fish biology and management and (2) how this symposium advances this knowledge.

Keywords: trophy fish synthesis maximum size managment

Abstract Number: 100773

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Oral Presentation

Trout Fisheries in Regulated Rivers

Use of Angler Survey Data in the Management of Arkansas' Trout Fisheries

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In January 2004, the Arkansas Game and Fish Commission (AGFC) approved a strategic trout management plan, which will guide the future management of all trout resources in the state. One of the primary goals included in this plan is the gathering of science-based information on all components of Arkansas' trout fisheries, including the human dimension. Since the adoption of the management plan, the AGFC Trout Management Program (TMP) has gathered data on trout anglers using phone, mail, and on-site surveys. We will discuss how the TMP has applied this information to a variety of management issues including the identification of potential opposition to proposed management actions, evaluation of current management strategies, and the development of specific management objectives.

Keywords: trout management phone angler survey

Abstract Number: 100842

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Oral Presentation

Trout Fisheries in Regulated Rivers

Assessment of Potential Spawning Habitat, and Length at Maturity of Brown Trout in Tennessee Tailwaters

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Regulated rivers in the southeastern U.S. are popular trout fisheries that typically are supported by extensive stocking programs. Regulated rivers with reproducing populations of brown trout *Salmo trutta* exist in Tennessee, but there is a paucity of published information on brown trout reproduction in regulated rivers. Potential spawning areas (e.g., near instream structures or side channels; n = 34) were identified in four rivers (South Fork of the Holston, Watauga, Caney Fork, and Clinch) and habitat surveys were conducted spring 2005. Surface substrate size was the only habitat characteristic that differed among rivers. Mean substrate size at three rivers (South Holston, Clinch, and Caney Fork Rivers) was within the published optimal size range for redd construction. Electrofishing surveys in summer 2005 verified successful reproduction at spawning areas only in the South Fork of the Holston and Watauga rivers. Age-0 brown trout were collected at all sample sites in the South Fork of the Holston River; mean catch was 177 fish-h⁻¹. Sixty-three percent of the sample sites in the Watauga River yielded age-0 brown trout and the average catch was only 34 fish-h⁻¹. Predicted length at which 50% of brown trout will be mature varied among rivers and ranged from 255 mm to 360 mm. Habitat was not a limiting factor for brown trout reproduction in the four regulated rivers. Other factors such as

disruptive flows or low numbers of mature females were probably responsible for poor reproduction in the Clinch and Caney Fork Rivers.

Keywords: brown trout spawning tailwaters

Abstract Number: 100689

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Oral Presentation

Trout Fisheries in Regulated Rivers

The Effects of Catch and Release Areas on Movement and Mortality of Rainbow Trout in Bull Shoals and Norfolk Tailwaters

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Catch-and-release areas were developed in the mid 1990's on the tailwater systems of the White and Norfolk Rivers, Arkansas, with the goal of improving survival and residence time of rainbow trout *Oncorhynchus mykiss* in areas normally under put-and-take management. In a paired study design, rainbow trout were implanted with radio-transmitters from within and below each catch-and-release (CR) area to investigate the assumptions that, 1) trout stay within CR areas and 2) mortality is reduced within CR areas. Current velocity, substrate type, temperature, and dissolved oxygen were recorded at fish locations. Preliminary results showed greater summer and fall residence times in CR than non-CR areas. Summer movements in all areas were limited (0-10 meters) with fish maintaining positions in single pools or riffles. In autumn, several fish made upstream migrations covering distances ranging 6-40 kilometers. Knowledge of movement patterns and home ranges will allow managers to more effectively establish the size and location of special regulation areas.

Keywords: *Oncorhynchus mykiss* radio-telemetry catch-and-release

Abstract Number: 100729

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Oral Presentation

Trout Fisheries in Regulated Rivers

Foraging patterns of brown trout and rainbow trout in an Arkansas tailwater: a stable isotope and gut content analysis approach

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Catch-and-release trout fishing regulations were implemented on Bull Shoals and Norfolk tailwaters in Arkansas to provide high catch rates of larger sized trout. However, little biological information exists on trout production in these systems. The objective of this study was to quantify the proportions of prey items consumed by brown and rainbow trout using stable isotope and gut content analysis. Trout were collected from Norfolk and Bull Shoals tailwater in spring and summer of 2005. Large (> 400 mm TL) brown and rainbow trout in Bull Shoals catch-and-release area had elevated d15N values (3‰), indicating a dietary shift and an increase in trophic position compared to smaller trout. However, this same shift in trophic position was not apparent in Norfolk tailwater. Chironomidae (pupae and larvae), Cladocera spp., Amphipoda, banded sculpin, and Isopoda were commonly ingested. Filamentous algae was also found in many stomachs, indicating epibenthic foraging. Information collected in this study will provide valuable insight into the effectiveness of Bull Shoals and Norfolk catch-and-release areas. This information will then be used in bioenergetics modeling to assess prey items important to trout production in Arkansas tailwaters.

Keywords: trout stable-isotope gut-content Arkansas tailwater

Abstract Number: 100731

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Oral Presentation

Trout Fisheries in Regulated Rivers

The Lake Cumberland tailwater trout fishery and the relationship with reservoir discharge

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Wolf Creek dam, forming Lake Cumberland, is a US Army Corps of Engineers (USACOE) project with flood control and hydropower generation as primary functions. With a drainage area of 15,000 km² and flood control storage capacity exceeding 751,000 ha-m, the project is a major component in the USACOE dam system in the KY-TN region. The 121 km of the Cumberland River below Lake Cumberland hosts Kentucky's premier trout fishery. With growth rates that have exceeded that reported for many other southeastern tailwaters, the Lake Cumberland tailwater has consistent trophy potential for both brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). After peaking in 2002, an approximate 50 % decline in the electrofishing catch rates of both brown and

rainbow trout were observed in 2003 and 2004. Because the trout population in only the upper half of the tailwater is monitored, it was unknown whether the brown and rainbow trout populations had actually declined or if the fish had moved to areas where they were invulnerable to electrofishing at the time of sampling. Since 2003 and 2004 were notable wet years in the region, notorious for leading to diminished water quality in the river, indirect effects of increased hydropower generation and flood gate releases were examined. Lower dissolved oxygen levels and warmer river temperatures were found to be highly correlated with total reservoir discharge when analyzed on an annual basis over an eleven year period. High discharge was found to be negatively correlated with annual electrofishing catch rates of both brown and rainbow trout. Seasonal growth was also negatively impacted in years of high discharge.

Keywords: brown rainbow trout tailwater discharge

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Oral Presentation

Trout Fisheries in Regulated Rivers

Dawn of the (soon to be) dead: Growth and survival challenges faced by adult brown trout in a Virginia tailwater

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The Smith River below Philpott Dam contains a naturalized population of brown trout Salmo trutta that supports an extremely popular tailwater fishery. Historically, this river produced substantial numbers of trophy-sized (≥ 460 mm in length) fish, although fish of this size are quite rare today. Angler surveys show that Smith River anglers greatly prefer catching large trout to catching many trout. As a result, one of the primary management objectives for this fishery is to increase the density of larger brown trout. Overall brown trout abundance is relatively high (94 fish/100 m), and trophy fish production does not appear to be restricted by recruitment problems. However, slow growth rates (5 years to reach 300 mm) and low survival rates (total annual survival = approximately 40%) regulate the size structure of the population ($RSD_{\text{Preferred}} = 3.5\%$ and $RSD_{\text{Memorable}} = 0.1\%$). Growth appears to be primarily limited by food availability, whereas survival may be limited by several factors. Increasing the abundance of nongame fishes with temperature manipulation may hold the key to increasing growth rates of brown trout. Improving brown trout survival rates may be possible by increasing forage abundance, reducing temperature flux, and stabilizing the flow regime. These changes are possible with modifications to the

intake structure in Philpott Dam and alteration of the flow regime with new turbines. Increasing growth and survival rates should positively impact the size structure of the brown trout population and enhance the trophy aspects of this fishery.

Keywords: Brown trout Tailwater Growth Survival Temperature Instream flows

Abstract Number: 100863

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Oral Presentation

Trout Fisheries in Regulated Rivers

Decades of Daily Disruptions Dent Brown Trout Habitat and Recruitment

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Over the 50 years of daily peak power generation, no ramping restrictions, and loss of gravel due to operations of Philpott Dam, on Smith River, has created a wider, rectangular-shaped channel, with steeper banks. The pattern caused by channel degradation, tributary headcutting, bank erosion, and downstream aggradation has limited the length of productive habitat to between 3 and 10 river kilometers from the dam. Here the channel appears to contain key habitats where we found the highest redd densities, abundance, and spawner biomass for brown trout (*Salmo trutta*). Recruitment of brown trout to the fishable size classes is constrained by the daily hydropower peaking operations. The number of young brown trout produced each year was strongly related to the average magnitude of the peak flow and the duration of generation flows. Although, brown trout actively removed fine sediment via redd construction and spawning, thereby increasing gravel permeability, the fine sediments from tributaries and bank erosion rapidly intruded into the spawning gravel in downstream reaches of the river. We recommend mitigating the effects of fluctuating releases from Philpott Dam through a combination of flow management and habitat improvement.

Keywords: Hydropower, brown trout, flow management, spawning habitat

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Oral Presentation

Trout Fisheries in Regulated Rivers

Angler Attitudes and Opinions and Economic Impact of Trout Anglers on the Canyon Reservoir Tailrace

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The Canyon Reservoir tailrace is a 22.2-km portion of the Guadalupe River located below Canyon Reservoir in Comal County, Texas. The tailrace was first stocked with rainbow trout in 1966. It is one of the most popular winter trout fisheries in Texas and was listed in 2005 by Trout Unlimited as one of the United States top 100 trout fishing destinations. While the tailrace has always supported a popular put-and-take winter (December to February) fishery, water temperatures from May through October were thought to exceed lethal levels (>25 C) for trout. Oversummer survival was confirmed in the early-90's and in 1997 an 18-inch minimum length and one trout daily bag limit was implemented in 15.9-km stretch of the tailrace. Since the mid-90s angler utilization of the fishery has dramatically declined. An analysis of covariance model suggested that historical angler counts were related to the fishing regulation change, river flow (cfs), number of days post stocking, day of the week, access site and ambient air temperature. Anglers were also surveyed to measure economic impact of the fishery and gain a better understanding of angler attitudes and opinions towards tailrace fishing regulations and access. Recommendations for increasing angler use included increasing the number of stockings, decreasing the interval between stockings, increasing the number of free access sites and more effectively promoting free lease access site availability.

Keywords: trout tailrace economics utilization

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Oral Presentation

Urban Fisheries

Evaluation of Monthly versus Biweekly Stocking of Channel Catfish in the Arkansas Urban Fishing Program

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Declines in recreational fishing participation, under-representation of women and minorities among the angling population, and increasing urban immigration have prompted many state management agencies to start urban fishing programs. Arkansas Game and Fish Commission (AGFC) currently stocks channel catfish biweekly as part of their Urban Fishing Program (UFP), and the transportation costs can be prohibitive because frequent stockings at many locations are required. We evaluated monthly stocking as an alternative to biweekly stocking in the UFP. We conducted a creel study from April 2, 2005 to August 3, 2005 on six ponds stocked with channel catfish by AGFC. Three ponds received the AGFC standard biweekly

stocking, and three ponds received monthly stocking at double the biweekly density. Bus-route type roving creel surveys at the study ponds were used to collect data on angler demographics, effort, catch, and attitudes. Urban pond anglers were predominantly African-American (82%). Effort, catch, and harvest of catfish varied greatly between the six ponds with an average catch rate of catfish (CPUE) ranging from 0.34 to 0.61 per pond. The majority (63%) of anglers had not caught any catfish when interviewed, but most anglers (56%) still rated their overall trips as good or excellent. The mean CPUE for the three ponds stocked monthly (0.45 ± 0.08 catfish/h) was not significantly different than ponds stocked biweekly (0.36 ± 0.02 catfish/h), nor did angler ratings of fishing success differ significantly between the two groups of ponds.

Keywords: Urban Fishing, Stocking Frequency, Channel Catfish, minorities, angler survey

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Oral Presentation

Urban Fisheries

The Arkansas Game and Fish Commission's Family and Community Fishing Program

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The Arkansas Game and Fish Commission's Family and Community Fishing Program was created in 1999. Though it began with two cities and only a handful of ponds, it currently has expanded to 14 cities and more than 28 ponds. The program's objectives are to enhance urban fishing opportunities, increase knowledge of fishing techniques and aquatic stewardship values of youth, and to increase local community involvement in the creation and enhancement of fishing opportunities. From April through August, channel catfish are stocked either biweekly or monthly into most urban fishing ponds. Hybrid striped bass are also stocked into select ponds during the spring or fall months to provide another fish for anglers to target. Rainbow trout are stocked in urban ponds and one urban stream on a biweekly basis from December to March to provide urban anglers with a fishery during the winter. Fishing clinics and fishing derbies are used to kick-off seasonal stockings in many of the participating cities. During fishing clinics, children under 16 are given a free fishing rod and reel and provided with common fishing methodologies to enable them to be more successful when fishing these urban areas. Clinics and derbies are provided free to the public, which encourages families to attend these events. Events are advertised using television interviews, radio broadcasts, newspaper articles, flyers at local businesses, the Internet, and word-of-mouth. The Family and Community Fishing Program is providing anglers for the future and building community and family relationships.

Keywords: urban fishing Arkansas

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Oral Presentation

Urban Fisheries

Evaluation of fishing derby effects on fishing effort and harvest at derby locations and characteristics of fishing derby participants

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Recruiting new anglers is a primary concern of fish and game agencies, and successful recruitment depends on reaching new anglers at a young age. Fishing derbies are a common recruitment technique, yet their effectiveness is rarely evaluated. Arkansas Game and Fish Commission (AGFC) currently supports fishing derbies by stocking catfish into derby ponds prior to derby events. We are evaluating the derby stocking program to determine if derbies increase fishing effort at derby locations following the event, and if derby events recruit new anglers. We are sampling a total of 32 derby events stratified evenly between rural and urban locations, and between derby events that are open or closed to the public. We have currently completed sampling on 13 derby events. Preliminary findings indicate that fishing effort on derby ponds increased significantly the week after a derby event ($Z = -2.91$; $P = 0.0037$). Derby participants were primarily Caucasian (67%), while those fishing on the ponds before and after the derbies were primarily African-American (52%). Finally, the majority (89%) of adults that participated in or accompanied children at derbies reported either currently possessing a fishing license or having possessed one in the past. Although our results are incomplete, it appears that derbies increase angling at derby locations outside of derby events. Also, although many derby participants are not new to fishing, derby events may play an important role in retention of anglers through increased contact with the sport.

Keywords: fishing derbies, youth anglers, effort, harvest, demographics, angler recruitment and retention

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Oral Presentation

Urban Fisheries

Fish Orlando's FAB FIVE

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In 1998, the Florida Fish and Wildlife Conservation Commission expanded their Orlando urban fisheries program into what is now known as Fish Orlando! Goals of the expanded program were to increase tourist and promotional components as well as develop water bodies managed for different species of fish. In 1999, the Fish Orlando! program unveiled the FAB FIVE, i.e. water bodies managed for quality sized fish and/or a unique fishing experience. Seven years later highlights include a 137 hectare lake with a catch-n-release largemouth bass (*Micropterus salmoides*) fishery where constituents can rent a new Bass Tracker Boat for \$15 a morning, a 2.8 hectare borrow pit with a 76.2 cm channel catfish (*Ictalurus punctatus*) minimum size limit and a hybrid striped bass (*Morone chrysops x Morone saxatilis*) fishery on a 126.7 hectare lake right in the heart of downtown Orlando. Promotional highlights include the distribution of approximately 200,000 Fish Orlando! Fishing Maps as well as an annual family fishing event that drew approximately 4,000 participants in 2004.

Keywords: Urban Fisheries Orlando

Abstract Number: 100694

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Oral Presentation

Urban Fisheries

Development and implementation of an urban fisheries program in Kentucky

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Kentucky, like many other states in the U.S., is shifting from a rural to an urban population. As a result of this demographic change, KDFWR has initiated an urban fishing program beginning in 2005 aimed at providing urban residents with high quality fishing areas close to home. We chose five lakes throughout the state (two in the Louisville area, two in north Kentucky, and one on Fish and Wildlife property in Frankfort) to begin the pilot program. A stocking regime consisting of rainbow trout *Oncorhynchus mykiss* (stocked in November 2005 and April 2006), channel catfish *Ictalurus punctatus*, largemouth bass *Micropterus salmoides*, and hybrid sunfish *Lepomis macrochirus x L. cyanellus* (all three species stocked in May, June, and July 2006) was developed to provide anglers with year-round fishing opportunities. We plan to analyze harvest rates of these fish through monthly DC-pulse surface electrofishing runs, as well as creel surveys beginning in April 2005. Angler attitudes towards the urban fishing program will be examined using attitude surveys starting November 2005. Results from these surveys will be used to analyze success of the

program in its first year, alter the stocking regime and current regulations, and to determine feasibility of program expansion.

Keywords: Key Words: urban fishing program, stocking, fishing

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Oral Presentation

Urban Fisheries

Minnesota's Urban Fishing Program - Opportunity Plus Education

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The Minneapolis/St. Paul metropolitan region of Minnesota, collectively known as the Twin Cities, provides an ideal setting for an active urban fishing program. With over 2.5 million residents and over 1,800 water bodies within the seven-county Twin Cities region, the opportunities and challenges are vast. The Minnesota Department of Natural Resources has had some pieces of an urban fishing program for the past 30 years. But with fishing license sales flat and the Twin Cities population increasing and diversifying, the program was upgraded, restructured, and renamed in 2001. The Fishing In the Neighborhood (FiN) Program is designed to increase angling opportunities close to home and increase environmental awareness for Twin Cities' residents. We will highlight a recent case study to show how the FiN Program functions in cooperative projects and builds on itself. Program elements, such as stocking, aquatic education, and angler access improvements are typical of most urban fishing programs. We will emphasize aspects of the program that are less obvious, but have been important in making it successful. These activities include user surveys, investment in small-scale habitat improvement, managing for quality and quantity, remote activity censuses, partnerships, internal reporting, promotion, and innovative approaches to angler recruitment. Links between the FiN Program and MN DNR's aquatic education program (MinnAqua), as well as the importance of these programs to larger departmental initiatives, will be discussed. Utilizing research-supported best practices in education, training, outreach, and structure, MinnAqua and FiN work together to help connect an increasingly urbanized society with the outdoors.

Keywords: urban, small lake, fish management, Twin Cities, Minnesota, aquatic education, outreach, recruitment

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Oral Presentation

Urban Fisheries

Georgia's Community Based Fishing Program

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In 2001, 72 percent of U.S. residents who fished lived in a metropolitan statistical area with most anglers coming from large urban areas. Unfortunately most residents of large urban areas don't have the fishing opportunities or immediate access to public fishing areas managed by state wildlife resource agencies. This is especially true in Georgia where most Public Fishing Areas (PFA) and reservoirs are outside these urban areas. The Georgia Department of Natural Resources developed a pilot community fishing program in 2003 in cooperation with the City of Savannah Parks and Recreation Department, the Chatham County Parks, Recreation and Cultural Affairs Department, the City of Richmond Hill, and BASS PRO Outdoor World where eight lakes totaling 127 acres were intensively managed and stocked with catchable size catfish. These lakes can provide fishing opportunities to over 256,616 residents in Southeast Georgia. Preliminary creel surveys in urban lakes documented increased pressure and significantly more angler trips and effort per acre than many of the state's Public Fishing Areas. The program also provided an opportunity to host numerous kids fishing events and fishing clinics for youth summer urban camps attended by over 825 kids throughout the summer months.

Keywords: Urban Fishing Kids Fishing Events Community Fishing

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Oral Presentation

Urban Fisheries

Expand Opportunity Close-to-Home

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The Oklahoma Department of Wildlife Conservation and the Oklahoma City Parks and Recreation Department entered into a Memorandum of Understanding in January 2004 to cooperate in the Close-to-Home Fishing Program (CTHFP). The original objectives of this urban fishing program were to expand fishing opportunities, create additional fishing and boating access, enhance aquatic education programs, and increase outreach efforts in waters owned by Oklahoma City. By January 2006 the

program has grown to include seven more municipalities and a total of 29 water bodies. Although each body of water has a customized Fishery Management Plan, all waters in the CTHFP are covered by uniform regulations. Research conducted by the Oklahoma Cooperative Fish & Wildlife Research Unit at Oklahoma State University is planned to determine angler preferences and efficacy of channel catfish and hybrid sunfish stockings in CTHFP waters.

Keywords: Oklahoma urban fishing close-to-home management

Abstract Number: 100792

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Oral Presentation

Urban Fisheries

Texas Urban Fishing Programs

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Texas Parks and Wildlife has provided fishing opportunities to its urban constituents for many years but recent patterns of population growth have added impetus to provide high quality fishing opportunities "close to home" for the state's 17 million urban residents. Texas' urban fishing program is a multi-faceted "work-in-progress", not a finished product. Some components have been around for many years; others are new. A statewide network of community fishing lakes, developed over the past decade, brings fishing opportunities to small cities and towns, as well as metropolitan centers. These lakes are stocked a few times each year with small, but harvestable channel catfish *Ictalurus punctatus* (rainbow trout *Oncorhynchus mykiss* in winter), similar to other southern states. A newer component is the "Texas Urban Fishing (TUF) Program". This pilot program provides high quality, year-round fishing opportunities in major metropolitan areas and targets non-traditional users from local neighborhoods. The TUF program is designed to be self-supporting, easily expandable, and reliant upon effective city partnerships. Frequent stockings throughout the year will combine with angler education, tackle loaner programs and a coordinated marketing strategy to attract users. Originally based on evaluations and institutional wisdom from this and other state agencies, the program has evolved to be similar to the successful Arizona urban fishing program – and that program is the model for much of our current and future efforts. Critical to the success of Texas programs will be continued commitment from all levels of the agency, successful partnerships with communities, and continued research and evaluation.

Keywords: urban fishing Texas

Abstract Number: 100835

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Poster Presentation

Catfish Management

THE EFFECT OF DIFFERENT COMBINATION RATIOS ON YIELDS OF TILAPIA *Oreochromis niloticus* AND AFRICAN CATFISH *Clarias gariepinus* IN FERTILIZED EARTHEN PONDS.

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Oreochromis niloticus is native to Africa; it however has been introduced to over 87 Countries worldwide for aquaculture purposes. Its global production has increased from less than 0.05 million mt in 1970 to 1.5 million mt in 2002, growing at 13.5 Annual percent Rate (APR). However, tilapia has a problem of over breeding leading to small sized (stunted) tilapia recruits which are of low value to consumers. When stocked with a predator high yields are usually obtained. A 90 days experiment of Nile tilapia and African catfish stocking combinations 2:1, 6:1 and 19:1 based on weight and a control of Nile tilapia alone was conducted in small earthen ponds (100m²) at Chepkoilel Fish Farm, Moi University, Eldoret –Kenya. Results indicated that the tilapia: African catfish combination that gave the highest yield was 2:1. Differences in mean final weight of *Oreochromis niloticus* between ratios 2:1 and 6:1 were significant ($P > 0.05$). There was also a significant difference between ratios 2: 1, 6:1 and ratios 19:1 and the control. However there was no significant difference between combination ratios 19:1 and the control (monoculture) at $P < 0.05$). Mean final weight and total yield of market size *Oreochromis niloticus* in the mixed culture treatments were superior ($P < 0.05$) to that attained in the tilapia monoculture (control) treatment. Estimated annual production of market size *O. niloticus* at 2:1 and 6:1 were high and significantly different ($P > 0.05$), ranging from 3.9-4.04 ton /ha/yr.

Keywords: Polyculture, Tilapia, Catfish, Moi University and Lake Victoria Basin

Abstract Number: 100708

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Poster Presentation

Contributed Presentation

Biotic diversity of mid-shelf bank communities in the northwestern Gulf of Mexico

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Hard banks in the northwestern Gulf of Mexico support diverse fish and coral communities, and, several of these banks have recently been designated as habitat areas of particular concern (HAPCs) by the Gulf of Mexico Fishery Management Council. Here, we present preliminary results from an ongoing study aimed at characterizing and monitoring benthic habitat and reef fish assemblages at one of these areas, Sonnier Bank. We conducted photographic surveys of the benthos on two primary peaks using SCUBA and determined the percent coverage of coral, sponge, and macroalgae with image analysis. We also surveyed ichthyofauna with SCUBA and ROV (remotely operated vehicle). Our assessment of benthic communities was similar to a previous characterization of the area as a *Millepora*-sponge community by Rezak et al. (1985). The dominant coral species in our assessment was *Millepora alcicornis* with up to 70 percent coverage (per m²), while the dominant sponges were *Neofibularia nolitangere*, *Ircinia strobilina*, and *Agelas clathrodes* with up to 50, 15, and 12 percent coverage (per m³), respectively. Preliminary tallies from both SCUBA and ROV surveys have revealed a total of 45 fish species at Sonnier Bank compared to at least 88 fish species reported previously. At depths where visual surveys were conducted (<31m), there were higher abundances of groupers, grunts and snappers in the intermediate range (24-28m). Additional video analysis should reveal more species and allow us to evaluate the efficacy of our ROV approach by quantifying associations between species richness and elapsed time.

Keywords: Sonnier bank HAPC ROV visual survey coral reef fishes

Abstract Number: 100750

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Poster Presentation

Contributed Presentation

Evaluation of the Use of Personal Digital Assistants (PDAs) For Collecting Angler Survey Data

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Angler surveys are a common method for sampling recreational fisheries. Typically, survey data are recorded on paper forms and entered into electronic databases for future analyses. Entering survey data is tedious, expensive, and a source of data error. As an alternative to paper forms, we used Palm® Personal Digital Assistants (PDAs) to collect angler survey data. Approximately 950 interviews and 700 instantaneous angler counts were recorded during 2005, and all data were downloaded directly into a PC by connecting the PDA and PC with a USB cable and simply touching the Hot Sync icon. This technique was rapid and accurate, saving time, money, and eliminated another source of data entry error. Surveys were designed and administered through Quickformz software developed by RJB

Computers, Inc. Cost for each PDA was about \$100 and Quickformz licensing cost was about \$35. The PDAs proved durable with only one malfunction occurring in approximately 250 trips into the field. Using frequent downloads, we did not have significant data loss when the malfunction occurred. Quickformz Designer allowed for diverse question designs and multiple answer formats, including text, numeric, pull-down lists, signature, checkboxes, yes/no, date/time, and more. We used the PDAs and Quickformz software to record angler demographics, angler satisfaction rates, catch, harvest, effort, and date/time data. Overall we found the use of PDAs for conducting angler surveys to be inexpensive, durable, reliable, and an efficient way of collecting angler survey data.

Keywords: Angler Surveys, Data Collection, Palm Pilots, PDAs, creel surveys, survey design

Abstract Number: 100666

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Poster Presentation

Contributed Presentation

Population densities and habitat affinities of the threatened blackside dace (*Phoxinus cumberlandensis*)

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Abstract.- The blackside dace, *Phoxinus cumberlandensis* Starnes and Starnes, 1978, is a rare cyprinid restricted to small tributaries in the Upper Cumberland River system in southeastern Kentucky and northeastern Tennessee. The objectives of this study were (1) determine presence/absence and population densities of *P. cumberlandensis* within its historical range and (2) to validate the effectiveness of logistic regression habitat models to predict *P. cumberlandensis* presence/absence within the Upper Cumberland drainage. To date, forty-four 200 m reaches within 26 streams throughout the historical distribution of the blackside dace were sampled via single-pass backpack electrofishing. Blackside dace were found to inhabit 16 of 26 streams and 23 of 44 reaches; although, most reaches (73%) had catch rates of ≤ 10 dace per 200 m. For reaches where blackside dace were present, single pass electrofishing catch rates ranged from one to 96 (mean \pm SD = 23 ± 27). Petersen mark-recapture population estimates were conducted on six of the reaches within six streams and estimates ranged from 54 to 613 dace per 200 m reach. Population estimates were used to build a regression model to calibrate the single-pass electrofishing for the other 17 reaches inhabited by dace. Environmental variables (conductivity, dissolved oxygen, temperature, and turbidity) were measured at all 44 reaches to enable validation of previously developed logistic regression habitat models. Validation of models is currently in progress.

Keywords: *Phoxinus*, habitat modeling, endangered species conservation, population estimation, mark-reca

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Poster Presentation

Contributed Presentation

Evaluation of two types of gravel for use as sunfish attractors

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Methodology and effectiveness of using gravel for attracting sunfish was tested from Spring 2004 through Spring 2005. In November 2004, gravel was placed along the Eustis Lake Walk pier (ELW) in twenty frames (3.05 x 3.65 m) constructed of 5 x 15 cm pressure treated wood. Lime rock (#57 size) and quartz gravel (#7 size) were each placed in 10 randomly assigned frames. Electrofishing samples indicated that the gravel attractors were effective in concentrating sportfish. Catch rates of sunfish increased significantly from the 2004 pre-attractor (23.9 fish/hr) to the 2005 post-attractor sites (501.1 fish/hr). Angler catch for sunfish on the ELW was estimated to have increased from 220 + 125 fish in the 2004 survey to 2883 + 1305 fish in the 2005 survey. Sunfish angler success rate increased from 0.54 fish/hr in 2004 to 2.56 fish/hr in 2005 (a 374% increase). There was no significant difference in the number of sunfish caught from the two types of gravel, so the less expensive #57 lime rock is recommended to be used around public docks, boat ramps, and seawalls to improve sunfish catch for anglers.

Keywords: fish attractors sunfish gravel

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Poster Presentation

Contributed Presentation

Validation of daily growth increment formation in the otoliths of juvenile Brazos River fishes

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Proper use of otoliths for age and growth determination requires that the periodicity of increment formation within the otolith be known. The most reliable method of age validation involves the use of known age fish. When known-age fish cannot be used,

fish of unknown age can be either immersed in or injected with various chemicals which bind with calcium as the otolith grows; thereby creating a reference mark on the otolith that is detectable at a later date. Age is then validated by comparing the number of growth increments between the reference mark and the outside edge of the otolith with the amount of time that has elapsed since the chemical treatment. To assess the utility of age and growth data obtained from daily growth increments for Brazos River fishes, we conducted a chemical marking trial. Juvenile smalleye shiner, sharpnose shiner, plains minnow, and Red River pupfish were immersed in a 100mg/l solution of alizarin complexone for 24 hours. After immersion, fish were sampled at 5 day intervals for 30 days. Regression models indicated high correspondence between number of days post-treatment and number of growth increments between alizarin mark and the edge of the otolith for smalleye shiner ($r^2 = 0.98$), sharpnose shiner ($r^2 = 0.99$), and plains minnow ($r^2 = 0.97$), providing strong evidence that daily growth increments are indeed formed daily in these species. Unfortunately, ages for Red River pupfish could not be validated because clear alizarin marks were only detectable in 5 out of 56 otoliths.

Keywords: Validation Alizarin Otoliths

Abstract Number: 100697

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Poster Presentation

Contributed Presentation

Atlantic Croaker Maturation and Spawning in Texas Marine Waters

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Gonadal maturation of 725 Atlantic croaker (*Micropogonias undulatus*) was investigated from September 2002 to November 2003 during Fall and Spring seasons along the Texas coast. The specimens were composed of 20.14% males and 79.86% females, males ranged from 135 mm to 455 mm total length (TL) and females ranged from 130 mm to 437 mm TL. The majority (90 %) of Atlantic croaker females 2 years and older and 50% of age 1 females were reproductively mature in the Fall, as indicated by elevated gonadosomatic indices (GSI). Comparisons made between bays showed some significant differences in total length and GSI averages of mature females.

Keywords: Atlantic Croaker reproduction maturation GSI

Abstract Number: 100726

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Poster Presentation

Contributed Presentation

Characterization of exposure of a tilapid (*Oreochromis Mossambicus*) residing in a water reclamation facility.

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Recent evidence indicates that pharmaceutical and personal care products (PPCPs) are pervasive in wastewater treatment processes. PPCPs have been identified as problematic in laboratory exposures at very low concentrations, as low as 0.1 ng/L. Toxicity studies incorporating whole-life histories of exposed organisms would greatly help determine any potential effects these chemicals may have on native fish. However, translation of laboratory studies to native populations has been largely unsuccessful. In this regard, the City of Denton's Pecan Creek Water Reclamation Plant introduced a population of Mozambique tilapia, *Oreochromis mossambicus* (Peters, 1852) in October 2003 to combat a burgeoning population of Lemna. Tilapia primarily reside in the clarifier and sand filter beds of the facility, in water consisting of 100% treated effluent. Introduced tilapia have not only efficiently controlled Lemna growth, but are reproducing at prolific rates. My research is a comprehensive examination of possible consequences for tilapia exposed to this chemical "soup" and will incorporate an investigation of biomarkers, including cortisol and vitellogenin, production, growth, and reproductive effect. An initial demographic study involving visual sexing of fish revealed an aggregate female:male ratio (N=2709) of 57.9:42.1, significantly different from expected (Log-likelihood - G test, alpha = 0.05), but not unlike ratios observed in tilapia reared in cooler (20°C) temperatures. As a warm water species, sexual differentiation in tilapia is influenced by temperature, with warmer water producing a preponderance of males, cooler water more females. Further research will prove beneficial in determining impact of wastewater effluent exposure to fish populations.

Keywords: Tilapia Wastewater Endocrine disruption

Abstract Number: 100747

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Poster Presentation

Contributed Presentation

The Early Life History of Marine Fishes: A Graduate Course in Larval Fish Identification and Ecology

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We announce a lecture and laboratory course offering a comprehensive view of the biology and taxonomy of early life stages of fishes. These stages, including pelagic eggs, larvae and newly-transformed juveniles, are abundant and diverse components of aquatic ecosystems. Their small size, dynamic growth and mortality rates, and dependence on ambient environmental factors, including ocean physics, make these stages vulnerable to variability in climate and to stresses of anthropogenic origin. Level of reproductive success in teleosts, termed recruitment, is highly variable and largely dependent on variability in survival of these early life stages. Knowledge of their morphological development contributes to studies of phylogenetic relationships. Ontogenetic data serve to clarify the complex systematics of teleost fishes, the most diverse and largest class of vertebrates. Early life stages often have specialized adaptations to insure survival in stressful habitats. In the laboratory, larvae of 160 families of teleostean fishes are examined and characters useful in identification are presented. This is a graduate-level course for students with an interest in fish ecology, fisheries science, ichthyology and biological oceanography. It is presumed that students will have some experience and background in those disciplines. Prerequisites include an undergraduate degree in a biological discipline; permission of the instructors is required to be admitted to the course. No more than 18 students will be accepted. The lectures and laboratories will be held at the Marine Science Center of the University of New England, Biddeford, Maine.

Keywords: larval fish identification recruitments systematics graduate course

Abstract Number: 100768

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Poster Presentation

Contributed Presentation

Movements of blue marlin in the Gulf of Mexico recorded with PAT tags

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Atlantic blue marlin (*Makaira nigricans*) populations are being exploited unsustainably and fishing mortality (primarily by pelagic long-liners) is approximately 4x the level required for MSY. Pelagic long-line fishing effort by the U.S. fleet is highest in the Gulf of Mexico; on average 3.5 million hooks were set per year between 1996 and 2003. Since 1999, by-catch of blue marlin in the Gulf of Mexico has been higher (n=2759) than in all other parts of the north Atlantic combined (n=1912). We deployed 21 pop-up archival transmitting (PAT) tags on blue marlin to

understand how vertical and horizontal movements in the Gulf of Mexico influence susceptibility to pelagic long-line fishing. We observed that blue marlin tend to remain within the northern Gulf of Mexico for several months where long-line fishing effort has become concentrated in recent years. They primarily utilized the upper mixed layer (from the surface to the thermocline) of the water column, and the observed vertical movements suggested differential vulnerability to long-line fishing depending on the depth of the thermocline. In the western Gulf where shallow thermocline depths predominate, blue marlin spent most of their time at depths <60m, indicating that they would be especially susceptible to shallow long-line sets (i.e., long lines with a small number of gangions between floats). Conversely, blue marlin associated with the loop current in the eastern Gulf (where the thermocline is considerably deeper) spent more time in deeper habitats up to 200m, indicating vulnerability to both shallow and deep long-line hooks.

Keywords: blue marlin, pelagic long-line, PAT tags, pelagic fish movements

Abstract Number: 100789

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Poster Presentation

Contributed Presentation

Feeding Habits of juvenile Black Drum (*Pogonias cromis*) from South Texas creeks

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Black drum (*Pogonias cromis*) are one of the most commercially and recreationally important finfish in Texas. They have an estuarine dependent life cycle. Adults are found coastally and migrate into estuaries to spawn. Eggs, early larvae, and juveniles are found in bays. Larval and juvenile black drum from the Laguna Madre, a hypersaline lagoon, are commonly found in creeks. The objective of this study is to examine the food habits of juvenile Black Drum from these creeks. Black drum were caught from two creeks, San Fernando Creek and Escondido Creek. Juvenile black drum were obtained using a cast net, and then placed in 10 % formalin that fixes the fish and stopped further digestion. Standard length (SL) was taken for each fish. During dissection, the stomach and intestine was examined and contents were identified to lowest possible taxon. Ten fish have been examined. The size of the fish examined ranged from 4.1 to 11.5 SL. Food items found were larval insects, gastropods, ostracods, amphipods, and isopods.

Keywords: black drum, *pogonias cromis*, feeding, juvenile

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Poster Presentation

Contributed Presentation

Adult Paddlefish Survival in Ozark Lake, Arkansas River, Arkansas

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and Quinn, J.W. Arkansas Game and Fish Commission (AGFC), Mayflower, AR.

The levels of fishing and natural mortality on paddlefish populations in the Arkansas River, Arkansas are unknown. Data regarding these important facets of paddlefish population dynamics are needed to enable managers to design, implement, and support regulations that promote sustainability. The purpose of this study was to estimate survivorship of harvestable-size (&ge 914 mm) paddlefish in the Arkansas River, Arkansas. We implanted 50 adult paddlefish in Ozark Lake with ultrasonic transmitters and conducted monthly searches for telemetered fish from January 2004 to December 2005. Average minimum and maximum relocation probabilities ranged from 0.680 to 0.841. Commercial and recreational fishing harvest on telemetered fish was high (25% and 10%, respectively). We modeled natural mortality using a Kaplan-Meier staggered design procedure where survival was estimated to be 0.865 ± 0.147 ($S \pm 95\%$ CI). In addition, recent regulations have assumed paddlefish in the Arkansas River to be closed populations, however telemetered fish infrequently moved between pools. Regulations that recognize the efficiency of commercial and recreational angler harvest relative to paddlefish longevity are recommended.

Keywords: Paddlefish mortality

Abstract Number: 100818

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Poster Presentation

Contributed Presentation

Ichthyofaunal differences between oyster reef and littoral estuarine habitats with emphasis on spotted seatrout (*Cynoscion nebulosus*) sexual digeography

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The Texas Parks and Wildlife Department is investigating recent anecdotal information suggesting that male spotted seatrout prefer open-water oyster-reef

habitats and that females prefer littoral habitats. Twenty oyster reef gill-net sets were added to TPWD's standard 40 shoreline sets in East Matagorda Bay during the 2005 sampling season. Preliminary analyses suggest differences in sex ratios and population structure of spotted seatrout between the habitats. Additionally, fish assemblages vary between the habitats.

Keywords: spotted seatrout *Cynoscion nebulosus* GSI habitat use fish assemblage oyster reef estuaries li

Abstract Number: 100820

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Poster Presentation

Contributed Presentation

Components of Fishing Mortality for Largemouth Bass at Sam Rayburn Reservoir with Implications for Alternative Length Limits

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The largemouth bass *Micropterus salmoides* fishery at Sam Rayburn Reservoir is managed with a 356-mm minimum length limit (MLL). In 2001, 47% of anglers favored more restrictive largemouth bass length limits, assuming a resulting increase of fish > 457 mm. In 2003, 6,021 largemouth bass > 315 mm were tagged to estimate annual fishing mortality and explore potential benefits of more restrictive length limits via population modeling. Due to popularity of tournament angling (52% of anglers participate and annual events exceed 300) and high voluntary release rate (42%) at Sam Rayburn Reservoir, our fishing mortality estimate included non-tournament harvest, tournament mortality, and catch-and-release mortality. Catch and harvest of tagged fish by tournament and non-tournament anglers was estimated via creel sampling to avoid non-reporting uncertainty, adjusted for recruitment and tag loss, and expanded to estimate total annual tagged fish catch and harvest. Tournament and catch-and-release mortality was simulated at rates of 10, 30, and 50% and 5, 10, and 15%, respectively. Population loss from non-tournament harvest was 6 - 14% and tournament and catch-and-release mortality simulations both resulted in losses of 1 - 6%. Our estimated range of total fishing mortality was 7 - 24%. Compared to the current 356-mm MLL, population modeling indicates 406-mm and 457-mm MLLs provide minimal increases of fish reaching 457 mm (1 - 4% and 3 - 11%, respectively). A more restrictive MLL would reduce tournament catch available for weigh-in and provide little benefit compared to the current regulation.

Keywords: largemouth bass, fishing mortality, length limit, population modeling, tournament, Sam Rayburn, Texa

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Poster Presentation

Contributed Presentation

INSTANTANEOUS GROWTH AND MORTALITY ESTIMATES OF AGE-0 CARPSUCKERS (*CARPIODES* SPP.) IN THE OCONEE RIVER, GEORGIA

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Some suckers (Catostomidae) are good indicators of habitat degradation because they are intolerant of poor water quality conditions (e.g., high turbidity). Two undescribed species of carpsuckers *Carpoides* spp. occur in a regulated reach of the Oconee River in middle Georgia. High flows resulting from natural (rainfall) and artificial events (hydropower generation) in this reach result in orders-of-magnitude increases in turbidity. Therefore, these two undescribed species, which are most closely related to the highfin carpsucker *C. velifer* and the quillback carpsucker *C. cyprinus*, were selected as indicators for turbidity-related habitat degradation in this reach. Instantaneous growth and mortality of age-0 carpsuckers from the Oconee River in middle Georgia 1995-2001 were estimated with exponential equations. Estimates of instantaneous growth (G) ranged from 0.10 to 0.90; instantaneous mortality (Z) could be estimated only for 1995 and that rate was 0.45. Single linear regression analysis indicated a significant relationship ($r^2 = 0.95$ $p = <0.01$) between instantaneous growth rates and summer river discharge (in cubic feet per second). Similarly, the abundance of age-0 carpsuckers also was significantly related to number of days river discharge was above 3,000 cfs ($r^2 = 0.61$ $p = 0.04$). These results suggest that: 1) moderate flows during spawning and rearing are important for producing strong-year classes of carpsuckers, and 2) river discharge is variable among years, with suitable flows for strong year-class occurring every few years. As a result, river management strategies should attempt to regulate river discharge to simulate historic flows typical for the region.

Keywords: Instantaneous growth, Instantaneous mortality, Abundance, River discharge, Age-0 fishes, Young-of-th

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Poster Presentation

Contributed Presentation

Salinity tolerance of goldfish: a widely-distributed non-native cyprinid in the U.S.A.

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The goldfish (*Carassius auratus* L.) is a Eurasian cyprinid that has been widely introduced in the U.S.A. In this study, we evaluated the species' tolerance to low levels of salinity. Results from this laboratory experiment indicate that the goldfish is able to persist in low-salinity environments (<10 ppt) for long periods of time and at higher salinities for short time periods. When acutely shifted from freshwater to low-salinity conditions (5-15 ppt) the species is capable of survival for at least 72 h. However, acute transfer to salinities of 20-25 ppt lead to 100% mortality by 8 h. Under chronic low-salinity conditions, the goldfish showed high levels of survival at salinities of 5 and 10 ppt, but significant mortality at salinities of 15 and 20 ppt. A newly developed variety of goldfish (Black Saltys) was roughly equivalent to standard goldfish in its salinity tolerance.

Keywords: Cyprinidae non-indigenous salinity stenohaline freshwater

Abstract Number: 100873

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Poster Presentation

Contributed Presentation

Fishery Impact Monitoring of Open-Rack Vaporization LNG Facilities

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Assessment of fishery impacts monitoring of open-rack vaporization LNG facilities is a critical issue for fishery management in the Gulf of Mexico. Rising energy costs lead to the use of more economical energy sources such as Natural Gas. However, a balance must be found between such energy sources and environmental impacts. This presentation describes fishery monitoring plan development and implementation process in the Gulf. Site characteristics such as water depth and distance offshore play a large role in the structure of monitoring plans. LNG operators, State and Federal agencies work together to develop an agreed upon monitoring plan for each specific facility. A typical plan would involve pre-construction baselines studies and monthly post-construction monitoring for three to five years. Collections include plankton tows at discrete depth strata using opening and closing net arrays, two mesh sizes in the net array to identify extrusion of planktonic organisms, and bottom trawls using a 40 ft net (comparable to SEAMAP data). Other field collections typically include benthic community characterization, sediment texture and

chemistry analysis, water quality measurements, and hydrographic and current regime profiler deployments. Larval fish data are used in age-1 equivalency models to forecast potential impacts to target species. In conjunction with fish larvae, commercially important decapod larvae are also identified. Quarterly data reports are reviewed by the State and Federal agencies to assess potential fishery impacts and to assist in adjusting the monitoring program. Major emphasis is placed on quality control during sample collection, taxonomic identification, and data analysis, to ensure that the data from the various programs (including SEAMAP) will be comparable and to produce the highest-quality scientific data.

Keywords: fishery monitoring, larval fish, water quality

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Poster Presentation

Instream flows

Field Guide to Freshwater Fishes of Texas

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This guide provides high resolution photographs, distinguishing characteristics, a synopsis of habitat and life history information, and range descriptions for freshwater fishes of Texas. The purpose is to aid in the identification of Texas fishes by students of ichthyology, fish enthusiasts, and anglers. In addition, this guide will also benefit biologists and resource managers in fish identification as a supplemental text to Hubbs et al. (1991) dichotomous key and other fish texts. Photographs were taken with a Nikon Coolpix 950 digital camera. Most, photographs were taken within 24-48 hours of collection each fish in an effort to capture natural color patterns. Color patterns differ between breeding and nonbreeding individuals and between males and females in some fishes; consequently, additional photographs were taken to display this variability in color patterns. For rare and endangered species, photographs were taken of preserved specimens held in the Texas State University Ichthyology Teaching Collection.

Keywords: Texas Fish, Field Guide

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Poster Presentation

Trophy Fish Management

TOWARDS MEETING THE INCREASING DEMAND FOR FISH IN THE LAKE VICTORIA BASIN THROUGH AQUACULTURE DEVELOPMENT.

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Food security concerns were raised as early 1789, when Thomas Malthus studied population growth in Europe against food production growth rate and said he feared for global starvation. The global population currently increases at 85 million people per year having increased from 1.6 billion in 1750 to 6.1 billion in 2000. This population needs food and that food production rate need to be higher than human population growth rate. It is estimated that by 2050 when the world population is projected to be over 9 billion, African will have to increase food production by 300% to provide minimally adequate diets for the projected population of 2 billion. It is well documented that most wild fish stocks have been over exploited or have reached their maximum sustainable yield due to over fishing, habitat degradation and pollution. The situation in East Africa especially Lake Victoria Basin is that, capture fisheries are in decline and that the demand outstrips the supply by over 500,000tonnes currently. While there is limited room to increase fish production from capture fisheries, the much needed increase will have to come from aquaculture. This paper therefore undertakes to review and examine the status, potential and opportunities available for growing *Labeo victorinus*, *Lates niloticus* together with Nile tilapia and African catfish. Results obtained indicate that Nile perch is potential for aquaculture and that aquatic fern (*Azolla pinnata*) can be used for fish feed formulation.

Keywords: Lake Victoria, Aquaculture, *Labeo victorinus*, Nile perch and Nile tilapia.

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