ANNUAL PROCEEDINGS
of the
TEXAS CHAPTER

AMERICAN FISHERIES SOCIETY

College Station, Texas

8 – 10 February 2004

Volume 26

TEXAS CHAPTER

AMERICAN FISHERIES SOCIETY

The Texas Chapter of the American Fisheries Society was organized in 1975. Its objectives are those of the parent Society – conservation, development and wise use of recreational and commercial fisheries, promotion of all branches of fisheries science and practice, and exchange and dissemination of knowledge about fishes, fisheries, and related subjects. A principal goal is to encourage the exchange of information among members of the Society residing within Texas. The Chapter holds at least one meeting annually at a time and place designated by the Executive Committee.

MEMBERSHIP

Persons interested in the Texas Chapter and its objectives are eligible for membership and should apply to:

Texas Chapter, American Fisheries Society
Secretary-Treasurer
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Annual membership dues are $12 for Active Members and $5 for Student Members.

ANNUAL PROCEEDINGS OF THE TEXAS CHAPTER AMERICAN FISHERIES SOCIETY

Annual Meeting
8-10 February 2004
College Station, Texas

2004-2005 Officers

Francis P. Gelwick, President
Texas A&M University

Dave Terre, President-Elect
Texas Parks and Wildlife Department

Paula Hawkins, Secretary-Treasurer
Texas Parks and Wildlife Department

Editorial Committee: Tim Bonner, Chairman
Preston Bean, Jackie Watson, Casey Williams

2005

Published by:
Texas Chapter, American Fisheries Society
c/o Texas State University
Department of Biology/Aquatic Station
San Marcos, Texas 78666

TABLE OF CONTENTS

Abstracts of Posters Presented at the Annual Meeting but not Published in the Proceedings

Technical Papers Presented at the Annual Meeting and Peer-Reviewed for Publications

PAST TEXAS CHAPTER PRESIDENTS AND MEETING LOCATIONS

Date	President	Location
1976		College Station
1976	Ed Bonn	Lake Brownwood
1977	Jim Davis	San Antonio
1978	Bill Rutledge	San Marcos
1979	Bobby Whiteside	College Station
1980	Richard Noble	Arlington
1981	Charles Inman	Austin
1982	Gary Valentine	Kerrville
1983	Don Steinbach	Lake Texohoma, OK
1984	Gary Matlock	Port Aransas
1985	Maury Ferguson	Junction
1986	Brian Murphy	San Marcos
1987	Joe Tomasso	Kerrville
1988	Dick Luebke	Abilene
1989	Mac McCune	San Antonio
1990	Bobby Farquhar	Lake Texohoma, OK
1991	Gene McCarty	Galveston
1992	Bill Provine	Kerrville
1993	Barbara Gregg	Port Aransas
1994	Loraine Fries	Lake Travis
1995	Pat Huston	College Station
1996	Mark Webb	Pottsboro
1998	Katherine Ramos	Athens
1999	John Prentice	Corpus Christi
2000	Paul Hammerschmidt	Bossier City, LA
2001	Charles Munger	San Marcos
2002	Gordon Linam	Junction
2003	Gene Wilde	Galveston
2004	Gary Garrett	College Station
2005	Fran Gelwick	Grapevine

TEXAS CHAPTER AWARDS RECIPIENTS

1977	Fish Culture - Don Steinbach (TAMU) Fisheries Management - Edward Bonn (TPWD) Fisheries Administration - David Pritchard (TPWD) Fisheries Research - John Prentice and Richard Clark (TPWD)
1978	Fish Culture - Pat Hutson (TPWD) Fisheries Education - Clark Hubbs (UT) Fisheries Research - Clark Hubbs (UT) Special Recognition - Edward Lyles (USFWS)
1979	Fish Culture - Robert Stickney (TAMU) Fisheries Education - Richard Noble (TAMU) Fisheries Management - Gary Valentine (SCS) Fisheries Research - Phil Durocher (TPWD) Special Recognition - Charles Inman (TPWD)
1980	None
1981	Fish Culture - Billy White (TPWD) Fisheries Education - Bobby Whiteside (TXSTATE) Fisheries Management - Steve Smith (TUGC) Fisheries Research - Al Green (TPWD) Special Recognition - Jim Davis (TAMU)
1982	Fish Culture - Roger McCabe (TPWD) Fisheries Research - Clell Guest (TPWD) Special Recognition - Bob Hofstetter (TPWD)
1983	Special Recognition - Robert Kemp (TPWD)
1984	None
1985	Fisheries Education - Donald Wohlschlag (UTMSI) Fisheries Research - Connie Arnold (UTMSI)
1986	Fisheries Management - Billy Higginbotham (TAES) Fisheries Research - Robert Colura (TPWD)
1987	Fish Culture - Kerry Graves (USFWS) Special Recognition - The Sportsmen's Club of Texas Best Presentation - Kerry Graves (USFWS)
1988	Honorable Mention (culture) - Loraine Fries (TPWD) Fisheries Research - Gary Garrett (TPWD) Special Recognition - Kirk Strawn (TAMU) Best Presentation - Joe Fries (USFWS) Honorable Mention (presentation) - Catherine Dryden (TAMU)
1989	Fish Culture - Robert Vega (TPWD) Fisheries Management - Joe Kraai (TPWD) Fisheries Administration - Gary Matlock (TPWD) Fisheries Research - Roy Kleinsasser and Gordon Linam (TPWD) Honorable Mention (research) - Bob Edwards (UTPA)

Best Presentation - Robert Smith (TAMU)

1990 Fish Culture - Glen Alexander and David Campbell (TPWD)
Fisheries Management - Dave Terre (TPWD)
Fisheries Administration - Gene McCarty (TPWD)
Best Presentation - Joe Kraai (TPWD)
Scholarships - Tommy Bates (TAMU:1989), Michael Brice (TTU)

1991 Fish Culture - Jake Isaac (TPWD)
Fisheries Management - Mark Webb (TPWD)
Fisheries Administration - Pat Hutson (TPWD)
Fisheries Research - Ronnie Pitman (TPWD)
Special Recognition - The Wetland Habitat Alliance of Texas
Best Presentation - Mark Stacell (TPWD)
Scholarships - Jim Tolan (TAMUCC), Michelle Badough (TXSTATE)

1992 Fish Culture - Camilo Chavez (TPWD)
Fisheries Education - Brian Murphy (TAMU)
Fisheries Management - Ken Sellers (TPWD)
Fisheries Research - Bob Colura (TPWD)
Special Recognition - Bobby Farquhar, Andy Sansom, and Rudy Rosen (TPWD)
Best Presentation - Maurice Muoneke (TPWD)

1993 Fisheries Management - Bruce Hysmith (TPWD)
Special Recognition - Joe Martin and Steve Gutreuter (TPWD)
Best Presentation - Jay Rooker (UTMSI)
Scholarships -Erica Schlickeisen (TXSTATE), Brian Blackwell and Nancy McFarlen (TAMU)

1994 Fish Culture - Ted Engelhardt (TPWD)
Fisheries Management - Steve Magnelia (TPWD)
Fisheries Administration - Dick Luebke (TPWD)
Special Recognition - Bob Howells (TPWD)
Best Presentation - Travis Kelsey (TXSTATE)
Scholarships - Kathyrn Cauble (TXSTATE), Howard Elder and Kim Jefferson (TAMU)

1995 Fish Culture - Robert Adami (TPWD)
Fisheries Education - Bill Neill (TAMU)
Fisheries Management - Spencer Dumont (TPWD)
Fisheries Administration - Roger McCabe (TPWD)
Fisheries Research - Maurice Muoneke (TPWD)
Special Recognition - Tom Heffernan and Robin Reichers (TPWD) S. Ken Johnson (TAMU)
Best Presentation (s) - Robert Weller (TTU), Robert D. Doyle (ACE)
Scholarships - Jay Rooker (UTMSI), Robert Weller (TTU), Gil Rosenthal (UT), John Findiesen and Karen Quinonez (TXSTATE)

1996 Fisheries Education - Billy Higginbothan (TAMU)
Fisheries Management - Gary Garrett (TPWD)
Fisheries Administration - Gene McCarty (TPWD)
Fisheries Research - Ivonne Blandon (TPWD)
Special Recognition - Reeves County Water Improvement Board
Best Presentation (s) - Craig Paukert (OSU), Gene Guilliland (ODWC)
Scholarships - Chad Thomas (TXSTATE), Anna-Claire Fernandez (UTMSI), Kenneth Ostrand (TTU), Dawn Lee Johnson
Technical Support - Jimmy Gonzales (TPWD)
Honorable Mention (technical support) - Eric Young (TPWD)

1997/8 Fish Culture - Tom Dorzak (TPWD)
Fisheries Education - Robert Ditton (TAMU)
Special Recognition - Fred Janssen, Chris Cummings, Dan Lewis, Dan Strickland, and Gary Graham (TPWD), Jim Davis (TAMU)
Best Presentation (s) -Timothy Bonner (TTU) and Gene Wilde (TTU)
Scholarships - Tony Baker and Allison Anderson (TAMU), Patrick Rice (TAMU-Galveston), Laurie Dries (UT)

1999 Fisheries Administration - Lorraine Fries (TPWD)
Special Recognition - Pat Hutson (TPWD, retired)
Best Presentation (s) - Gene R. Wilde and Kenneth G. Ostrand (TTU)
Scholarships - Scott Hollingsworth and William Granberry (TTU), Brian Bohnsack and Michael Morgan (TAMU)

2000 Fisheries Research - Gene R. Wilde (TTU)
Best Presentation - J. Warren Schlechte, coauthors - Richard Luebke, and T.O. Smith (TPWD)
Best Student Presentation - Scott Hollingsworth, coauthors - Kevin L. Pope and Gene R. Wilde (TTU)
Special Recognition - Emily Harber, Joe L.Hernandez, Robert W. Wienecke, and John Moczygemba (TPWD), Joe N. Fries (USFWS)
Scholarships - Mandy Cunningham and Calub Shavlik (TTU), Laurieanne Lancaster(SHSU)

2001 Fisheries Administration - Ken Kurzawski (TPWD)
Fisheries Education - Kevin Pope (TTU)
Fisheries Management - Brian Van Zee (TPWD)
Fisheries Research - Reynaldo Patino (TTU)
Fisheries Student - Timothy Bonner (TTU)
Technical Support - David DeLeon (TPWD)
Special Recognition - Rhandy Helton, Rosie Roegner, and Walter D. Dalquest (TPWD)
Best Presentation – Jason Turner, coauthors – Jay Rooker and Graham Worthy (TAMUG), and Scott Holt (UTMSI)
Scholarships, Undergraduate - Mandy Cunningham, and Cody Winfrey (TTU)
Scholarship, Graduate - Abrey Arrington (TAMU), and Laurianne Dent (SHSU)

2002 Fisheries Administration – Leroy Kleinsasser (TPWD)
Fisheries Management – Gordon Linam (TPWD)
Special Recognition – Raymond Mathews, Jr. (TWDB), Austin Bass Club of the Deaf
Best Presentation – Jay Rooker, coauthors – Bert Geary, Richard Kraus, and David Secor (TAMUG)
Best Student Presentation – J. P. Turner, coauthor – Jay Rooker (TAMUG)
Best Poster Presentation – Michael Lowe, Gregory Stunz, and Thomas Minello (NMFS)
Scholarships, Undergraduate – Felix Martinez, Jr. (TTU), Stuart Willis (TAMU)
Scholarships, Graduate – Mathew Chumchal (TCU), Michael Morgan (TAMU)

2003 Fisheries Culture – Dennis Smith (TPWD)
Fisheries Education – Gene Wilde (TTU)
Fisheries Student – Christine Burgess (TAMU)
Special Recognition – Larry McEachron (TPWD)
Best Presentation – Gregory Stunz (TAMUCC), coauthors Thomas Minello and Phillip Levin (NMFS)
Best Student Presentation – Monte Brown, coauthors Felix Martinez Jr., Kevin Pope, and Gene Wilde (TTU)
Best Poster Presentation – Suraida Nanez-James (TAMUG) and Thomas Minello (NMFS)

2004 Fisheries Culture - Lisa Griggs (TPWD)
Fisheries Education - Timothy Bonner (TXSTATE)
Fisheries Research - Dave Buckmeier (TPWD)
Fisheries Student - Casey Williams (TXSTATE)
Special Recognition - Deborah Wade (TPWD)

Best Presentation - Richard Kraus and David Secor (TAMUG)
Best Student Presentation - Tracy Leavy, coauthor Timothy Bonner (TXSTATE)
Best Poster Presentation - Brian Scott and Gary Aron (TXSTATE)

Abbreviations:

ACE - Army Corps of Engineers
NMFS - National Marine Fisheries Service
ODWC - Oklahoma Department of Wildlife Conservation
OSU - Oklahoma State University
SCS - Soil Conservation Service
SHSU - Sam Houston State University
TAES - Texas Agricultural Extension Service
TAMU - Texas A&M University
TAMUCC – Texas A&M University-Corpus Christi
TPWD - Texas Parks and Wildlife Department
TTU - Texas Tech University
TUGC - Texas Utilities Generating Company
TXSTATE - Texas State University-San Marcos
USFWS - US Fish and Wildlife Service
UT - University of Texas at Austin
UTMSI - University of Texas Marine Science Institute
UTPA - University of Texas/Pan American

TECHNICAL SESSION ABSTRACTS

Association Between Brush Cover and Stream Fish Assemblages in the Pedernales River Basin, Texas: Preliminary Findings

Jenny S. Birnbaum (*Dept. of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843-2258, birnbaum@tamu.edu*)
Kirk O. Winemiller (*Dept. of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843-2258, k-winemiller@tamu.edu*)

One strategy for increasing the water supply in semi-arid rangelands is management of encroaching brush. Removal of deep-rooted woody species, such as mesquite *Prosopis glandulosa* and juniper *Juniperus ashei*, is believed to increase groundwater recharge of streams in areas where annual precipitation exceeds 450 mm. However, scientific examination of this claim is scarce, and studies have yielded conflicting results. Effects of brush management on water yields are likely to be subtle and localized in accordance with geology, topography, and other landscape features. Our study focuses on effects of brush removal on headwater streams in the Pedernales River basin of central Texas. The study examines fish and benthic macroinvertebrate assemblages and species-habitat relationships in watersheds with variable vegetation cover. Preliminary results of the fish component of the study are presented. Canonical Correspondence Analysis (CCA) was used to investigate the influence of environmental variables on fish assemblage structure. Mean species richness, and species diversity were highest in watersheds with highest juniper cover. Overall, no obvious pattern emerged in the CCA axis scores for sites associated with different vegetation characteristics. Implications for brush management practices will be discussed.

Sample Size Requirements for Estimating Mean Length-at-Age, von Bertalanffy Growth Parameters, and Age Structure of Largemouth Bass Populations

David L. Buckmeier (*Heart of the Hills Fisheries Science Center, HC 7 Box 62, Ingram, TX 78025, david.buckmeier@tpwd.state.tx.us*)
J. Warren Schlechte (*Heart of the Hills Fisheries Science Center, HC 7 Box 62, Ingram, TX 78025, warren.schlechte@tpwd.state.tx.us*)

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

Reducing Predation on Stocked Largemouth Bass Fingerlings

David L. Buckmeier (*Heart of the Hills Fisheries Science Center, HC 7 Box 62, Ingram, TX 78025, david.buckmeier@tpwd.state.tx.us*)
J. Warren Schlechte (*Heart of the Hills Fisheries Science Center, HC 7 Box 62, Ingram, TX 78025, warren.schlechte@tpwd.state.tx.us*)
Robert K. Betsill (*Heart of the Hills Fisheries Science Center, HC 7 Box 62, Ingram, TX 78025*)

Habituating stocked fish to predator-rich environments before release can be feasible and a cost-effective way to improve stocking efficiency. We first investigated the effects of habituation in laboratory tanks. Survival of

fingerling largemouth bass *Micropterus salmoides* increased from 26% to 46% (P < 0.004) when fish were habituated in a predator-free enclosure for at least 15 minutes prior to their release, suggesting that fingerling largemouth bass adapted quickly to their new environments. We then conducted similar experiments in larger research ponds to insure applicability before implementing such strategies at reservoir stockings. Our pond experiment used a factorial design in which two periods of habituation (0 or 60 minutes) were crossed with two habitat types (absent or complex). Survival of stocked fingerling largemouth bass ranged from 4% to 22% after 24 h. Fish stocked into complex habitat survived equally well with or without habituation. Fish stocked into habitat had a 49% increase in relative survival when compared to fish stocked into areas without habitat and without habituation (P < 0.001). Fish stocked into areas without habitat that were habituated for 60 minutes survived as well as those stocked into complex habitat (P = 0.23). These results suggest habituation may be an effective option to reduce predation when habitat is scarce.

Tidal Streams Use Attainability Analysis Study

Greg Conley (*11942 F.M. 848, Tyler, TX 75707, greg.conley@tpwd.state.tx.us*)
Cindy Contreras (*3000 S. IH-35, Ste. 320, Austin, TX 78704, cindy.contreras@tpwd.state.tx.us*)
Janet Nelson (*3000 S. IH-35, Ste. 320, Austin, TX 78704, janet.nelson@tpwd.state.tx.us*)
Jim Tolan (*TAMUCC, Natural Resources Center, 6300 Ocean Dr., Ste. 2501, Corpus Christi, TX 78412, jim.tolan@tpwd.state.tx.us*)
Adam Whisenant (*11942 F.M. 848, Tyler, TX 75707, adam.whisenant@tpwd.state.tx.us*)

Tidal streams in Texas are components of estuaries, which provide vital habitat such as nursery grounds for many aquatic organisms including economically important species like shrimp and game fish. Currently there is no methodology in place to evaluate the aquatic life use (ALU) of a tidal stream, a designation that has regulatory importance such as limiting the levels of contaminants permitted in wastewater discharges. Texas Parks and Wildlife Department is leading a four-year study of five tidal streams, sampling fish, bottom-dwelling organisms, habitat, flow, and water quality, to measure the quality of aquatic life inhabiting these ecologically important areas. Tres Palacios Creek Tidal and Garcitas Creek Tidal are study streams on the middle coast, with West Caranchua Creek Tidal as the reference stream for both. Cow Bayou Tidal is the study stream on the upper coast, with Lost River as the reference stream. Field sampling began in spring 2003 and will continue through fall 2004.

The Effects of Propeller Scarring on Seagrass Associated Fauna

Dana D. Burfeind (*Texas A&M University-Corpus Christi, 6300 Ocean Drive ST 301, Corpus Christi, TX 78412, Burfeind@falcon.tamucc.edu*)
Gregory W. Stunz (*Texas A&M University-Corpus Christi, 6300 Ocean Drive ST 301, Corpus Christi, TX 78412*)

Seagrass *Halodule wrightii* is a critical habitat for a variety of marine organisms and it provides numerous benefits to its surrounding waters. Damage to seagrass from boat propellers has become a significant problem. Voluntary no motor zones were established in 2000 in order to protect these habitats. Preliminary research examining boater compliance in these areas indicates there is 100% non-compliance. Fragmentation from propeller scarring removes seagrass, creating an overall decline in the amount of habitat. However, intermediate levels of habitat fragmentation have been shown to increase the abundance of organisms and it is believed that the increased edge gives a greater area for the organisms to forage for food. This project was designed to investigate the effects of varying levels of propeller scarring of fish abundance and growth. We selected sites with three distinct scarring intensities in Aransas Bay, Texas, and classified them into 10 x 25m quadrats representing different levels of scarring: light (5% or less), moderate (5-15%) and severe (15% or more), and selected reference sites in areas without propeller scarring. Sites were sampled using duplicate epibenthic sled tows, and growth was measured using field enclosures

Fish Assemblages and Richness in Three Tributaries of the Neches River Drainage

William Dailey (*Texas A&M at Galveston, 5007 Avenue U, Galveston, TX, gulf_tarpon@tamug.edu*)
André M. Landry, Jr. (*Texas A&M at Galveston, 5007 Avenue U, Galveston, TX, landrya@tamug.edu*)

Freshwater ecosystems in east Texas represent a region of spectacular floral and faunal biodiversity. Qualitative bag seine collections taken over a period of nearly 25 years were used to characterize the ichthyofauna of Flat Branch, Big Sandy and Village Creeks in Tyler, Polk and Hardin Counties, Texas, respectively. Sixty-five species of fish representing 15 families were sampled from the three creeks. Flat Branch Creek is a very narrow (~1 m), spring-fed creek dominated by lotic waters with sandy and leaf-litter substrates along its five km length. Species richness at Flat Branch ranged from 31 species in October 1995 to 15 species in October 1999. Big Sandy Creek flows for approximately 75 km and provides lotic and lentic habitats whose width and depth rarely exceeded 6 and 2 m, respectively. Ichthyofaunal diversity at Big Sandy ranged from 25 species in July 1977 to 15 species in March 1977. Village Creek is a free-flowing, flat stream extending nearly 70 km to its junction with the Neches River. Its channel of moderate width (~ 20 - 40 m) is dominated by well-developed sandbars and snags serving as habitat and slowing waterflows to create micro- and mesohabitat. Heavy precipitation regularly charges impoundments and backwaters of its floodplain contributing to habitat heterogeneity and ichthyofaunal robustness (36 species in October 1995 to 16 species in August 1978). We discuss the dominant ichthyofauna and their habitat associations at each site.

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

Bart W. Durham (*Wildlife and Fisheries Management Institute Texas Tech University, Box 42125,Lubbock, TX 79409-2125*)
Gene R. Wilde (*Wildlife and Fisheries Management Institute Texas Tech University, Box 42125,Lubbock, TX 79409-2125*)

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

Discovery of a New Population of Devils River Minnow *Dionda diaboli*, With Implications for its Conservation

Gary P. Garrett (*HOH Fisheries Science Center, HC 7 Box 62, Ingram, TX 78025, gary.garrett@tpwd.state.tx.us*)
Robert J. Edwards (*Department of Biology; University of Texas-Pan American, 1201 West University Drive, Edinburg, TX 78541, redwards@panam.edu*)
Clark Hubbs (*Section of Integrative Biology, The University of Texas, Austin, TX 78712-1064, hubbs@mail.utexas.edu*)

The Devils River minnow *Dionda diaboli* is a cyprinid with a limited distribution in Texas and Mexico. It is listed as threatened in the United States and endangered in Mexico. Previously reported locations included the Devils River, San Felipe Creek, Sycamore Creek and Las Moras Creek in Texas and the Río Salado and Río San Carlos drainages in Mexico. It has been extirpated from Las Moras Creek, the lower Devils River and possibly Sycamore Creek. Its current status in Mexico is unknown. Recent collections in previously unavailable locations in the headwaters of nearby Pinto Creek revealed a large population of *D. diaboli*. The fish were found in their typical

habitat of fast-flowing, spring-fed waters over gravel substrates, usually associated with aquatic vegetation. This population not only provides additional security for the species, but would likely serve as the source of fish for a re-establishment project in Las Moras Creek. Unfortunately spring flows in Pinto Creek appear to be threatened by excessive pumping from the associated aquifer.

Catch-and-Release Mortality of Spotted Seatrout

Gregory W. Stunz (*Texas A&M University-Corpus Christi, 6300 Ocean Drive ST 311, Corpus Christi, TX 78412, greg.stunz@mail.tamucc.edu*)

The spotted seatrout *Cynoscion nebulosus* represents a very important recreational fishery along the Texas and Gulf Coasts. A critical factor for different management scenarios is the survival post-capture. This study investigates the mortality associated with hook-and-line-captured spotted seatrout by as a function of bait type, hook type, angler skill level, and fish size. During July to September 2003 spotted seatrout ranging from ca. 300-760 mm TL were captured using a variety of angling techniques. Fish were held in field enclosures (1.2m x 2.4 m) for 72 h. We observed a relatively low mortality for all treatments with the majority of fish surviving. The exception was with angler skill level, where novices had a significantly higher mortality rate than skilled anglers. To evaluate long-term mortality, spotted seatrout captured by various angling methods were held in laboratory facilities for 30 d. During this period these fish did not show long-term mortality. Since mortality was typically associated with hooking location rather than angling method, the location of hook-related injuries may be most important in determining catch-and-release mortality. In addition, these data suggest that management options involving the release of spotted seatrout are a viable management tools.

Mapping of Oyster Reefs and Anthropogenic Impacts in Lavaca Bay, Texas

Josh Harper (*Texas Parks and Wildlife Department, 2200 Harrison, Palacios, TX, 77465, joshua.harper@tpwd.state.tx.us*)
James Simons (*Texas Parks and Wildlife Department, 6300 Ocean Drive NRC #2501, Corpus Christi, TX, james.simons@tpwd.state.tx.us*)
Tim Dellapenna (*Texas A&M University-Galveston, 1001 Texas Clipper Rd, Sea Aggie Center, Galveston, TX 77553, dellapet@tamug.tamu.edu*)
Jason Bronikowski (*Texas A&M University-Galveston, 1001 Texas Clipper Rd, Sea Aggie Center, Galveston, TX 77553*)
William Sager (*Texas A&M University, 3146 TAMU, College Station, TX, 77843, wsager@tamu.edu*)
Mary Patch (*Texas A&M University, 3146 TAMU, College Station, TX, 77843*)

Oyster reefs are an important economic and ecological resource in Lavaca Bay, Texas, a sub-bay of the Matagorda Bay System. The geospatial coverage of these oyster reefs needs to be well defined to better study and manage Lavaca Bay. Texas Parks and Wildlife Department and Texas A&M University have jointly conducted a side-scan sonar and sub-bottom profile survey of Lavaca Bay to map the oyster reefs, as well as anthropogenic impacts such as pipelines, dredged channels, and structural debris. Side-scan sonar generates acoustic images analogous to aerial photographs of the bay bottom. Sub-bottom profiles create a vertical linear cross section of the bay stratigraphy. Comparison of this data to historical nautical charts allows for analysis of changes in areal coverage of the oyster reefs and changes in bathymetry of the bay. The sub-bottom profiles show historical reefs that have been covered by sediment as well as changes in sedimentation patterns. Maps of the oyster reefs will be made available to state agencies, researchers, industry representatives, and the general public.

Fish Assemblage Structure of Texas Streams: Local vs. Regional Factors

David J. Hoeinghaus *(Dept. of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843-2258)*
Jenny S. Birnbaum *(Dept. of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843-2258*)
Kirk O. Winemiller *(Dept. of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843-2258, k-winemiller@tamu.edu*)

We examined the relative influence of local versus regional environmental factors on fish assemblage structure across Texas. Samples were collected at 170 sites representing 11 sub-basins, from the Rio Grande River basin in western Texas to the Neches River basin in eastern Texas. Twenty-one regional factors and nineteen local factors were used in the comparison. Correspondence analysis (CA) was used to compare fish assemblage structure across sites without the influence of environmental factors. The effect of sub-basin on fish assemblage structure was significant (MANOVA, $P < 0.001$). Canonical correspondence analysis (CCA) was performed separately with local and regional environmental factors. Non-significant and redundant environmental factors were removed, and remaining factors were combined in a CCA evaluating the relative influences of local versus regional parameters. Ordination of the first two canonical axes derived from the combined CCA distinguished sub-basins by regional factors, and within sub-basin variation was explained by local factors. Findings have implications for management tools, such as indices of biotic integrity applied across biologic provinces. Our results indicate that a single index may be inappropriate for large geographic regions incorporating multiple watersheds.

Application of the Nursery-Role Concept to an Estuarine Fish

Richard T. Kraus (*Department of Biology, Texas A&M University, Galveston, TX 77551, krausr@tamug.edu*)
David H. Secor (*Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, One Williams Street, Solomons, Maryland 20688, secor@cbl.umces.edu*)

The nursery-role concept, that some juvenile habitats (i.e., nurseries) produce more adults per unit area than other habitats, emphasizes production in evaluating habitats for management and conservation. We applied this concept to white perch *Morone americana* an estuarine dependent species from Chesapeake Bay. We sampled adult white perch and measured Sr/Ca in otoliths to infer time spent in freshwater and brackish habitats during the first year of life. A few strong year-classes (1993, 1995, and 1996) dominated the samples, and nearly all of the individuals that we examined (93% of 363) migrated from freshwater larval habitats to brackish juvenile habitats. Within the dominant year-classes, brackish habitats were more productive on a per area basis than freshwater. In contrast, freshwater habitats were more productive per unit area in the remaining year-classes. Though population abundance was driven by strong-year classes that primarily use brackish juvenile habitats, the small contribution from freshwater appeared to be crucial during episodes of poor recruitment. This simple example illustrates how the nursery-role concept inadequately accommodates minority habitats when there are complementary roles between habitats in population dynamics.

Parasite of Juvenile Red Drum *Sciaenops ocellatus* from Aransas Bay, Texas

Rosana Lopez (*Texas A&M University Kingsville*)
Jaime Svadlenka (*Texas A&M University Kingsville*)
Steve Curran (*Texas A&M University Kingsville*)
M. Andres Soto (*Texas A&M University Kingsville*)

Red drum *Sciaenops ocellatus* are an important recreational and commercial fish in the Gulf of Mexico. Adult *Sciaenops ocellatus* live offshore and spawn along beaches and inlets. Currents carry eggs and larvae into estuaries. Larval and juveniles depend on the estuarine habitat particularly seagrass meadows for the first few years of life. Mortality factors for these fish are predation, starvation, parasitism, and improper advection. Although many studies have been conducted on the effects of predation and food availability on juvenile *S. ocellatus* not many have examined the relationship that parasitism may have on mortality or growth rates of these juvenile fish. The objective of this study is to determine if newly settled *S. ocellatus* are infected with parasites. Fish were collected by seine in early December in Aransas Bay, Texas, and were kept alive until dissected at the laboratory. Nineteen

fish were examined that ranged in size from 21-35 mm (TL). Digeneans, larval tapeworms, and nematodes were three types of parasites found in the intestines of juvenile *S. ocellatus*. Among fish examined, 74% were found to have at least one parasite. Prevalence of digeans, nematodes and larval tapeworms were 0.63, 0.05, and 0.21, respectively. Intensity of digeans, nematodes and larval tapeworms were 1.25, 1.0, 1.25, respectively.

Swimming Ability of Selected Freshwater Fishes

Tracy R. Leavy (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666*)
Timothy H. Bonner (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666, TBonner@txstate.edu*)

We determined swimming ability for 37 fishes in Texas and Louisiana to quantify and predict the effects of culverts on fish assemblage structure. In addition, swimming ability was correlated to habitat use and fish morphology to better understand the influence that flow has on structuring fish assemblages. Mean maximum current velocity ranged from 31 to 84 cm/s for cyprinids (*N* of species = 24), 31 to 43 cm/s for cyprinodonts (*N* = 2), 23 to 41 for centrarchids (*N* = 4), and 16 to 19 cm/s for poeciliids (*N* = 2). Mean maximum current velocity was 50.9 cm/s for characins, 70 cm/s for ictalurids, 33 cm/s for cichlids, 40 cm/s for percids, and 30 cm/s for atherinids where only one taxon of a family was assessed. From a mesohabitat (i.e., runs, pools, and riffles) perspective, fish with higher swimming abilities generally were found in swifter currents than those that inhabit more sluggish areas. Ten morphological measurements were determined for each species and correlated to their swimming ability. Our results indicated that morphological attributes were an inadequate indicator of swimming ability, but swimming ability was a good indicator of habitat use.

Fish Communities in Habitats of San Felipe Creek in the City of Del Rio, Valverde County, Texas

Hernán López-Fernández (*Dept. of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843-2258*)
Kirk O. Winemiller (*Dept. of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843-2258, k-winemiller@tamu.edu*)

Abstract is not available.

Preliminary Investigation of the Use of Daily Growth Increments in the Sagittal Otoliths of Blackfin Tuna (*Thunnus atlanticus*) for Age Determination

Michael R. Lowe (*Texas A&M University at Galveston, Department of Marine Biology, 5007 Ave U, Suite 102, Galveston, TX 77551*)
Jay R. Rooker (*Texas A&M University at Galveston, Department of Marine Biology, 5007 Ave U, Suite 102, Galveston, TX 77551*)
Gary A. Gill (*Texas A&M University at Galveston, Department of Marine Sciences, 5007 Ave U, Suite 102, Galveston, TX 77551*)
Yan Cai (Texas A&M University at Galveston, Department of Marine Sciences, 5007 Ave U, Suite 102, Galveston, TX 77551)

Sagittal otoliths of 20 blackfin tuna *Thunnus atlanticus* (31 to 80 cm fork length), caught by the recreational fishery in the Northwest Gulf of Mexico, were examined to establish protocols for the proper interpretation of daily increment deposition, age determination and accumulation rates of Methlymercury (MeHg). Transverse sections from sagittal otoliths were polished to the core on each side and, under the assumption that increment deposition was daily, growth increments were enumerated from the core to the ventral edge. In areas of the otolith where growth increments were unclear, the mean distance between increments was measured in adjacent planes and applied to difficult area. *Thunnus atlanticus* ranged in age from 128 days for the smallest individual (31 cm) to 763 days for the largest (80 cm). The mean percentage of growth increments that were unclear and had to be estimated was 7.6% (range = 3.1-16.5 %, SE = 1.1). A simple regression (y = 0.0158(age) + 2.5525, r^2 = .750) showed that 75% of the variability in estimated growth increment was explained by age. The relationship between observed fork length and

age was described by both the linear (FL = 0.7583(age) + 267.61, r^2 = 0.968) and the logarithmic (FL = 275.93Ln(age) - 1035.3, r^2 = 0.992) growth curves. A linear growth rate of 0.758 mm day^{-1} was observed for all fish, while fish between 30-40 cm, 41-60 cm, and greater than 60 cm FL exhibited growth rates of 2.0, 1.0, and 0.54 mm day^{-1}, respectively, for the logarithmic plot. The growth rates for the von Bertalanffy growth equation, FL = $97(1 - e^{-0.78(t + 0.179)})$ (r^2 = .992) , where FL is the fork length in cm and t in years, were 1.4, 0.9, and 0.6 mm day^{-1} over the same time intervals. Hatch dates were determined by subtracting the age of the fish from the collection date, and ranged from winter to spring, with most hatches occurring in November and December. Agreement of our growth curves with those of previous growth studies on congeners of *T. atlanticus*, using various ageing methods, suggesting that our approach is sound.

Effects of Salinity on the Survival and Growth Rate of Juvenile Pinfish *Lagodon rhomboides*

Natalie Ibarra *(Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station*)
Virginia Shervette (*Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station*)
Frances Gelwick (*Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station*)

Rapid growth and high survivorship can ensure the successful recruitment of fishes into an estuary. Salinity is one of several factors potentially affecting growth and survivorship in estuarine fishes, and thus, understanding its affects on recruitment is essential in fisheries management. We focused on the growth and survivorship of juvenile pinfish *Lagodon rhomboides* at salinities ranging from 0-60 ppt (in 15-ppt increments) over a three-week period in laboratory aquaria. We established five experimental treatments (0 ppt, 15 ppt, 30 ppt, 45 ppt, and 60 ppt). Salinity significantly affected the relative weight (one-way ANOVA, $P < 0.001$) and the average growth rate (ANCOVA, $P < 0.05$) of pinfish across the five salinity treatments. We also found significant differences in the survival of pinfish across the five salinity treatments (one-way ANOVA, $P < 0.001$). Responses of juvenile pinfish were non-linear for growth, body condition, and survival, and indicated similar ranges across which they each might constrain recruitment of pinfish.

A Comparison of the Brown Shrimp *Farfantepenaeus aztecus* Symbionts Collected from a Hypersaline Bay and a Typical Estuarine Bay

Vanessa Perez (*Texas A&M University Kingsville*)
Jose Antonio Rodriguez (*Texas A&M University Kingsville*)
Steven Curran (*Texas A&M University Kingsville*)
M. Andres Soto (*Texas A&M University Kingsville*)

The Gulf Coast of southern Texas and eastern Mexico is unique in that it contains the largest hypersaline bay in the world, the Laguna Madre. Salinities in the Laguna Madre and adjacent waters range from near 0 ppt during tropical storms to 100 ppt during severe droughts. The objective of this study is to compare symbiont assemblages of brown shrimp (*Farfantepenaeus aztecus*) collected from a hypersaline bay (upper Laguna Madre, ULM) to shrimp collected from a more typical estuary (Corpus Christi Bay, CCB). Shrimp were obtained from bait stores or caught using a bag seine or shrimp trawl. All shrimp were kept alive until dissections were performed at the laboratory. Total length of each shrimp was measured. Forty-two shrimp were examined from ULM, and 25 from CCB. A total of 14 symbionts were found at both sites. Thirteen symbionts were common to both sites. Gregarines, ciliates, nematodes, digeneans, and trypanorhynchs were a few symbionts found. The mean of the prevalences of symbionts between the two habitats were approximately the same (CCB = 0.21 to ULM = 0.21), but the mean intensities of the symbionts from the hypersaline bay was much lower (CCB: 31.94 to ULM: 12.36 per individual). Our results suggest that high salinities affect the symbiont assemblages of brown shrimp.

Phenotypic Plasticity and Performance in Red Drum *Sciaenops ocellatus*

Clifton B. Ruehl (*2258 TAMU, College Station, TX 77843*)
Thomas J. DeWitt (*2258 TAMU, College Station, TX 77843*)

Phenotypic plasticity can affect the success of fish living among different habitat types. This has stock enhancement implications as the habitat and diet of hatchery reared fish is often different than wild fish. We tested for diet-induced morphological plasticity and feeding performance in the red drum (*Sciaenops ocellatus*). Fish from a Texas marine hatchery were fed commercial diets supplemented with either hard or soft food for two months. Fish feeding performance was assayed for three days to measure their ability to manipulate and consume hard food items. External morphology was assessed using geometric morphometrics. Pharyngeal crushing muscles were dissected and weighed to measure the effects of hard food on muscle development. Fish from the hard treatment developed deeper and larger heads, heavier pharyngeal crushing muscles, and initially consumed hard food items more efficiently than fish from the soft food treatment. These findings indicate red drum are phenotypically plastic. The observed morphological variation is in accordance with observed variation among species. This study is an initial step to understand the nature and magnitude of phenotypic plasticity in red drum populations. Understanding these mechanisms should aid in developing and optimizing conservation and supplementation efforts thus, easing the transition of fish from hatchery facilities to estuaries.

Conservation Genetics of Spotted Seatrout *Cynoscion nebulosus* in the Gulf of Mexico.

Rocky Ward (*4200 Smith School Road, Austin, Texas 78744, rocky.ward@tpwd.state.tx.us*)
Kevin Bowers (*4200 Smith School Road, Austin, Texas 78744, kevin.bowers@tpwd.state.tx.us*)
William J. Karel (*4200 Smith School Road, Austin, Texas 78744, william.karel@tpwd.state.tx.us*)
Brandon Mobley (*4200 Smith School Road, Austin, Texas 78744, brandon.mobley@tpwd.state.tx.us*)
Rebecca Hensley (*4200 Smith School Road, Austin, Texas 78744, rebecca.hensley@tpwd.state.tx.us*)

Variability in microsatellite loci was examined in 1262 spotted seatrout in an effort to understand spatial and temporal genetic population structuring among sites in the Gulf of Mexico. Two loci from two different site/year samples (of 170 total comparisons) failed to meet Hardy-Weinberg expectations. Tests of within year population differentiation (P_{EXACT}) were non-significant following correction for simultaneous comparisons. Analysis of molecular variance (AMOVA) found the greatest source of among sample variance to be between Atlantic and Gulf samples (4.11%), with an estimated F_{ST} = 0.046 (P < 0.001). Cluster and multidimensional scaling analyses differentiated western Gulf of Mexico spotted seatrout from those of the eastern Gulf and the Atlantic Coast of Florida. Assignment tests were successful at correctly classifying Florida spotted seatrout to region in 69.14% of individuals (a priori probability = 23.08). Assignments of Texas and Louisiana individuals were much less effective, with success rates at or near chance levels. The correlation between matrices of genetic distance and geographic distance was high (r = 0.90) and statistically significant (P < 0.001), suggesting an isolation-by-distance model was appropriate for the genetic diversity observed in this species.

Evaluation of Methods for Establishing Native Aquatic Vegetation in Seven Texas Reservoirs

Mark A. Webb (*Texas Parks and Wildlife, Inland Fisheries District 3E, 1004 East 26th Street, Bryan, TX, 77803, mark.webb@tpwd.state.tx.us*)
R. M. Smart (*USCOE, USAE Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility, RR 3, Box 446, Lewisville, TX, 75056, msmart@gte.net*)
R. A. Ott, Jr. (*Texas Parks and Wildlife, 11942 FM 848, Tyler, TX, 7570, richard.ott@tpwd.state.tx.us*)

Aquatic vegetation plays an important role in freshwater systems, providing quality habitat for fish, sequestering nutrients from the water, stabilizing sediments, and improving water clarity. Because many Texas reservoirs are either sparsely vegetated or contain an overabundance of non-native species such as hydrilla *Hydrilla verticillata*, Texas Parks and Wildlife Department's Inland Fisheries Division began a program to develop procedures for establishing diverse native aquatic plant communities. Establishment techniques have been tested in seven reservoirs representing diverse geographical areas from 1998 through 2003. Aquatic plant species native to Texas, and representing three growth forms (submersed, floating-leaved, and emergent), were used. Plant survival and

spread was documented using GIS technology. Results were variable; however, founder colonies capable of long-term propagule production and spread were established in all seven reservoirs.

Development of a Largemouth Bass Hooking Mortality Model

Gene R. Wilde (*Wildlife and Fisheries Management Institute, Mailstop 4125, Texas Tech University, Lubbock, Texas 79409-4125 USA*)
Kevin L. Pope (*Wildlife and Fisheries Management Institute, Mailstop 4125, Texas Tech University, Lubbock, Texas 79409-4125 USA*)

Hooking mortality of largemouth bass *Micropterus salmoides* is most affected by the location of hooking wounds and water temperature. We used results from hooking mortality trials conducted at three temperatures (7, 17, and 27°C) to develop a model for hooking mortality in largemouth bass. Largemouth bass were acclimated to the three experimental temperatures and were hooked, by hand, in randomly chosen sites within the oral cavity. We used logistic regression to model effects of hooking location and temperature. Model results were validated by angling fish in small, outdoor pools, recording hooking location and water temperature, and then holding captured fish for 6 days to assess total hooking mortality.

Spatial and Temporal Variation in Fish Assemblages: Implications for Index of Biotic Integrity

Casey S. Williams (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666*)
Timothy H. Bonner (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666, TBonner@txstate.edu*)

Cyprinid fish assemblages were sampled monthly from three sites on Kisatchie Bayou, west-central Louisiana, and four sites on Banita Creek and Lanana Bayou in east Texas for one year. Species and richness were similar between drainages but differed in abundance; Kisatchie Bayou assemblage was dominated by *Cyprinella venusta* (74%). Canonical correspondence analysis was used to examine cyprinid species-environment relationships and effects of physical parameters, site, and season on spatial and temporal variation of assemblage structure. Physical parameters, site, and season explained 78% of the cyprinid assemblage variation in Kisatchie Bayou and 72% in Banita Creek and Lanana Bayou. Pure effects of physical parameters explained a significant ($P < 0.05$) proportion (35%) of assemblage structure variability in the Kisatchie Bayou assemblage, followed by season (9%) and site (6%). However, only the pure effect of site was significant ($P < 0.05$) in Banito Creek and Lanana Bayou. Differences in pure habitat effects among drainages accentuated minute differences in life history traits in dominate species of the assemblage.

Temporal Variation in Fish Assemblage Structure in Relation to Habitat Disturbance and Environmental Variability in Brazos River Oxbow Lakes

Steven C. Zeug (*Department of Wildlife and Fisheries Sciences, Texas A&M University*)
Kirk O. Winemiller (*Department of Wildlife and Fisheries Sciences, Texas A&M University*)
Soner Tarim (*Department of Wildlife and Fisheries Sciences, Texas A&M University*)

Fish assemblages and environmental characteristics of three oxbow lakes and an adjacent reach of the middle Brazos River were sampled quarterly from summer 1993 to summer 1996. Variation in oxbow geomorphology influenced patterns of flooding, disturbance, and environmental attributes and these in turn were associated with differences in fish assemblages among oxbows. The shallowest oxbow dried out with greatest frequency and assemblages were dominated by small colonizing species. The two deep oxbows were characterized by greater species richness, diversity, and biomass abundance. Maximum water depth was the best predictor of species richness across all years. Seven species were restricted to the river channel while six species were collected only in oxbows. Faunal exchange between river and oxbow habitats is determined by flood frequency. The youngest oxbow flooded frequently, and its assemblage was periodically dominated by species common in the river channel but rare or absent in the more isolated oxbows.

Comparative Growth of Pinfish in Field Mesocosms Across Marsh, Oyster, and Soft-Bottom Habitat Types in a Mississippi Estuary

Virginia Shervette (*Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX*)
Frances Gelwick (*Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX*)

Estuaries are semi-enclosed coastal bodies of water, which have free connection with the open sea, and within which seawater is measurably diluted with freshwater from land drainage. Because of their connection to freshwater inputs, the ocean, and the land, estuaries are extremely susceptible to human disturbances. Understanding how species utilize estuarine habitats is critical for future conservation efforts in estuaries. This pilot study in Grand Bay, MS focused on growth of pinfish across three habitat types: marsh, oyster, and soft-bottom. We quantified relative growth of juvenile *Lagadon rhombiodes* within field enclosures that restricted fish to a homogeneous habitat type and in which fish could forage on the bottom substrate while predators were excluded. Such enclosures have been used successfully to measure growth rates for a variety of habitats and species. We found that growth rates of pinfish in Spartina marsh and oyster habitat types were higher than growth in soft-bottom (one factor ANOVA, $P <$ 0.005). Pinfish grew fastest in the marsh habitat (0.52 mm/day ± 0.36 SD), next fastest in oyster habitat (0.30 mm/day ± 0.19 SD), but growth was negative in soft-bottom habitat type (-0.05 mm/day ± 0.24 SD).

POSTER SESSION ABSTRACTS

Lab Evaluation of a Bioenergetics Model for Inland Silverside

Caleb Huber (*Texas Tech University Wildlife and Fisheries Management Institute, Mailstop 42125, Lubbock, TX 79409, caleb.g.huber@ttu.edu*)
Chris Chizinski (*Texas Tech University Wildlife and Fisheries Management Institute, Mailstop 42125, Lubbock, TX 79409*)
Kevin Pope (*Texas Tech University Wildlife and Fisheries Management Institute, Mailstop 42125, Lubbock, TX 79409*)

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

Resource Use Among Sympatric Lepisosteidae Species in the Middle Brazos River and Associated Oxbows

Clinton Robertson (*Dept. of Wildlife and Fisheries Science, Texas A&M University, 101 Old Heep Bldg, College Station, TX 77843, clinton_robertson@hotmail.com*)
Steve Zeug (*Dept. of Wildlife and Fisheries Science, Texas A&M University, 101 Old Heep Bldg, College Station, TX 77843, szeug@tamu.edu*)
Kirk Winemiller (*Dept. of Wildlife and Fisheries Science, Texas A&M University, 101 Old Heep Bldg, College Station, TX 77843, k-winemiller@tamu.edu*)

This project examines habitat and diet partitioning among the three sympatric gar species (*Lepisosteus osseus*, *L. occulatus* and *Atractosteus spatula*) at two spatial scales. First, species relative abundances were compared in the lotic river channel vs. lentic oxbows. Second, microhabitat associations were examined within each location. Fishes were collected using experimental gill nets and standardized beach seine hauls. Diet composition and importance of prey items were evaluated by volumetric analysis of stomach contents. Preliminary results indicate that *L. osseus* is more abundant in channel habitats, with few collected in oxbow habitats. *Lepisosteus oculatus* is

more abundant in oxbow habitats, with few collected in channel habitats. *Atractosteus spatula* was less common than the other gars, with one individual caught in the channel and another in oxbow. Preliminary diet analysis indicates high variability among channel and oxbow habitats, with the diet of *L. osseus* in the channel being dominated by fishes of the families Ictaluridae and Cyprinidae, while the diet of *L. occulatus* in oxbows is dominated by fishes of the families Centrarchidae, Cyprinidae and Clupeidae. More data are being collected for comparisons of diet among the different gar species in similar habitats and for the same species of gar in different habitats.

Parasites of Juvenile Atlantic Croaker *Micropogonias undulatus* from Texas

Jaime L. Svadlenka (*Texas A&M University Kingsville*)
Rosana Lopez (*Texas A&M University Kingsville*)
Steven Curran (*Texas A&M University Kingsville*)
M. Andres Soto (*Texas A&M University Kingsville*)

The Laguna Madre, located in the Gulf Coast of southern Texas, is the largest hypersaline bay in the world. Salinity levels in this bay system range from near 0 ppt to 100 ppt. To measure the impact of hypersalinity, a study is being conducted to compare the parasite assemblages of Atlantic croaker (*Micropogonias undulatus*) caught in the hypersaline bay (Laguna Madre, TX) to those caught in a typical estuary (Corpus Christi Bay, TX). Forty-five Atlantic croaker caught from typical estuaries have been examined. The Atlantic croaker examined ranged in size from 10-15 cm (TL) and were caught from July through September. All Atlantic croaker were obtained from commercial bait shops. Monogeans were most prevalent (0.6). Pedunculated digeneans (prevalence = 0.49), small nematodes (0.40) were found in the body cavity. Large nematodes were found in the intestine (0.36). Other parasites found include tapeworms and digeneans in the pyloric ceca and intestine. Acanthocephalans were also found in the intestine. Parasites will be identified to lowest possible taxon using standard parasitological techniques.

Effects of Fluctuating Temperatures and Trematode Infection on the Reproduction of the Fountain Darter *Etheostoma fonticola*.

Dusty L. McDonald (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666*)
Timothy H. Bonner (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666, tbonner@txstate.edu*)
Thomas M. Brandt (*National Fish Hatchery and Technology Center, U.S. Fish and Wildlife Service, 500 East McCarty Lane, San Marcos, TX 78666*)

We assessed the effects of fluctuating temperatures and gill parasitism on egg and larval production of the endangered fountain darter *Etheostoma fonticola*. Fountain darters with and without *Centrocestus formosanus* were exposed to constant (24°C) and fluctuating (24 to 26°C, 26 to 28°C and 28 to 30°C) water temperatures for 21 d. No difference was detected for total egg ($P = 0.78$) and larval production ($P = 0.11$) between infected and healthy fountain darters. Total egg production was greatest at 24°C and significantly decreased ($P < 0.05$) by 42% at temperature regime 24 to 26°C, 65% at temperature regime 26 to 28°C, and 99.6% at temperature regime 28 to 30°C. Larval production was greatest at 24°C and significantly decreased ($P < 0.05$) by 63% at temperature regime 24 to 26°C, 99.9% at temperature regime 26 to 28°C, and 100% at temperature regime 28 to 30°C. Temperatures that fluctuated between optimum and sub-optimum levels also reduced the number of eggs and larvae produced by fountain darters. Results of this study, combined with others, refined temperature requirements of the fountain darter reproduction with water temperatures ≥ 26°C reducing egg production and water temperatures ≥ 25°C reducing larval production.

Susceptibility of Fountain Darter Age Groups to Mortality By an Exotic Trematode *Centrocestus formosanus*

Dusty L. McDonald (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666*)
Timothy H. Bonner (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666, tbonner@txstate.edu*)
Thomas M. Brandt (National Fish Hatchery and Technology Center, U.S. Fish and Wildlife Service, 500 East McCarty Lane, San Marcos, TX 78666)

We determined infestation rates for dead and surviving larval, juvenile, and adult fountain darters *Etheostoma fonticola* exposed to an exotic trematode, *Centrocestus formosanus*. Estimates from survival curves indicated that 50% of the larval fish (total length: 9 to 13 mm) would die within 116 minutes and 50% of the juvenile fish (16 to 20 mm) within 330 minutes when exposed to 512,200 cercariae/L. Less than 25% of the adult fish (36 to 41 mm) had died in 8 h of exposure. Number of metacercariae that caused mortality was directly related ($P < 0.01$) to fish length although length alone did not explain the accelerated rate of mortality observed in smaller fish. Varying degrees of trematode tolerance among size groups suggested that larvae and juveniles were more susceptible to mortality induced by *C. formosanus* infection than adults. This result has implications for population health as greater mortality in smaller fountain darters could limit the number of fish reaching sexual maturity.

Effect of Disinfectants and Antivirals on the Infectivity and Replication of Largemouth Bass Virus

Brian A. Scott (*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666*)
Gary M. Aron ((*Department of Biology, Texas State University, San Marcos, 601 University Dr., San Marcos, TX 78666*, *ga06@txstate.edu*)

Largemouth Bass Virus (LMBV), a species in the family Iridoviridae, is thought to be the cause of largemouth bass *Micropterus salmoides* fish kills. The virus has been reported to remain viable in water 3-4h with the potential to move from lake to lake in contaminated livewells of boats. To prevent the spread of LMBV, bass anglers are instructed to let boats and fishing equipment completely dry in the sun for 24h before use in a different lake. There are no recommendations for the treatment of either infected fish or contaminated waters. This study evaluated the effect of disinfectants and antivirals on the infectivity and replication of LMBV, respectively. The inactivation of LMBV following exposure to chemical disinfectants was determined by $TCID_{50}$ assay. LMBV was inactivated greater than 99% following exposure to iodine (0.025%), formalin (4%), sodium hypochlorite (0.14%), and ethanol (70%). Exposure of infectious virus to UV light (2×10^3 ergs $\cdot\ s^{-1} \cdot (cm^2)^{-1}$) for 20s, or 37°C for 5d resulted in greater than 99% inactivation of the virus. However, LMBV was not effectively inactivated following a 24h exposure to 37ºC. The effect of antivirals on the replication of LMBV was determined by XTT cell viability assays. Pokeweed antiviral protein (0.078 μm/ml), ribavirin (1.48 μg/ml), and guanidine (2630 μg/ml) provided 99%, 47%, and 34% protection to BF-2 cell monolayers from virus infection, respectively. Since boat live wells may not be acessible to sunlight or dry completely in 24h, current recommendations would not be sufficient to prevent spread of the virus. This study suggests that chemical disinfection of boats and fishing equipment would be required to reduce the risk of LMBV spread to non-infected lakes and pokeweed antiviral protein may be of use in the treatment of virus-infected fish and contaminated lakes.

Mercury Content in Different Fishes from the Gulf of Mexico

Yan Cai (*Texas A&M University at Galveston, Marine Biology Department*)
Jay Rooker (*Texas A&M University at Galveston, Marine Biology Department*)
Gary Gill (*Texas A&M University at Galveston, Marine Biology Department*)

To examine the trophic structure and contaminant bioaccumulation of MMHg in the fishes of the Gulf of Mexico, MMHg concentrations were determined in the tissues of 13 species of pelagic and nearshore fishes, with a special emphasis on apex predators (large vertebrates). Results are used to characterize contaminant loads of mercury across several trophic positions in marine food webs present in the Gulf. Also, because fish muscle

samples were collected in 2 consecutive years (2002 and 2003) from two locations along the coast of the Gulf, spatial and interannual variation is investigated by comparing MMHg in consumers from different regions in different years. Finally, to test the theory that MMHg is accumulated as the fish grow, I explored the relationship between fish size and MMHg content, and find out that for species king mackerel, cobia, greater amberjack and blackfin tuna, MMHg content is a function of fish size.

Economic Value of Fishing at a Low-use Reservoir

Christopher J. Chizinski (*Wildlife and Fisheries Management Institute, Texas Tech University*)
Kevin L. Pope (*Wildlife and Fisheries Management Institute, Texas Tech University*)
David B. Willis (*Department of Agricultural and Applied Economics, Texas Tech University*)
Gene R. Wilde (*Wildlife and Fisheries Management Institute, Texas Tech University*)
Edwin J. Rossman (*U.S. Army Corps of Engineers*)

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

Use of Regulatory Catch-and-Release to Improve a Trophy Largemouth Bass Fishery at Gibbons Creek Reservoir, Texas

JEFFREY C. HENSON

Texas Parks & Wildlife Department, Inland Fisheries District 3E, 1004 E. 26th Street, Bryan, TX 77803

Abstract. - Gibbons Creek Reservoir opened to public fishing in March 1985 managed with a 381-533-mm slot length limit. Within 3 years, the number of largemouth bass *Micropterus salmoides* ≥ 533 mm being caught by anglers at Gibbons Creek Reservoir had peaked and begun to decline. In 1988, the lower limit of the slot was reduced to 356-mm. Electrofishing CPUE (number per/hour) of 356-533 mm largemouth bass peaked and declined in the same period. In an attempt to increase the numbers of trophy largemouth bass in the population, a catch-and-release-only regulation for largemouth bass was adopted effective September 1993. No statistical difference in electrofishing CPUE of largemouth bass ≥ 356 mm was observed after the regulation was imposed. Also, the number of largemouth bass > 533 mm reported by anglers to the controlling authority continued to drop and reached the lowest levels on record in 2000. During the period the catch-and-release-only regulation was in effect, the relative abundance of largemouth bass > 356 mm did not increase; neither did the number of largemouth bass > 533 mm.

Catch-and-release regulations have been used with some success to protect largemouth bass *Micropterus salmoides* stocks in smaller impoundments where the stocks were subject to high levels of directed angling pressure, potentially leading to over-harvest and subsequent depletion (Weithman and Anderson, 1977; Champeau and Denson, 1987; Storey and Ott, 1992). However, in these cases, the regulation was imposed with the onset of public fishing as a preventative measure.

When opened for public fishing in March 1985, fishing pressure was very high at Gibbons Creek Reservoir due to a pre-opening publicity campaign initiated by the controlling authority, Texas Municipal Power Agency (TMPA). For 2 years prior to opening to the public, TMPA allowed sportswriters and other fishing professionals to fish the reservoir. The reservoir was even featured in several syndicated television fishing shows that aired nationwide. Though few largemouth bass > 533 mm were being caught at that time, large numbers of quality-sized largemouth bass were caught and released. This media blitz created great expectations among anglers nationwide so that by the time Gibbons Creek Reservoir opened, demand for access was very high and entry was by reservation only.

To protect the largemouth bass fishery from initial over-harvest, a slot length limit was put in effect by Texas Parks & Wildlife Department (TPWD) that allowed the harvest of largemouth bass ≤ 381 mm and ≥ 533 mm. The lower end of the slot was reduced to 356 mm in September 1988. The bag limit was three fish per angler per day. For the first 3 years, the slot limit appeared to protect the population, as angler harvest remained negligible, angler catch rates remained steady, and electrofishing CPUE of slot-sized largemouth bass increased (Kurzawski and Durocher 1993).

Between 1988 and 1992, angler catches of largemouth bass > 533 mm drastically declined (Fig. 1). The occurrence of largemouth bass > 533 mm in TPWD electrofishing samples remained fairly constant during this period suggesting no change in relative abundance of trophy largemouth bass. However, the electrofishing CPUE of largemouth bass in the protected slot between 356 and 534 mm was also low compared to what was observed at Gibbons Creek Reservoir in the first 3 years it was open to public fishing, suggesting an over-harvest of largemouth bass below the slot, not allowing sufficient numbers to recruit to protected sizes. This was a reasonable hypothesis considering that anglers were encouraged to harvest largemouth bass below the slot to increase the numbers of largemouth bass recruiting into the slot. The possibility that this could lead to a significant depletion of sub-slot fish was not considered.

In an effort to address concerns expressed by TMPA and anglers that the trophy fishery was declining, a catch-and-release-only regulation for largemouth bass was implemented in September 1993. The regulation included an allowance for anglers who caught a largemouth bass $\geq$ 559 mm (decreased to 533 mm in September 2000) to retain the fish long enough for weighing at a lakeside weigh station with subsequent release or, if qualifying, donation to the ShareLunker Program. This program allows anglers to donate largemouth bass weighing 5.9 kg or more to TPWD for genetic studies. After the completion of genetic studies, the fish is returned to the point of origin for release. The angler is provided a fiberglass replica mount courtesy of TPWD.

Quinn (1996) found that the use of regulatory catch-and-release has increased in recent years for largemouth bass, but the effects of these regulations are not well documented. He reported that regulatory agencies use catch-and-release for a variety of biological and sociological reasons. Suspected over-harvest and adjustment of size structure were both common reasons for using regulatory catch-and-release. The objectives of this study were to determine if 1) the relative abundance of largemouth bass over 356 mm increased and 2) angler catches of largemouth bass > 533 mm reported to TMPA increased during the years that the catch-and-release-only regulation was in effect at Gibbons Creek Reservoir, Texas.

Methods

Gibbons Creek Reservoir is a 1,012-hectare power plant cooling reservoir operated by the TMPA located on Gibbons Creek, a tributary of the Navasota River, in Grimes County, Texas. The drainage area of Gibbons Creek Reservoir is 220 km2. Impounded in 1981, the reservoir has been open to public fishing since March 11, 1985.

The largemouth bass population at Gibbons Creek Reservoir has been sampled every year since 1990 with a boat-mounted electrofishing unit equipped with a 5kW, 230 VAC generator converted to pulsed DC current using a Smith-Root model GPP 5 pulsator. Surveys were conducted in the fall (October or November) of each year beginning 30 minutes after sunset. Six fixed stations were sampled for 0.25 hour each for 1.5 hours of total shock time per survey. Total length and weight were measured for each largemouth bass captured. Catch per unit of effort (CPUE) defined as the number of largemouth bass > 356 mm caught per hour of electrofishing (CPUE356) was calculated from each years survey. A one-tailed Mann-Whitney test (Mann and Whitney 1947) was used to test the alternative hypothesis that electrofishing CPUE356 was greater during the years following the catch-and-release-only regulation change. Statistical significance was set at 0.05.

Detailed records documenting visitation were kept by TMPA both before and after the catch-and-release-only regulation, as well as numbers of largemouth bass caught and weighed at a lakeside weigh station since that regulation was imposed. These data were summarized and examined empirically, looking at historical trends in the data and drawing appropriate inferences based on those trends

Results and Discussion

No significant increase in electrofishing $CPUE_{356}$ was observed during the years after the catch-and-release-only regulation (P > 0.10). Also, numbers of trophy largemouth bass being reported to TMPA by anglers continued to decline so that by the year 2000, only one largemouth bass $\geq$ 533 mm was reported, the lowest in the reservoir's history (Fig. 2).

It had been assumed that anglers would have anticipated an increase in the number of trophy-sized largemouth bass due to the restrictive nature of the regulation, thus increasing interest and visitation to the reservoir. However, in 1999, TMPA expressed concern that the catch-and-release-only regulation may have contributed to a decline in visitation to the reservoir. Yet, according to TMPA data, the decline in visitation actually began after 1989 as angler catches of largemouth bass > 4.5 kg declined (Fig. 3). The decline in angler catches of trophy largemouth bass was more likely due to the attrition of Florida largemouth bass *Micropterus salmoides floridanus* originally stocked into the reservoir. Florida largemouth bass fingerlings were stocked in 1981 by TPWD just after the reservoir was impounded. These fish grew very rapidly so that by 1988, some exceeded 4.5 kg and the standing reservoir record (7.25 kg) was set that year. By 1988, probably few of the initially stocked Florida largemouth bass that had actually reached trophy proportions remained in the population and these remaining fish were difficult to catch by anglers as it has been documented that largemouth bass become less vulnerable to angling as they get older (Bennett 1974). As the catches of trophy largemouth bass declined, so did visitation.

In Texas, a Florida largemouth bass stocking program began in 1972 with the objective of increasing angler catches of trophy largemouth bass. From 1974 to 1986, both the mean weight and numbers of largemouth bass being submitted to TPWD's angler recognition program increased (Forshage et al. 1989). Also, the number of reservoirs producing trophy largemouth bass increased, in spite of the fact that the largemouth bass fisheries in these reservoirs were being managed with a variety of harvest regulations. Survey data collected by TPWD (unpublished) suggests that when reservoirs are stocked with Florida largemouth bass, trophy bass begin to appear about seven to ten years later. In many reservoirs that receive only one or a few early stockings of Florida largemouth bass, these same data indicate that the percentage of pure Florida largemouth bass genotypes decreases over time while Florida largemouth bass allele frequencies remain high. Eventually this results in populations comprised primarily of F_1 and later generation hybrids as was the case at Gibbons Creek Reservoir. This suggests that periodic stockings of pure Florida largemouth bass into reservoirs may be a more significant contributing factor in creating trophy largemouth bass fisheries regardless of harvest regulations.

Applying a catch-and-release-only regulation to the largemouth bass fishery at Gibbons Creek Reservoir did not increase the numbers of largemouth bass > 356 mm, nor did it increase the angler catches of largemouth bass >533 mm. When applying strict harvest regulations on largemouth bass fisheries it should be considered that, while these regulations in some cases may re-structure the populations, they may not achieve intended specific objectives (i.e. produce trophy-size largemouth bass) due to other confounding factors. Factors such as declining habitat, inconsistent year class strength, insufficient forage and the proportion of the population composed of pure Florida largemouth bass may have impacts that are far more significant on abundance of trophy largemouth bass.

At the request of TMPA, beginning September 2002, the largemouth bass fishery at Gibbons Creek Reservoir is once again managed with a slot length limit. The new regulation prohibits the harvest of largemouth bass between 356 and 610 mm with one fish over 610 mm allowed per angler per day. Also beginning in 2000, new criteria were established by TPWD for the ongoing periodic stocking of Florida largemouth bass into reservoirs that meet established criteria. These criteria require that reservoirs have sufficient habitat and forage as well as a history of producing trophy largemouth bass, all of which are met at Gibbons Creek Reservoir. If habitat and forage continue to be sufficient, this regulation combined with regular stockings of Florida largemouth bass may increase the numbers of trophy largemouth bass in Gibbons Creek Reservoir.

Acknowledgements

I acknowledge the Texas Parks & Wildlife Department's Inland Fisheries District 3E crews that collected the fish population data, as well as the TMPA for the weigh station and visitation data they provided. I also thank my colleagues at TPWD, Inland Fisheries Division for the in-house review of this manuscript, as well as Tim Bonner and Gene Wilde for their review and helpful comments.

LITERATURE CITED

Bennett, G. W. 1974. Ecology and management of largemouth bass, *Micropterus salmoides*. Pages 10-17 *in* J. L. Funk, editor. Symposium on overharvest and management of largemouth bass in small impoundments.

North Central Division American Fisheries Society Special Publication 3.

Champeau, T. R., and K. W. Denson. 1987. Effectiveness of a catch-and-release regulation for largemouth bass in a Florida lake. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 41:150-158.

Forshage A. A., P. P. Durocher, M. A. Webb, and D. G. Lewis. 1989. Management application of angler recognition program data. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 43:36-40.

Kursawski, K. F., and P. P. Durocher. 1993. Effects of a slot length limit on largemouth bass in a newly opened Texas reservoir. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 47:711-719.

Mann, H. B., and D. R. Whitney. 1947. On a test of whether one of two random variables is stochastically larger than the other. The Annals of Mathematical Statistics. 18: 50-60.

Quinn, Steve. 1996. Trends in regulatory and voluntary catch-and-release fishing. Pages 152-162 *in* L. E. Miranda and D. R. Devries, editors. Multidimensional approaches to reservoir fisheries management. American Fisheries Society Symposium 16.

Storey, K. W., and R. A. Ott, Jr. 1992. The largemouth bass catch-and-release regulation at a new reservoir, Purtis Creek State Park Lake, Texas. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 46:377-385.

Weithman, A. S., and R. O. Anderson. 1977. Catch-and-release fishing for largemouth bass on Hunter's Lake-1963 to 1977. Pages 109-118 *in* R. A. Barnhart and T. D. Roelofs, editors. Catch-and-release fishing as a management tool. National Sport Fishing Symposium, Humbolt State University, Arcata,Calif.

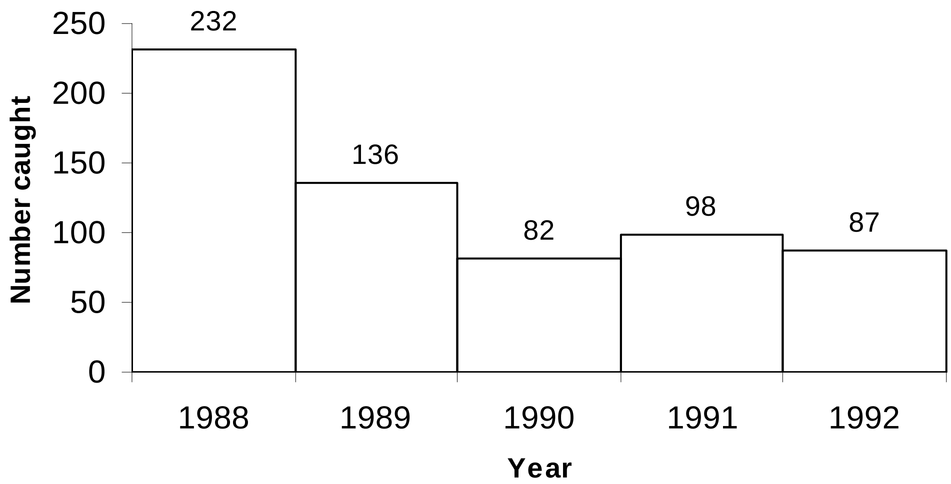


Figure 1. Number of largemouth bass > 533 mm caught by anglers at Gibbons Creek Reservoir between 1988 and 1993.

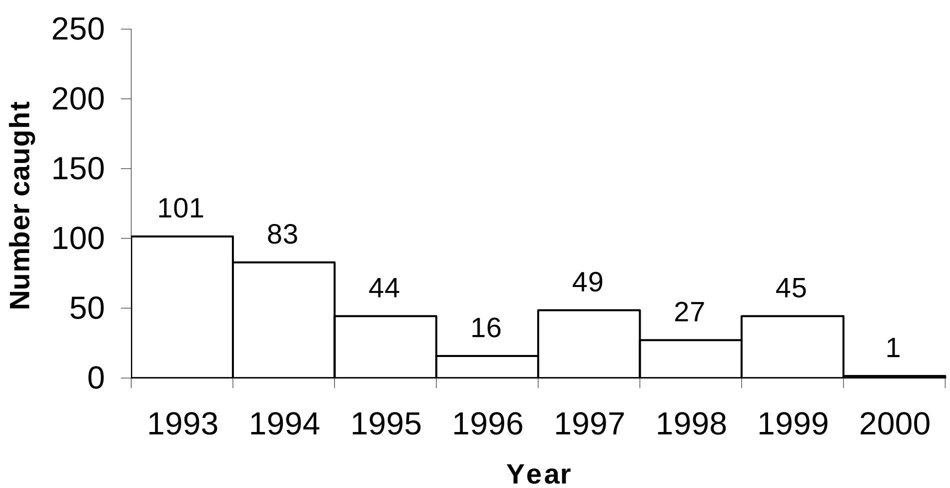


Figure 2. Number of largemouth bass > 533 mm caught by anglers at Gibbons Creek Reservoir between 1994 and 2000.

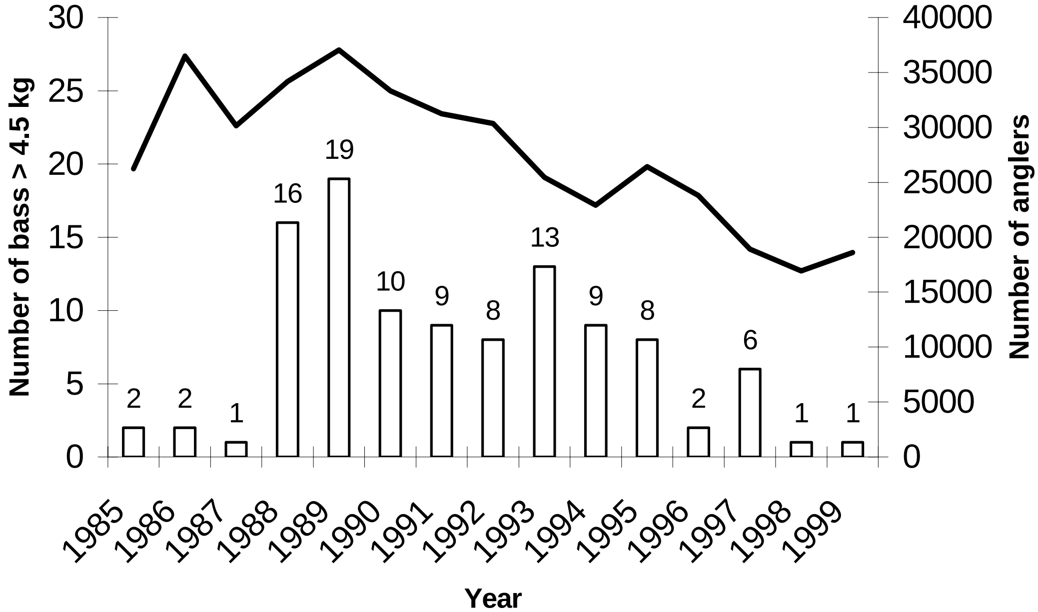


Figure 3. Numbers of largemouth bass > 4.5 kg reported by anglers (bars) compared to the number of anglers visiting Gibbons Creek Reservoir (line) between 1985 and 1999.

Comparing Survival, Growth, and Catchability Between Florida Largemouth Bass from the Homosassa River and Broodfish at Texas Parks and Wildlife Hatcheries

JOHN A. PRENTICE AND J. WARREN SCHLECHTE

Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, 5103 Junction Highway, Ingram, Texas 78025, (830) 866-3356

Abstract – Florida largemouth bass *Micropterus salmoides floridanus* from the Homosassa River (HRFLMB), Florida, possess a unique allele locus that might provide a genetic mark with possible benefits and uses for fisheries managers in post-stocking investigations. Ponds were stocked with fingerling bass and fish were observed for two years to evaluate survival, growth, and catchability of HRFLMB compared to Texas Parks and Wildlife Department hatchery-produced Florida largemouth bass (TFLMB). Year 1 survival in ponds was lower (P = 0.02) for TFLMB, but likely was related to pre-stocking stresses. No survival differences were found in year 2 (P = 0.26). Also, no differences were found in growth (length at year 1, P = 1.00, or year 2, P = 0.84, or weight at year 1, P = 0.49, or year 2, P = 0.34) or overall catchability (Wald X^2 = 0.75, P = 0.386). Therefore, HRFLMB appear to provide a permanent and non-encumbering mark for use in population monitoring following stocking.

The ability to mark fishes to evaluate effects of various fisheries management activities is a very powerful and often essential tool. However, ideal marking techniques must be permanent, non-encumbering, and must not alter performance or behavior (Parker et al. 1990; Nielsen 1992). A mark of genetic origin is beneficial because it is permanent and requires no handling for application. However, even minor genetic differences have been shown to alter growth and spawn return times of *Oncorhynchus* spp. (Peven and Hays 1989) and catch rate of Florida largemouth bass *Micropterus salmoides floridanus*, (FLMB) compared to largemouth bass *M. s. salmoides* (Chew 1975).

Florida largemouth bass from the Homosassa River (Citrus County, Florida) possess a unique allele locus (IDHP-1) in the enzyme system isocitrate dehydrogenase (IDH) (Philipp et al. 1982; Oakey 1988). The Homosassa River in Florida is a small and isolated system of shallow spring-fed habitats that varies from reservoirs or larger rivers where FLMB broodstock for Texas Parks and Wildlife Department (TPWD) hatcheries originated. Although Homosassa River FLMB (HRFLMB) have been used in Florida hatcheries and found to achieve large sizes with no differences observed in spawning compared to FLMB (Krause, R.A., Florida Game and Fresh Water Fish Commission, personal communication), variations in performance between HRFLMB and TPWD hatchery-produced Florida largemouth bass (TFLMB) in Texas systems have not been studied.

HRFLMB have been incorporated into the TPWD fish culture broodstock programs to allow development of broodstock with a unique genetic mark (Fries 1991). Stocking HRFLMB can allow fishery managers to identify hatchery-produced individuals in the wild, which aids in post-stocking evaluations. However, there is a need to determine if fish with this genetic mark have differences in survival, growth, or catchability that would need to be taken into account during such post-stocking investigations.

This study examined differences between TFLMB and HRFLMB in 1- and 2-year old growth and survival in ponds, and 2-year old catchability in ponds.

Methods and Materials

Young for this study were produced by standard hatchery procedures (Hutson 1990) from electrophoretically certified broodstock (Harvey et al. 1980) at A.E. Wood State Fish Hatchery (San

Marcos, Texas). Fingerlings of TFLMB were harvested from rearing ponds that had been drained the day before being loaded into transport tanks and being hauled to Heart of the Hills Fisheries Science Center, Ingram, Texas (HOH). Fingerlings of HRFLMB were harvested the day of being loaded and transported to HOH. Hatchery production was limited for HRFLMB that resulted in slightly larger HRFLMB than TFLMB (Table 1). Replicate hauling trips were not made due to limited numbers. Transport tank water volume was 284 L. Water in each tank was treated with compressed oxygen, to maintain 7.0 to 9.0 mg/L dissolved oxygen, and NaCl, to maintain a 0.25% solution, during the 4-h transport. One tank contained 8,320 TFLMB and another tank contained 7,330 HRFLMB. Upon arrival at HOH, fish were tempered for water quality and temperature differences between hauling and HOH water for 35 min. Individuals of each FLMB type were divided into one of eight indoor aquaria (four 2,100-L aquaria for each FLMB type and 1,500 fish per aquaria) with screened (to prevent unknown fishes entry) flow-through water supply. For each FLMB type, three aquaria were used for observing post-transport mortality and one aquarium held fish to be used for tagging. Total length ranges and means of tagged fish were 39 to 63 mm and 51.6 mm for HRFLMB, and 41 to 53 mm and 48.4 mm for TFLMB. All aquaria received live *Cyprinus carpio* fry *ad libitum* and freshly-hatched brine shrimp nauplii (*Artemia* sp.) were added twice per day.

Post-hauling mortality was observed in each aquarium at 24 and 48 h after arrival at HOH. Dead and dying fishes (fish observed with gill movement but with no or erratic swimming movement in the water column) were counted and removed from each aquarium and TL recorded for each fish at each of these times.

We injected fingerling FLMB with full-length coded wire tags (CWTs, Northwest Marine Technology [NMT], Inc., Shaw Island, Washington) to enable identification of each FLMB type by tag location. Tagging was done 24 h after arrival at HOH. To distinguish FLMB types, we selected two tag locations based on high tag retention and no evidence of biological effect (Heidinger and Cook 1988, Buckmeier 2001). For stocking in two ponds, we tagged TFLMB in the anterior musculature of the nape region just lateral to the mid-dorsal line and HRFLMB in the caudal peduncle musculature just lateral to the mid-dorsal line. For stocking in the other two ponds, we reversed the tag locations for each FLMB type to diminish any effect of tagging location. We anesthetized fish with a buffered tricane methanesulfonate solution (375 mg/L of $NaHCO_3$ and 75 mg/L of MS222 per 20 L of water) before tagging. Tagging was conducted using a Mark IV unit (NMT) fitted with a stationary needle and an injection needle guard to allow tag penetration to a depth of 1.5-2.0 mm. We held fish for 24 h post-tagging in four 2,100-L aquaria with flow-through water supply and feeding as described above.

In June 2000, we stocked four adjacent and similarly-shaped hatchery ponds (about 0.25 ha each) with FLMB. Fill and maintenance water was screened to prevent entry of unknown fishes (Hutson 1990). To better simulate a natural setting, submergent and emergent aquatic vegetation was provided in all ponds. Ponds were not fertilized, nor were fishes fed any artificial diet. We provided forage species (mosquitofishes *Gambusia*, sunfishes *Lepomis* and goldfish *Carassius auratus*) in equal total weights by species. To enable FLMB types to experience conditions as similar as possible, equal numbers of each tag-type fish were stocked together into each pond each year (Table 2). At the end of each year (June 2001 or July 2002), ponds were drained and all fishes were collected. Stocked FLMB were separated from other fishes, including age-0 FLMB. Stocked FLMB were identified by type based on tag location with a NMT handheld wand detector and measured to the nearest mm and g. All fishes (except age-0 FLMB) were returned to the same ponds, but HRFLMB and TFLMB were returned in equal numbers in each pond determined by the least surviving type for each pond, for the second year of comparisons.

Ricker (1975) defined catchability as the fraction of fish that are caught by exerting a defined unit of effort. As such, analysis of catchability is the study of catch occurrence and its associated timing. Allison (1995) noted that survival analysis is appropriate and less biased for events that occur to individuals in time and with data that are missing because the experiment was concluded before all individuals had been caught (censoring). The recognition that catchability incorporates time, and is in fact, longitudinal data for individual fish, and that the event time (catch) is known for individual fish, but only a portion of the fish in the pond, suggests that survival analysis would be an appropriate tool to analyze these data. Accurate measure of fish catchability is affected by many variables and how those variables interact with each individual fish, and it is important to discern a predictive model for analyses that mimics observed behavior.

Catchability experiments were conducted in summer of the second year after stocking. Four anglers fished ponds a total of 3 h (1.5 h in morning and 1.5 h in afternoon) in 45-min periods each fishing day. All ponds were fished simultaneously by one angler per pond during each period. Each fishing day, anglers were assigned randomly to a pond for the first fishing period and each angler rotated to a new pond in each succeeding time period such that each angler fished all ponds. Equal numbers of fishing days were given to all ponds. All anglers used identical baits (yellow or white spinner baits). Captured fish were placed in holding tanks at each pond. Upon completion of each fishing period, we identified FLMB to type with the NMT coded-wire detector wand, then counted and transferred them to individual indoor holding tanks until catchability experiments were completed (one tank per pond) to minimize bias in catchability estimates. Returning captured fish to study ponds would cause a bias in catchability estimates because those fish were expected to be caught again, or have a memory of capture. For each angling period, we recorded how many fish of each FLMB type each angler caught.

Although constant catchability is assumed in fisheries models, in many cases, the assumption of constant catchability is unwarranted (Quinn and Deriso 1999). Proc LifeReg allows the user to specify and test various assumptions about the pattern of catchability. Under the assumption of constant catchability, the exponential distribution would be used. However, for non-constant catchability, the Weibull, gamma and log-normal distributions provide a variety of options. For nested distributions, likelihood ratio tests are used to compare the fit of the various distributions (Allison 1995); for non-nested distributions, the Akaike's Information Criterion can be used (SAS 1999).

To analyze size at age (length and weight) and survival (*N* collected each summer at pond draining / *N* stocked the previous year) data for differences between types each year, we used paired t-tests, because each pond held both types of bass. Percent survival data were arcsine of square-root transformed (Snedecor and Cochran 1989) prior to analyses. Influence of tag location on survival was determined using analysis of variance (SAS, 1999). Catchability (*N* caught per angling increment / *N* present) analyses we used were modeled with Proc LifeReg (SAS, 1999). Number of fish present was determined by those counted from each pond at draining and assumed no mortality for the period from catchability experiments to pond draining. Catch comparisons of FLMB types for all ponds combined and within each pond were done with the Wald Test Chi-Square (X^2). Effects were considered significant at $P \leq 0.05$.

Results and Discussion

A total of 7,330 HRFLMB fingerlings in one pond and ≥30,000 TFLMB fingerlings in another pond was produced from multiple brooder pairs of each FLMB type and used for this study. Therefore, we assumed results for comparisons of pond survival, growth, and catchability reflect true population ranges. However, results of the single fish-hauling effort allow a low inference level for the fish transport survival portion of this study.

The two strains of bass had similar mortalities (< 1%) at the end of transport, but we observed higher mortalities for TFLMB compared to HRFLMB at 24- and 48-h post transport (Table 1). Limited hatchery production of the HRFLMB did not allow for replicate hauling efforts at densities that would simulate normally used hauling methods. The higher post-transport mortalities for TFLMB may have reflected additional stress on those fingerlings resulting from greater density of fish in the TFLMB rearing pond and the greater time (pond drained the evening before loading for TFLMB versus the pond drained the day of loading for HRFLMB) in a more crowded situation. HRFLMB and TFLMB were transported in different tank compartments and at different densities. Although tanks were very similar and densities for both fish types (HRFLMB = 26/L; TFLMB = 29/L, Table 1) were in a safe range of ≤ 300/L (McCraren 1978, Hutson 1990), it is also possible there were tank and density factors affecting transport survival that cannot be segregated. Further study on fecundity and fingerling survival of HRFLMB compared to TFLMB could help explain what differences exist and whether differences are meaningful to fisheries management applications.

First year survival was less than second year survival in all ponds and for both HRFLMB and TFLMB (Table 2). At the end of year 1 (Table 2), survival of HRFLMB was greater than that of TFLMB ($P = 0.02$), while at the end of year 2 no difference was found ($P = 0.26$). Location of CWT tags was not indicated to have affected survival in either year ($P = 0.48$). Tagging with CWTs should have imposed minimal additional stress and mortality based on similar use on LMB with low mortalities by others (Heidinger and Cook 1988, Buckmeier 2001). It is not clear why HRFLMB had greater survival than TFLMB for year 1. Post-transport mortality was continuing at 48 hours (Table 1) and suggests a delayed mortality could have continued after stocking in ponds.

We found no difference in mean size between HRFLMB and TFLMB in either year (Table 3) by length (year 1, $P = 1.00$ or year 2, $P = 0.84$) or weight (year 1, $P = 0.49$ or year 2, $P = 0.34$). Not only was growth of HRFLMB and TFLMB similar, but these FLMB also grew more rapidly than statewide averages reported for wild LMB populations in Prentice (1987). The growth observed could be due to many factors including pond environment and fish genetic potential, but similar performance between fish types supports the idea of no fish performance encumbrance due to the genetic mark. Relatively isolated fish populations, such as the Homosassa River FLMB, can suffer from reduced genetic heterozygosity that can lead to decreased fitness observed in reduced growth (Smith and Chester 1981, Hallerman et al. 1986). Although the Homosassa River source population of HRFLMB brooders for this study was found to have high levels of genetic variation and mean heterozygosities, compared to other Florida rivers (Oakey 1988), it is important that production of HRFLMB offspring maintains high genetic variation. Observation of growth at older ages may show a growth difference between HRFLMB and TFLMB (similar to that reported by Maceina et al. [1988] for FLMB and LMB), but this has not been indicated in Florida state hatcheries (Krause, R.A., Florida Game and Freshwater Fish Commission, personal communication).

A trend of decreasing percent of both fish types caught was observed as cumulative angler effort increased (Figure 1). Comparison of multiple forms of catchability modeling, such as equal and variable, or patterned, catch through time, indicated catchability data were best modeled with the log-normal distribution. Use of the log-normal distribution suggests that, for the population over time, risk of being caught would initially be high followed by decreased risk (Allison 1995). Considering overall catch (all ponds combined), no difference was found between fish types (Wald $X^2 = 0.75$, $P = 0.386$, Figure 1). However, we found considerable differences in catch between ponds with varying ranges of catchabilities over time (Wald $X^2 = 11.56$, $P = 0.009$, Figure 2). No difference was found between FLMB types in Pond A (Wald $X^2 = 0.436$, $P = 0.51$, Figure 2) and Pond D (Wald $X^2 = 1.12$, $P = 0.29$, Figure 2). Cumulative percent catch was < 25% and < 45% in ponds A and D, respectively. In Pond B, TFLMB were caught at a higher rate than HRFLMB (Wald $X^2 = 5.56$, $P = 0.016$, Figure 2), while in Pond C, the reverse was true (Wald $X^2 = 5.94$, $P = 0.015$, Figure 2). Cumulative percent catch of TFLMB in Pond B was relatively higher than cumulative catch in ponds A and D, but highest cumulative percent catch was observed for HRFLMB in Pond C (Figure 2). Observed variations in catch between ponds suggests catch differences are due more to various factors of habitat or ponds than to genetics, as found in cases between NLMB and FLMB (Zolczynski and Davies 1976, Bottroff and Lembeck 1978, Kleinsasser et al. 1990). However, catch was measured in this study from a gear efficiency (number of fishes caught per unit of effort) perspective. Future consideration might be given to measuring catch more closely based on fish behavior responses by measuring length of time fishing to achieve each catch rather than total catch per unit of effort.

HRFLMB appear to provide a non-encumbering mark for use in population monitoring following stocking. If pond survival differences observed during year 1 represent true population values, HRFLMB could provide a positive difference in stocking contribution in the wild when compared to TFLMB stocks. As such, using HRFLMB to evaluate stocking success of all FLMB stocks might lead to a positive bias in stocking success. Although it may be possible to account for this bias, more work on whether these two stocks have differential first-year survival needs to be done.

Acknowledgments

We thank staff at A.E Wood State Fish Hatchery for fish production and Heart of the Hills Fisheries Science Center for study assistance and critical review of the manuscript. Funding for this study was provided by Federal Aid in Sport Fish Restoration, Grant F-31-R, Job 95 to the Texas Parks and Wildlife Department.

Literature Cited

Allison, P. D. 1995. Survival Analysis Using the SAS System: A Practical Guide. SAS Institute Inc., Cary, NC. 292 pp.

Bottroff, L.J., and M.E. Lembeck. 1978. Fishery trends in reservoirs of San Diego County, California, following the introduction of Florida largemouth bass, Micropterus salmoides floridanus. California Fish and Game 64(1):4-23.

Buckmeier, D.L. 2001. Coded wire tag insertion sites for small fingerling black bass. North American Journal of Fisheries Management 21:696-698.

Chew, R.L. 1975. The Florida largemouth bass. Pages 450-458 *in* R.H. Stroud and H. Clepper, editors. Black Bass Biology and Management, Sport Fishing Institute, Washington, D.C.

Fries, L.T. 1991. A rare genetic mark in Florida bass from the Homosassa River, Florida. Annual Proceedings of the Texas Chapter American Fisheries Society 14:1.

Hallerman, E.M., R.O. Smitherman, R.B. Reed, W.H. Tucker and R.A. Dunham. 1986. Biochemical genetics of largemouth bass in mesosaline and freshwater areas of the Alabama River system. Transactions of the American Fisheries Society 115:15-20.

Harvey, W.D., I.F. Greenbaum, and R.L. Noble. 1980. Electrophoretic evaluation of five hatchery stocks of largemouth bass in Texas. Annual Proceedings of the Texas Chapter American Fisheries Society 3:49-63.

Heidinger, R.C., and S.B. Cook. 1988. Use of coded wire tags for marking fingerling fishes. North American Journal of Fisheries Management 8:268-272.

Hutson, P.L. 1990. Florida largemouth bass culture in Texas. Texas Parks and Wildlife department, Inland Fisheries Branch, Management Data Series No. 35, Austin. 46pp.

Kleinsasser, L.J., J.H. Williamson, and B.G. Whiteside. 1990. Growth and catchability of northern, Florida and F_1 hybrid largemouth bass in Texas ponds. North American Journal of Fisheries Management 10:462-468.

Maceina, J.J., B.R. Murphy, J.J. Isely. 1988. Factors regulating Florida largemouth bass stocking success and hybridization with northern largemouth bass in Aquilla Lake, Texas. Transactions of the American Fisheries Society 117:221-223.

McCraren, J.P. 1978. Manual of fish culture: fish transportation. U. S. Fish and Wildlife Service, Washington, D. C.

Nielsen, L.A. 1992. Methods of marking fish and shellfish. American Fisheries Society Special Publication 23, Bethesda, MD. 208 pp.

Oakey, D.D. 1988. Genetic analysis and manipulation of sport fish stocks. Florida Game and Fresh Water Fish Commission, Performance Report, Federal Aid in Sport Fish Restoration, Project No. F-48. 9 pp.

Parker, N., and 5 co-editors. 1990. Fish-marking techniques. American Fisheries Society Symposium 7, Bethesda, MD. 879 pp.

Peven, C.M., and S.G. Hays. 1989. Proportions of hatchery- and naturally produced steelhead smolts migrating past Rock Island Dam, Columbia River, Washington. North American Journal of Fisheries Management 9:53-59.

Philipp, D.P., W.F. Childers, and G.S. Whitt. 1982. Biochemical genetics of largemouth bass (*Micropterus salmoides).* Electric Power Research Institute. Palo Alto, CA.

Prentice, J.A. 1987. Length-weight relationships and average growth rates of fishes in Texas. Texas Parks and Wildlife Department, Inland Fisheries Data Series, No. 6, Austin, 61 pp.

Quinn, T.J., II and R.B. Deriso. 1999. Quantitative Fish Dynamics. Oxford University Press. New York, NY. 542 pp.

Ricker, W.E. 1975. Computation and Interpretation of Biological Statistics for Fish Populations. Bulletin of the Fisheries Research Board of Canada. Bulletin 191. Ottawa, Ontario. 382 pp.

SAS Institute Inc. 1999. SAS/STAT user's guide, Version 8. SAS Institute, Cary, North Carolina. 3884 pp.

Smith, M.H., and R.K. Chester. 1981. Rational for conserving genetic variation in salmonid fishes. Ecological Bulletins – NFR 34:13-20.

Snedecor, G.W., and W.G. Cochran. 1989. Statistical methods. Eighth edition. Iowa State University Press, Ames. 503 pp.

Zolczynski, S.J.,Jr., and W.D. Davies. 1976. Growth characteristics of the northern and Florida subspecies of largemouth bass and their hybrid, and a comparison of catchability between the subspecies. Transactions of the American Fisheries Society 105:240-243.

TABLE 1. Size and mortality of Homosassa River (HRFLMB) and TPWD hatchery broodfish Florida largemouth bass (TFLMB) subjected to handling stress of harvest and transport at arrival (end of transport) and 24- and 48-hours post transport (mean±SE; fish observed in three 2,100-liter aquaria with 1,500 fish per aquarium) from A.E. Wood State Fish Hatchery, San Marcos, Texas, to Heart of the Hills Fisheries Science Center, Ingram, Texas.

	Florida largemouth bass type	
Variable	HRFLMB	TFLMB
Harvest size (total length, mm)		
Mean	58.1	48.4
Range	47 – 70	34 – 60
Transport		
N loaded /284 L	7,330	8,320
N dead at transport end	32	16
Post transport cumulative mortality		
N dead at 24 hours	13.0±1.53	37.3±3.22
N dead at 48 hours	19.0±0.82	53.7±9.90

TABLE 2. Percent survival of two Florida largemouth bass types (Homosassa River [HRFLMB] and TPWD hatchery broodstock [TFLMB]) stocked into (number stocked into pond appears in parentheses)and retrieved from at draining, four 0.25-ha study ponds at Heart of the Hills Fisheries Research Center, Ingram, Texas (2001 – 2002).

		Florida largemouth bass type	
Pond	Year	HRFLMB	TFLMB
A	1	54.4 (160)	20.0 (160)
	2	100.0 (20)	95.0 (20)
B	1	75.6 (160)	28.8 (160)
	2	87.0 (46)	67.4 (46)
C	1	63.8 (160)	22.5 (160)
	2	100.0 (36)	91.7 (36)
D	1	54.4 (160)	41.9 (160)
	2	83.6 (67)	94.0 (67)

TABLE 3. Mean (±SE) total length (mm) and weight (g) of Florida largemouth bass from the Homosassa River (HRFLMB) and from TPWD hatchery broodstock (TFLMB) collected at study pond draining when fishes were at ages 1 and 2, Heart of the Hills Fisheries Science Center, Ingram, Texas. Mean values with a letter in common across a row are not significantly different between fish types, $P \leq 0.05$.

		Florida largemouth bass type	
Year	Parameter	HRFLMB	TFLMB
1	Total length	211.6 ± 9.47 A	211.7 ± 9.94 A
	Weight	111.5 ± 24.50 A	108.6 ± 19.03 A
	N	397	175
2	Total length	297.1 ± 12.67 A	296.4 ± 15.16 A
	Weight	368.2 ± 56.65 A	355.5 ± 60.31 A
	N	155	154

FIGURE 1. Percent of Florida largemouth bass caught per angler effort (45 minutes) during year 2 for Homosassa River (HRFLMB) and TPWD hatchery broodfish (TFLMB) in all study ponds combined at Heart of the Hills Fisheries Science Center, Ingram, Texas.

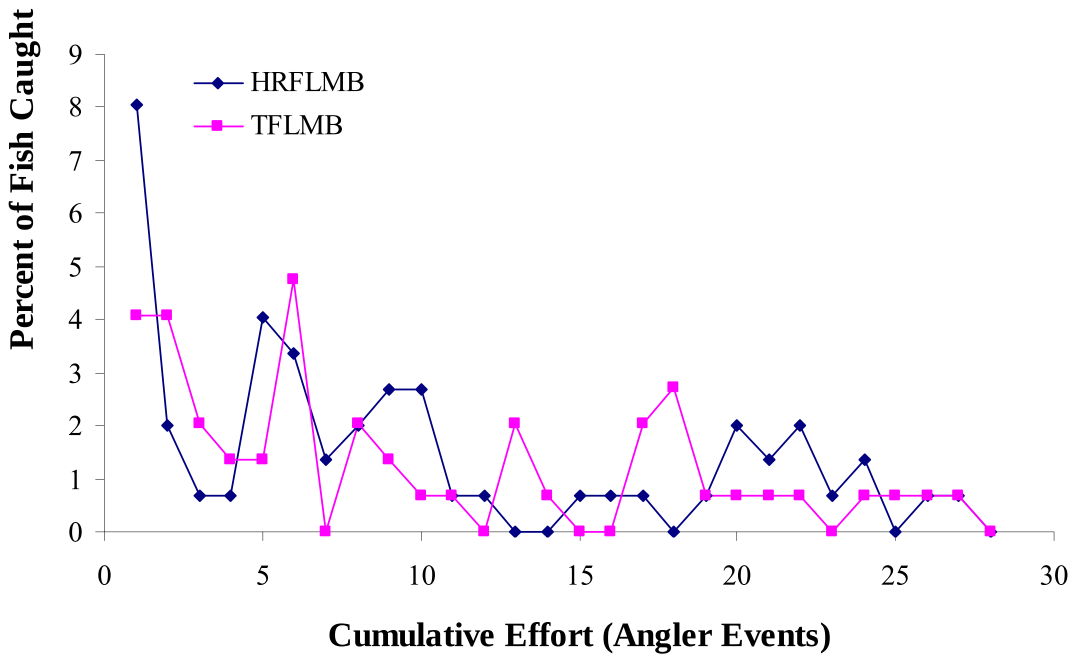
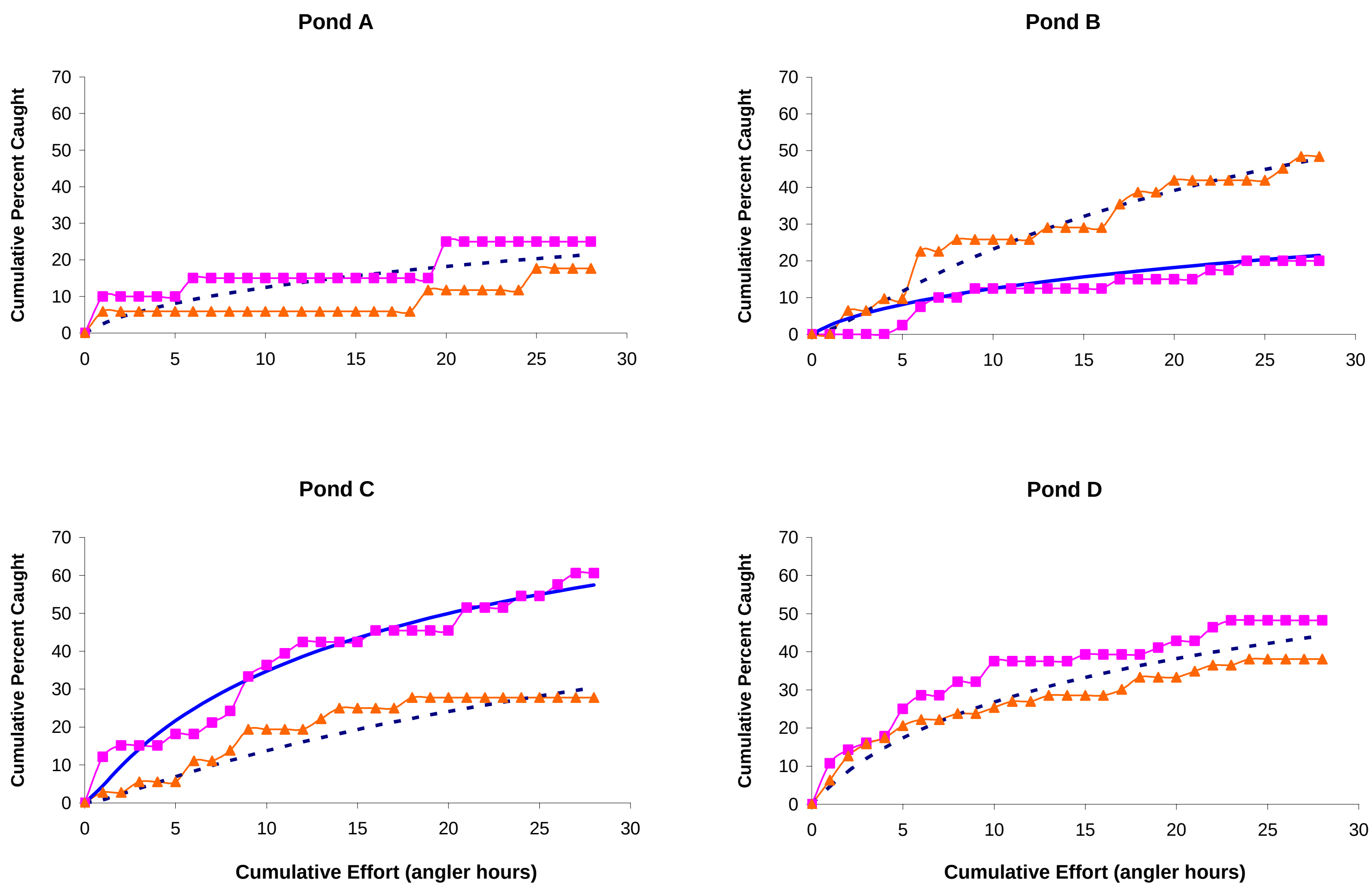


FIGURE 2. Observed and predicted catch (cumulative percent of each total fish population caught with cumulative fishing effort) during year 2 for Florida largemouth bass from the Homosassa River (HRFLMB) and TPWD hatchery broodfish (TFLMB) in study ponds A, B, C and D at Heart of the Hills Fisheries Science Center, Ingram, Texas. Observed HRFLMB and TFLMB catches are indicated by graph lines highlighted by squares and triangles, respectively. Predicted (fitted) HRFLMB and TFLMB catches are indicated by solid or dashed graph lines, respectively. In ponds A and D, where no catch difference was found between FLMB types, the predicted (fitted) line is dashed.



Acknowledgments

The contributions of the abstract authors and the Editorial Committee (Tim Bonner, Preston Bean, Jackie Watson, and Casey Williams) towards the preparation of this Proceedings is gratefully acknowledged

The entire Chapter is appreciative to the many contributors who donated auctionable and raffleable goods, money, and services for the 2004 meeting in College Station, Texas

Citation:

Author(s). 2005. Title. Pages ____ in T. H. Bonner, editor. Annual Proceedings of the Texas Chapter, American Fisheries Society, Volume 24. Texas Chapter, American Fisheries Society, San Marcos, Texas.

ISSN 1060-2224