

ANNUAL PROCEEDINGS
of the
TEXAS CHAPTER

AMERICAN FISHERIES SOCIETY



Tyler, Texas

15-17 January 2015

Volume 37

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
15-17 January 2014
Tyler, Texas

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Texas Parks and Wildlife Department

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TABLE OF CONTENTS

Past Texas Chapter Presidents and Meeting Locations	vi
Texas Chapter Award Recipients.....	vii
Abbreviations	xiii

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

Adaptive fisheries management in the face of extreme drought <i>Lang, T., R. Mauk, W. Dutter, and S. Hise</i>	1
Impacts of climate change on the water quality of Big Cypress Creek and Lake O' the Pines <i>Rushin, R.</i>	1
Drought driven re-establishment of Guadalupe Bass <i>Micropterus treculii</i> in the Blanco River, Texas <i>Magnelia, S., G. Linam, D. Lutz-Carrillo, K. Saunders, R. Ranft, and K. Kolodziejczyk</i>	2
Movement of federally endangered Fountain Darters <i>Etheostoma fonticola</i> during low spring flows <i>Littrell, B., J. T. Jackson, E. L. Oborny, and K. G. Ostrand</i>	2
Using a niche model to hindcast and forecast golden alga blooms: when did golden alga first arrive in the Brazos River and which lake will be affected next? <i>VanLandeghem, M., and R. Patiño</i>	3
The effect of electroshocking on unionid mussel larval release <i>Symonds, D., L. R. Williams, and N. B. Ford</i>	3
Changes in angler behavior in Aransas Bay <i>Bartram, B.</i>	4
Contribution, size, and diet of stocked Largemouth Bass in three aquatic vegetation types in Toledo Bend Reservoir <i>Ashe, D. E., M. T. Driscoll, and J. W. Schlechte</i>	4
Flow-dependent competition between the endangered <i>Gambusi nobilis</i> and the invasive <i>Gambusia geiseri</i> <i>Delaune, K. D., and C. W. Hargrave</i>	4

Mapping the tempo-spatial distribution of batoids to improve conservation in a subtropical estuary <i>Possatto, F. E., K. O. Winemiller, H. L. Spach, M. R. Lamour, K. M. Santos, M. K. Broadhurst, and R. B. Millar</i>	5
Evaluation of Water Willow (<i>Justicia americana</i>) use by reservoir fishes <i>O’Hanlon, R., C. Mynatt, M. Webb, and F. Gelwick</i>	5
Ecological effects of Water Willow (<i>Justicia americana</i>) on aquatic invertebrate species <i>Mynatt, C., R. O’Hanlon, M. Webb, and F. Gelwick</i>	6
Use of side-scan sonar to identify and count Alligator Gar: potential for evaluating population density from sonar imagery <i>Fleming, B. P., D. J. Daugherty, and N. G. Smith</i>	6
Development of Fathead Minnow as a model organism for the study of immune function: characterization of molecular responses to pathogen infection <i>Thornton, L. M, M. C. LeSueur, A. T. Yost, D. A. Stephens, J. T. Oris, and M. K. Sellin Jeffries</i>	7
TPWD’s cross divisional efforts in the Llano River watershed to benefit aquatic resources <i>Bean, M., T. Birdsong, M. Parker, M. Shelley, and A. Kalmbach</i>	7
Effect of interannual hydrological variation on fish assemblage composition in the central Amazon <i>Röpke, C., S. Amadio, and K. O. Winemiller</i>	8
Determining viable host-fish species for <i>Fusconia askewi</i>, <i>Potamilus amphichaenus</i>, and <i>Pleurobema riddellii</i> in east Texas <i>Bertram, E. J. S. Placyk, Jr., and L. R. Williams</i>	8
Can river-reservoir interfaces serve as surrogate nurseries for riverine fishes? <i>Acre, M. R., T. B. Grabowski, and N. G. Smith</i>	9
Spatial and temporal distribution of catfish game species at the river-reservoir ecosystem scale <i>Grubh, A., B. P. Fleming, M. Homer, and S. Robertson</i>	9
Flow dynamics and temporal distribution in fish assemblage structure in two Texas Gulf Coast rivers <i>Rodger, A. W., C. A. Krabbenhoft, and K. O. Winemiller</i>	10
Characterizing the benthic food resources and habitat utilization of Black Drum (<i>Pogonias cromis</i>) in Baffin Bay, Texas <i>Mendenhall, K., J. Pollack, M. Ajemian, G. Stunz, and T. Palmer</i>	10

A historical summary of the fish assemblages of the Wichita River, Texas <i>Cross, L., and G. R. Wilde</i>	11
Specific gravity of ova and fry of broadcast-spawning cyprinids <i>Coleman, C. G., and G. R. Wilde</i>	11
Does water chemistry limit the distribution of New Zealand mud snails in Redwood National Park? <i>Vazquez, R., and D. M. Ward</i>	11
Pattern of invasion of a nonindigenous cyprinid and potential shifts in the native fish assemblage structure <i>Best, A., and C. E. Johnston</i>	12
Selecting strategic habitat areas to help protect North Carolina’s coastal fisheries <i>Jensen, C.</i>	12
Using ongoing fishery monitoring to predict the relationship between seagrass habitats and fish CPUE and diversity <i>Clarkson, E.</i>	13
Establishment of native aquatic vegetation in conjunction with an integrated pest management program <i>Woelfel, H. M. P. Masser, and M. A. Webb</i>	13
Adaptive management of Eastern Oysters (<i>Crassostrea virginica</i>) in Texas – implementation of emergency closure guidelines in Copano Bay, Texas <i>Mace, C. E.</i>	14
Aquatic food-web structure varies longitudinally with natural and anthropogenic influences in the Pecos River, Texas and New Mexico <i>East, J., and A. A. Pease</i>	14
Early development of Mexican Snook <i>Centropomus poeyi</i> (Teleostei: Centropomidae) <i>Kubicek, K., R. Martinez Garcia, C. A. Alvarez González, and K. Conway</i>	15
Evaluation of community-level physiological profiling for monitoring microbes in fish hatchery ponds <i>Kurten, G. L., and A. Barkoh</i>	15
Spatial patterns in Texas lotic fish communities <i>Lane, M., S. Curtis, J. Oakley, M. Mokrech, and G. Guillen</i>	16

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

Long-term changes in the fish assemblage of the upper Brazos River, Texas <i>Wilde, G. R., and K. B. Mayes</i>	17
Discharge from the Rio Conchos (Mexico) drives streamflow, salinity, and fish diversity in the Big Bend area of the Rio Grande/Rio Bravo del Norte (USA/Mexico): a retrospective analysis <i>Miyazono, S., R. Patiño, and C. M. Taylor</i>	17
Angler effort determined from camera images and a creel survey on a Texas reservoir <i>Dumont, S., and M. Homer, Jr.</i>	17
Size-selective predation by Gulf Killifish on endangered Sharpnose Shiner <i>Wilde, G. R., A. C. Urbanczyk, R. Vazquez, C. Coleman, and W. L. Cross</i>	18
Challenges of fish surveys in an arid environment <i>Carrano, E.</i>	18
Structure and dynamics of fish communities in the upper Uruguay River, Brazil <i>De Bem, J. C., E. Z. Filho, S. H. Silva, K. O. Winemiller, and C. Röpke.</i>	19
Are river-reservoir interface habitats operating as fish nurseries for Lake Texoma? <i>Gilbert, M. D., and A. A. Pease</i>	19
Investigating predation impacts of non-native Gulf Killifish <i>Fundulus grandis</i> on Pecos River fishes <i>Vaughan, C. M., J. H. Breaux, J. L. East, and A. A. Pease</i>	20
Effects of experimental warming on stream ecosystem structure and function <i>Hargrave, C. W., K. P. Gary, and J. Lee</i>	20
Basic aspects of immunity in two teleost model organisms, the Fathead Minnow and the Sheepshead Minnow <i>Thornton, L. M., M. C. LeSueur, and M. K. Jeffries</i>	21
The Fathead Minnow fish embryo toxicity test: an alternative method for evaluating whole effluent toxicity and surface water quality <i>Stephens, K. S. Roush, J. T. Oris, and M. K. Jeffries</i>	21
The effects of a ubiquitous aquatic plant contaminant, PBDE-47, on growth and thyroid function in fish and amphibians <i>Yost, A. L., L. M. Thornton, E. M. Path, B. J. Venables, and M. K. Jeffries</i>	22

Encroachment of Common Reed in the Canadian River and its effect on the river channel from 2008 through 2012	
<i>Urbanczyk, A. C., and G. R. Wilde</i>	22
Distribution, abundance, and habitat use of the Saltmarsh Topminnow (<i>Fundulus jenkinsi</i>)	
<i>Robertson, J., S. Curtis, J. Oakley, and G. Guillen</i>	23
Quantifying the dietary tryptophan requirement of juvenile Red Drum	
<i>Pewitt, E.</i>	23
Conservation assessment and mapping products for Great Plains priority fish taxa	
<i>Labay, B., D. Hendrickson, A. Cooper, and J. Perkin</i>	24
Morphological divergence in multiple <i>Notropis oxyrhynchus</i> populations	
<i>French, C., A Cohen, D. Hendrickson, and B. Langerhans</i>	24
The "Fluviageny" - analyzing temporal river fragmentation using phylogenetics	
<i>Gordon, A., D. Hendrickson, and B. Labay</i>	25
Evaluating the effects of drought and anthropogenic alterations on the growth of stream fishes on the Edwards Plateau, central Texas	
<i>Massure, W. A., T. B. Grabowski, and T. Arsuffi</i>	25
Potential morphological response of Guadalupe Bass populations to hydrologic alteration and urbanization within the Colorado River Basin, Texas	
<i>Pease, J. T. B. Grabowski, A. A. Pease, and P. T. Bean</i>	26
The role of sexual selection in hybridization between pupfishes (genus <i>Cyprinodon</i>)	
<i>Becher, C., and J. Gumm</i>	26
Territoriality and 'dear enemy' recognition between heterospecific pupfishes (genus <i>Cyprinodon</i>)	
<i>Brooks, C. A. C., and J. Gumm</i>	27
Acknowledgements	28

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 Texoma, 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 Texoma, 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
2006	Dave Terre	San Antonio
2007	Debbie Wade	Lake Jackson
2008	Art Morris	Junction
2009	Tim Bonner	Fort Worth
2010	Brian Van Zee	Athens
2011	Ken Kurzawski	San Marcos
2012	Craig Bonds	Galveston
2013	George Guillen	Conroe
2014	Richard Ott	Pottsboro
2015	Bruce Hysmith	Tyler

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 - Kathryn 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 Higginbotham (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)
- 2005 Fisheries Administration – Roger McCabe (TPWD)
 Fisheries Management – Todd Driscoll (TPWD)
 Fisheries Student – Bart Durham (TTU)
 Special Recognition – Jimmie Green (TPWD) and Kirk Green
 Special Recognition – The Patsy B. Hollandsworth Family Foundation
 Best Presentation – Gregory Stunz (TAMUCC), and coauthors Jay Rooker (TAMUG), Joan Holt and Scott Holt (UT)
 Best Student Presentation – Julie Hulbert, and coauthors Timothy Bonner and David Pendagrass (TXSTATE), and Joe Fries (National Fish Hatchery – San Marcos)
 Best Poster Presentation – Michael Baird (TPWD)
 Scholarships, Undergraduate – Brian Bartram (TAMUCC), John Putegnat (TAMU)
 Scholarships, Graduate – Megan Fencil (UTMSI), Casey Williams (TXSTATE)
- 2006 Fisheries Education – Kevin Pope (TTU)
 Fisheries Management – Dave Terre (TPWD)
 Fisheries Research – Loraine Fries (TPWD)
 Technical Support – Todd Robinson (TPWD)
 Special Recognition – Bruce Hysmith (TPWD)
 Special Recognition – Joan Glass (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)
 Scholarships, Undergraduate – Chris Arredondo (TAMUCC), Josh Perkin (TXSTATE)
 Scholarships, Graduate – Bart Dunham (TTU), Casey Williams (TXSTATE)
- 2007 Fisheries Administration – Larry McKinney (TPWD)
 Fisheries Culture – Gary Garrett (TPWD)
 Fisheries Management – Charlie Munger (TPWD)
 Fisheries Research – Gary Garrett (TPWD) and Bob Edwards (UTPA)
 Fisheries Student – Chris Chizinski (TTU)
 Honorable Mention (Fisheries Student) – Brad Littrell (TXSTATE)
 Technical Support – Reynaldo Cardona (TPWD)
 Special Recognition – Robert Howells (TPWD)
 Special Recognition – Fred Janssen (TPWD)
 Special Recognition – Craig Scofield (TPWD)
 Special Recognition – Sandy Henry (Science Spectrum, Lubbock)
 Best Presentation – Craig Bonds, coauthors John Taylor and Jeremy Leitz (TPWD)
 Best Student Presentation – Matthew Chumchal (OU), coauthors Michael Slattery, Ray Drenner, Matthew Drenner and Leo Newland (TCU)
 Best Poster Presentation – Richard Ott and Timothy Bister (TPWD)
 Scholarships, Graduate (M.S.) – Brian Bartram (Baylor)
 Scholarships, Graduate (Ph.D.) – John Froeschke (TAMUCC)

- 2008 Fisheries Administration – Lance Robinson (TPWD)
 Fisheries Education – Andre M. Landry, Ph. D. (TAMUG)
 Fisheries Research – Bart Durham (TTU)
 Fisheries Student – Preston Bean (TXSTATE)
 Honorable Mention – Zachary Shattuck (TXSTATE)
 Technical Support – Corey Clouse (TPWD)
 Special Recognition – Chad Thomas (TXSTATE)
 Best Presentation – Matthew Chumchal (TCU)
 Best Student Presentation – Rodney Gamez (TAMUCC)
 Best Poster Presentation – James Tolan (TPWD)
 Scholarships, Undergraduate – JoHanna Weston (UD)
 Scholarships, Graduate (M.S.) – Megan Bean (TXSTATE)
 Scholarships, Graduate (Ph.D.) – Preston Bean (TXSTATE)
- 2009 Fisheries Administration – Phil Durocher (TPWD)
 Fisheries Education – Michael Masser (TAMU)
 Fisheries Research – Ray Drenner (TCU)
 Fisheries Student – Joshuah Perkin (TXSTATE)
 Honorable Mention –
 Fisheries Management – John Moczygemba (TPWD)
 Technical Support – Mike Gore (TPWD)
 Special Recognition –
 Best Professional Presentation – Ray Drenner (TCU)
 Best Student Presentation – Ted Valenti (BAYLOR)
 Best Professional Poster Presentation – Pat Bohannon (TPWD)
 Best Student Poster Presentation – Brianne Kiester (TCU)
 Scholarships, Undergraduate – Michelle Parmley (TXSTATE); Nicholas Bertrand (TXSTATE)
 Scholarships, Graduate (M.S.) – Joshuah Perkin (TXSTATE)
 Scholarships, Graduate (Ph.D.) – Bridgette Froeschke (TAMUCC)
 Clark Hubbs Research Award – Ben Labay (TXSTATE)
- 2010 Fisheries Administration – Mike Ray (TPWD)
 Fisheries Research – Aaron Barkoh (TPWD)
 Fisheries Culture – Hugh Glenewinkel (TPWD)
 Fisheries Student – Ben Labay (TXSTATE)
 Fisheries Management – Richard Ott (TPWD)
 Special Recognition – Mandy Scott (TPWD)
 Best Professional Presentation – Michael Tobler (TAMU)
 Best Student Presentation – Ben Labay (TXSTATE)
 Best Professional Poster Presentation – Mike Stahl (TPWD)
 Best Student Poster Presentation – Ben Labay (TXSTATE)
 Scholarships, Undergraduate – Jake Wimberly
 Scholarships, Graduate (M.S.) – Laura Bivins
 Scholarships, Graduate (Ph.D.) – Gabriella Ahmadia
 Clark Hubbs Research Award – Seiji Miyazono (TTU)
- 2011 Fisheries Administration – Art Morris (TPWD)
 Fisheries Education – Fran Gelwick (TAMU)
 Fisheries Culture – Juan Martinez (TPWD)
 Fisheries Research – Kristy Kollaus (TXSTATE)
 Fisheries Student – Katie Roach (TAMU)
 Fisheries Management – Dan Bennett (TPWD)
 Technical Support – Danny Lewis (TPWD)
 Special Recognition – Craig Bonds (TPWD)
 Special Recognition – Carl Kittel (TPWD)
 Special Recognition – Brian Van Zee (TPWD)

- Best Professional Presentation – David Buckmeier (TPWD)
 Best Student Presentation – Sandra Bibiana Correa (TAMU)
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 Scholarships, Graduate (Ph.D.) – John Mohan
 Scholarships, Graduate (Ph.D.) – Judson Curtis
 Clark Hubbs Research Award – Carmen G. Montana (TAMU)
- 2012 Fisheries Administration – Craig Bonds (TPWD)
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 Fisheries Research – Kirk Winemiller (TAMU)
 Fisheries Student – Carmen G. Montana (TAMU)
 Technical Support – Robert “Bobby” Wienecke (TPWD)
 Special Recognition – Seven Coves Bass Club
 Special Recognition – TTU-Department of Biology: Gene Wilde, Aaron Urbanczyk, Doug Knabe
 Special Recognition – TPWD-River Studies: Kevin Mayes, Clint Robertson, Kevin Kolodziejczyk
 Special Recognition – TPWD-Hatcheries: Dale Lyon, Carl Kittel, Daniel Field, Greg Polk
 Special Recognition – Kevin Mayes (TPWD)
 Best Professional Presentation – Brad Littrell (BIO-WEST)
 Best Student Presentation – William Smith (TAMU)
 Best Professional Poster Presentation – Raelynn Deaton (SEU)
 Best Student Poster Presentation – Dan Fitzgerald (TAMU)
 Scholarships, Undergraduate – Ruben Palacios (TAMUCC)
 Scholarships, Graduate (M.S.) – Karen Drumhiller (TAMUCC)
 Scholarships, Graduate (Ph.D.) – Larissa Kitchens (TAMUG)
 Harry Tennyson Scholarship – William Smith (TAMU)
 Harry Tennyson Scholarship – Matt VanLandeghem (TTU)
 Clark Hubbs Research Award – Steven Curtis (TXSTATE)
- 2013 Fisheries Administration – Brenda Bowling (TPWD)
 Fisheries Administration – Tim Birdsong (TPWD)
 Fisheries Education – George Guillen (UHCL)
 Fisheries Culture – Jennifer Butler (TPWD)
 Fisheries Student – Rebecca Pizano (TAMU)
 Fisheries Management – Mark Webb (TPWD)
 Technical Support – Bill Hughes (TPWD)
 Special Recognition – Randy Rushin (Water Monitoring Solutions)
 Special Recognition – East Texas Woods and Waters Foundation
 Special Recognition – Kirk Winemiller (TAMU)
 Special Recognition – Loraine and Joe Fries (TPWD, USFWS)
 Best Professional Presentation – Ashley Oliver (Halff and Associates)
 Best Student Presentation – Tiffany Hedrick-Hopper (TTU)
 Best Professional Poster Presentation – Kevin Mayes (TPWD), Brenda Bowling (TPWD)
 Best Student Poster Presentation – Niki Ragan (SHSU)
 Scholarships, Undergraduate – Lindsey Carey (TAMU)
 Scholarships, Graduate (M.S.) – Virginia Eaton (TXSTATE)
 Scholarships, Graduate (Ph.D.) – Alin Gonzales (TAMUCC)
 Harry Tennyson Scholarship – Melissa Giresi (TAMU)
 Harry Tennyson Scholarship – Michael Dance (TAMUG)
 Clark Hubbs Research Award – Daniel Fitzgerald (TAMU)
- 2014 Fisheries Administration – Dave Terre (TPWD)
 Fisheries Education – Reynaldo Patiño (TTU, USGS)

- Fisheries Culture – Possum Kingdom Fish Hatchery Team (TPWD)
 Fisheries Research – Warren Schlechte (TPWD)
 Fisheries Student – Tony Rodger (TAMU)
 Fisheries Management – Brad Littrell (BIO-WEST)
 Technical Support – Patsy Berry (TPWD)
 Special Recognition – Fishes of Texas Team (UT Texas Natural History Collections)
 Special Recognition – Gary Garrett (TPWD)
 Special Recognition – Todd Driscoll (TPWD)
 Best Professional Presentation – Joshua Perkin (Kansas State University)
 Best Student Presentation – Kole Kubicek (TAMU)
 Best Professional Poster Presentation – Bryan Legare (TPWD)
 Best Student Poster Presentation – Jessica Pease (TTU)
 Scholarships, Undergraduate – Crystal Purcell (University of Dallas)
 Scholarships, Undergraduate – Takona Tipton (TAMU)
 Scholarships, Graduate (M.S.) – Jessica East (TTU)
 Scholarships, Graduate (Ph.D.) – Landes Randall (TAMU)
 Harry Tennyson Scholarship – Maelle Comic (TAMUG)
 Harry Tennyson Scholarship – Lisa Havel (UTMSI)
 Clark Hubbs Research Award – Jessica East (TTU)
- 2015 Fisheries Education – Dan Roelke (TAMU)
 Fisheries Culture – Deborah Wade (TPWD)
 Fisheries Research – Dan Daugherty (TPWD)
 Fisheries Research, Honorable Mention – Tim Grabowski (USGS, TTU)
 Fisheries Student – Jessica East (TTU)
 Fisheries Student, Honorable Mention – Erin Bertram (UTT)
 Fisheries Management – Marcos De Jesus (TPWD)
 Technical Support – Karim Aziz (TPWD)
 Special Recognition – Jimmie Green
 Special Recognition – John Taylor (TPWD)
 Special Recognition – Bass Brigade – Texas Brigade
 Best Professional Presentation – B.P. Fleming, Dan Daugherty, Nate Smith (TPWD)
 Best Student Presentation – D. Symonds (UTT)
 Best Professional Poster Presentation – Gene Wild (TTU)
 Best Student Poster Presentation – Meriel LeSueur (TCU)
 Scholarships, Graduate (M.S.) – Matthew Acre (TTU)
 Scholarships, Graduate (M.S.) – Quentin Hall (TAMUCC)
 Scholarships, Graduate (M.S.) – Danielle Macedo (TAMU)
 Scholarships, Graduate (Ph.D.) – Jenny Oakley (TAMU)
 Harry Tennyson Scholarship – Erica Knowles (WTAMU)
 Harry Tennyson Scholarship – Kenneth Zachary (TAMU)
 Clark Hubbs Research Award – Aaron Urbanczyk (TTU)

Abbreviations:

ACE – Army Corps of Engineers
 BAYLOR – Baylor University
 NMFS – National Marine Fisheries Service
 ODWC – Oklahoma Department of Wildlife Conservation
 OSU – Oklahoma State University
 SCS – Soil Conservation Service
 SEU – St. Edwards University
 SHSU – San Houston State University
 TAES – Texas Agricultural Extension Service

TAMU – Texas A&M University – College Station
TAMUG – Texas A &M University - Galveston
TAMUCC – Texas A&M University – Corpus Christi
TCU – Texas Christian University
TCEQ – Texas Commission on Environmental Quality
TPWD – Texas Parks and Wildlife Department
TTU – Texas Tech University
TUGC – Texas Utilities Generating Company
TXSTATE – Texas State University – San Marcos
UD – University of Dallas
UHCL – University of Houston – Clear Lake
USFWS – U.S. Fish and Wildlife Service
USGS – U.S. Geological Survey
UT – University of Texas – Austin
UTMSI – University of Texas Marine Science Institute
UTPA – University of Texas – Pan American
UTT – University of Texas – Tyler
WTAMU – West Texas A &M University

TECHNICAL SESSION ABSTRACTS

Adaptive fisheries management in the face of extreme drought

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Texas has been in the grip of a major drought since 2010. In Wichita Falls this record drought is the result of only 60-inches of rain falling from October 2010 to May 2014 when normally 100-inches of rain would fall during that time frame. As a result, some major reservoirs are experiencing lake levels 20-feet or more below conservation pool and some have simply dried up. The City of Wichita Falls, as the major consumer and wholesaler of water in the area, has gone to extreme lengths to extend the life of local water supplies and thus the life of the community. Efforts have included ordinances imposing water restrictions, cloud seeding, experimental efforts to minimize evaporation, and development of a direct-potable reuse facility. Although area fisheries are facing a significant challenge, the TPWD Mission has remained steadfast “*To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.*” While some traditional options of providing outstanding fishing opportunities in the area were taken off the table by the drought, it has also opened the doors for other opportunities. Some of the lakes that completely dried up were dominated by rough fish and stunted sport fish. When water returns these lakes can be restocked and managed to a more publicly desirable fishery. The low water elevations have exposed the condition of many area boat ramps and led to municipalities more readily realizing their condition and investing in fixing and extending these ramps. The ability to drive in parts of lake beds has increased staff capacity to deploy many large piles of woody debris that, when inundated, will aid in increasing catch rates of anglers. Smaller community waters have been able to maintain levels and staff has utilized this opportunity to more intensively manage these fisheries. Staff has been able to expend greater effort on outreach events. Finally, the drought has changed the social climate sufficiently to pursue a lake restoration project that would otherwise not be palatable.

Impacts of climate change on the water quality of Big Cypress Creek and Lake O’ the Pines

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The Third National Climate Assessment (2014) predicts several impacts on stream and reservoir water quality due to climate change. One long-term effect of climate change in Texas is a significant reduction in annual precipitation and surface runoff. Due to the reduction in flow, climate change impairs the water quality of streams through increased residency times of nutrients and other contaminants. Increased evapotranspiration rates exacerbate the effects on reservoir water quality.

Big Cypress Creek flows through East Texas and is a tributary to several reservoirs including Lake Cypress Springs, Lake Bob Sandlin, Lake O’ the Pines and Caddo Lake. Trend analyses were performed on over forty years of water quality data collected in Big Cypress Creek, its tributaries, and Lake O’ the Pines. Statistically significant trends were identified which support predictions shown in The Third National Climate Assessment. The Assessment and supporting water quality trends from the Big Cypress Creek watershed will be discussed.

Drought driven re-establishment of Guadalupe Bass *Micropterus treculii* in the Blanco River, Texas

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As a result of hybridization with introduced Smallmouth Bass *Micropterus dolomieu*, Guadalupe Bass was extirpated from the Blanco River (Blanco and Hays counties, Texas). In summer 2011 severe drought reduced upper sections of the river to a series of enduring pools. Under these conditions Smallmouth Bass and their hybrids were removed from forty pools in a 15 mile reach of river between Blanco State Park and a natural physical barrier limiting upstream movement of fishes. Hatchery produced genetically pure Guadalupe Bass were stocked once flows returned in spring 2012 and 2013. Sites downstream of the 15 mile reach targeted for Smallmouth Bass removal were also stocked with Guadalupe Bass to compare the influence of just stocking, versus the removal of Smallmouth Bass and hybrids combined with stocking. One-hundred fish field identified as Guadalupe Bass or hybrids collected inside and outside of the 15 mile restoration area were collected for genetic analysis in August 2014. Recovered fish were primarily non-introgressed Guadalupe Bass (n = 86). Within the 15 mile reach targeted for restoration no hybridization was detected. A subset of these samples, selected by species status and size (n = 46), was evaluated to determine origins and parentage. Among the recovered Guadalupe Bass some (n = 13) were stocked hatchery fish, primarily (n = 11) from the 2013 stocking. Most individuals (n = 33) were offspring of fish stocked in 2012. Hatchery stocked fish were recovered only in the restoration area, while offspring of hatchery fish were recovered in the restoration area and downstream.

Movement of federally endangered Fountain Darters *Etheostoma fonticola* during low spring flows

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Kenneth G. Ostrand (*U.S. Fish and Wildlife Service*)

The fountain darter *Etheostoma fonticola* is a federally endangered percid which is found only in the thermally-stable headwaters of the Comal and San Marcos Rivers in Central Texas. We marked 2,212 individual wild-caught fountain darters from the headwaters of the Comal River with fluorescent Visible Implant Elastomer (VIE) tags and recorded their relocations over several months during a period of exceptionally low spring flow in late spring and summer 2014. During the study period, low spring flow conditions led to atypical increases in water temperature and the disappearance of aquatic macrophytes (an important fountain darter habitat component) from the study area. Based on 149 relocations, average (20.9 m) and maximum (131 m) movement of fountain darters was slightly higher than that reported under more typical habitat and flow conditions in the Old Channel of the Comal River (10 m and 95 m, respectively). However, rather than move large distances (>250 m) towards more environmentally stable spring-influenced areas downstream, relocated fountain darters appeared to utilize microhabitats within the local area, suggesting a relatively low potential for long distance movement despite deteriorating habitat conditions. This data will be important in parameterization of an ecological model being developed as part of the ongoing Edwards Aquifer Habitat Conservation Plan (EAHCP) to predict changes to fountain darter populations under future low flow scenarios.

Using a niche model to hindcast and forecast golden alga blooms: when did golden alga first arrive in the Brazos River and which lake will be affected next?

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Blooms of the toxigenic golden alga (*Prymnesium parvum*) have impacted fisheries resources in Texas and at least 22 other states in the USA. Its presence and abundance are strongly influenced by water quality as inland blooms typically occur in eutrophic, brackish water reservoirs. There is no consensus on whether golden alga is a recent invader of inland waters or a native species that has expanded its range due to recent environmental change. This uncertainty complicates efforts to control dispersal. We constructed a ZIP-regression niche model for golden alga and applied it to archived water quality data for three golden alga-affected, mainstem reservoirs in the Brazos River Basin: Whitney, Granbury, and Possum Kingdom. This approach allowed a retrospective assessment of when bloom conditions first appeared in these reservoirs. Whitney and Granbury developed favorable conditions in the mid-1990's and Possum Kingdom as early as 1976, well before their first reported bloom occurrences in 2001. These results support the hypothesis that golden alga is a recent invader of preexisting favorable habitats in the Brazos River. The niche model was also combined with forecasting of water quality data to determine if favorable conditions could develop and lead to blooms in currently-unaffected, tributary reservoirs. Based on projections of water quality, golden alga blooms could occur in Lake Stamford and Hubbard Creek within the next 5 years, but Lake Alan Henry and Fort Phantom Hill seemed unlikely to experience blooms in the near future. Unlike mainstem reservoirs into which waterborne dispersal is unrestricted in a downstream direction once upstream colonization has occurred, dispersal into tributary reservoirs is likely to require overland vectors. The present niche model may be useful to identify relative susceptibility of reservoirs and assist resource managers in restricting the spread of golden alga or planning to mitigate or adapt to future blooms.

The effect of electroshocking on unionid mussel larval release

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Freshwater mussels are often cited as the most imperiled group of organisms in North America, with 37 of the approximately 300 natives species extinct, and another 105 imperiled or critically imperiled. Of the 37 species in East Texas, six are state threatened (*Fusconaia askewi*, *Fusconaia lananensis*, *Lampsilis satura*, *Obovaria jacksoniana*, *Pleurobema riddelli*, *Potamilus amphichaenus*). Electroshocking for fish has been shown to be less invasive to habitats, more efficient for collection, and more accurate than other collection methods. Freshwater mussels (Unionidae) aren't targeted during electroshocking of streams, however the impacts of such exposures have only recently been studied. This study sought to examine if exposure to electrical current induced a physiological response resulting in the evacuation of mussel larvae, called glochidia. Gravid (pregnant) *Lampsilis teres* and *Leptodea fragilis* were collected from the Sabine River at multiple sites during the summer of 2014. Mussels were relocated to fish tanks in the University of Texas at Tyler aquatic research laboratory where they were housed for the duration of the experiment. Mussels were shocked with a Halltech backpack electrofisher at 450 V and 80 Hz for 10 seconds per trial. Water from the fish tanks was siphoned through a 153 micron mesh to collect any expelled glochidia. Filtrate was examined under a dissecting scope using Bogorov plankton counting trays. There was no significant statistical difference between the amount of glochida collected before and after electroshocking. Due to this, it is believed that electroshocking does not have negative effects on glochidial release in unionid mussels. Electroshocking should be done outside of important breeding seasons for endangered mussels, as riverbed disturbances during shocking events may still impact mussel fecundity.

Changes in angler behavior in Aransas Bay

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The Aransas Bay complex has long been a popular fishing destination for Texas anglers. This bay system is subject to some of the highest angling pressure on the Texas coast due to its popularity with tourists, beautiful waters, and traditionally, excellent angling for Spotted Seatrout. After over a decade of consistent angler catch rates for Spotted Seatrout from 1992-2004, Aransas Bay experienced a decline in catch rates for Spotted Seatrout beginning in 2005, followed by a drastic drop in 2008-2009. In 2009, fishing guides in the Aransas Bay complex began shifting their efforts from Spotted Seatrout to Black Drum. According to the Texas Parks and Wildlife Department Marine Harvest Monitoring Program, Black Drum landings by guided trips have increased by an order of magnitude in the last five years. In fact, among guided fishing trips, the catch rates for Black Drum are now equal to catch rates for Spotted Seatrout in Aransas Bay. The trend is also evident with regard to the species sought while angling as stated by the clients and the guides themselves when queried during angler intercepts. Currently, TPWD resource monitoring data shows that Black Drum populations appear to be stable despite the marked increase in angling pressure, although comments from constituents indicate concern about the long-term health of this now popular fishery. The Black Drum appears to be filling a valuable niche in the fishing guide community while the Spotted Seatrout fishery will likely improve following harvest regulation changes for Spotted Seatrout in September 2014.

Contribution, size, and diet of stocked Largemouth Bass in three aquatic vegetation types in Toledo Bend Reservoir

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Texas Parks and Wildlife Department (TPWD) stocks Toledo Bend Reservoir annually with fingerling Florida Largemouth Bass (*Micropterus salmoides floridanus*). Studies suggest that Largemouth Bass stockings often result in variable and low contributions to cohort abundance. To test whether the aquatic vegetation where stocking occurred could be one element of this variability, juvenile Florida Largemouth Bass were marked with a pelvic fin clip and stocked in three different aquatic vegetation types (hydrilla *Hydrilla verticillata*, coontail *Ceratophyllum demersum*, and Eurasian watermilfoil *Myriophyllum spicatum*). Stocking sites received 10,000 fingerlings (mean TL=35mm) and consisted of 2 km of contiguous habitat. Study sites were stocked in May-June 2010 (n=6) and May-June 2013 (n=5) and sampled with boom-mounted, boat electrofishing 3-weeks after stocking to assess stocking contribution, diet, and size of stocked fish. Contribution of stocked fish ranged from 0-10% across all sites (mean=3.2%) and no differences were detected among the three vegetation types. We detected no significant differences between the total length of stocked fish and naturally produced fish associated with the different vegetation types. Diet was similar for stocked and naturally produced fish; we observed fewer empty stomachs in fish collected from sites with Eurasian watermilfoil, whereas we saw more empty stomachs in hydrilla. TPWD Inland Fisheries protocol is to stock Largemouth Bass in the best littoral habitat without specifying vegetation type. Our results support the continuation of this protocol as there were no differences in contribution or total length of stocked fish by habitat type. Results of this study relative to contribution of stocking efforts are similar to previous studies.

Flow-dependent competition between the endangered *Gambusi nobilis* and the invasive *Gambusia geiseri*

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The desert-spring fish, *Gambusia nobilis* was once distributed widely throughout the Pecos River drainage from Texas into southern New Mexico. However, water withdrawal and habitat alterations within this

system have reduced the distribution of *G. nobilis* to ~6 regions throughout the drainage. Specifically, The San Solomon Spring complex near Balmorhea, Texas currently supports the largest natural *G. nobilis* population globally. However, populations in this area continue to face threats of extirpation because of habitat loss associated with agricultural irrigation in the area. Moreover, *G. nobilis* populations may be further stressed by the presence of an invasive congener (*G. geiseri*) that may compete with *G. nobilis* for resources. This is supported by recent population estimates showing that the invasive *G. geiseri* out numbers *G. nobilis* by as much as 20 to 1. Additionally, an analysis of gut content data and stable isotope data show high-diet overlap between *G. nobilis* and *G. geiseri*, suggesting that competitive dominance of *G. geiseri* may be a principal cause driving down *G. nobilis* population size in these localities. In order to test these predictions, a competition study with varying density treatments was conducted in the summer of 2012 but showed equal competitive interactions between the two congeners. However, we predict, based on field observations, flow may play an integral part in competitive interactions in this system. Herein, I will report on the results of a second competition study where flow was the key variable tested to determine competitive interactions. These data will be useful for modeling community dynamics necessary to adequately manage populations of the endangered *G. nobilis* throughout its range.

Mapping the tempo-spatial distribution of batoids to improve conservation in a subtropical estuary

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Using monthly otter-trawl surveys, we investigated the distribution and abundance of rays (cartilaginous batoid fishes) within the Paranaguá estuarine complex; a biodiversity hotspot adjacent to a World Heritage site in southern Brazil. This system has two longitudinal fluvial gradients (north/south–40 km and east/west–56 km). Three sectors within each fluvial gradient (outer, middle, and inner estuary) were surveyed over 11 consecutive months. Four batoid species were caught: *Gymnura altavela* (n = 4), *Narcine brasiliensis* (n = 4), *Dasyatis guttata* (n = 23) and *Rhinobatos percellens* (n = 37). Analyses were limited to *D. guttata*, *R. percellens*, and total batoid abundance. Based on results from linear mixed models, neither season nor water depth explained variation in the abundance of the individual species or batoids collectively. Rather, batoid abundance differed between the two longitudinal gradients, with more individuals caught in the middle and inner sectors of the north/south gradient than sectors of the east/west gradient. This result could be explained by two hypotheses: (i) compared to the east/west gradient, the shorter north/south gradient had greater and less variable salinity that was more favorable for batoids; and/or (ii) unlike the inner sectors of the east/west gradient that are near densely populated areas (two cities and a port), those of the north/south gradient are surrounded by an Environmental Protected Area and with better habitat quality. Nonetheless, both explanations support management options for rays that would restrict anthropogenic impacts in watersheds and shoreline areas in the middle and outer estuarine sectors.

Evaluation of Water Willow (*Justicia americana*) use by reservoir fishes

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Water-willow (*Justicia americana*) is popular in fish habitat improvement projects because of its ease of establishment and relative resistance to herbivory by Grass Carp (*Ctenopharyngodon idella*). However, the response by the fish community to water-willow establishment has not been well documented. In this study, 9.32 plots of water-willow established by Texas Parks and Wildlife Department in Lake Conroe, Montgomery County,

Texas were block netted then electrofished exhaustively to capture all possible fish in the treatment sites. Fish were identified to species then weighed to the nearest gram and measured to the nearest mm total length. Stomach contents were examined to determine food habits. Similar sampling was conducted in un-vegetated sites along the same shoreline as the control sites. Species composition, size composition by species, fish condition, and stomach contents were compared between water-willow and un-vegetated sites. Preliminary results suggest that biodiversity within water-willow sites is greater than in un-vegetated control sites.

Ecological effects of Water Willow (*Justicia americana*) on aquatic invertebrate species

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Water-willow (*Justicia americana*) is a perennial aquatic macrophyte that has been used extensively in recent years as a means to increase both vertebrate and invertebrate productivity in freshwater littoral zones. This popularity is in part due to its rapid and dense rhizome growth that allows water-willow to establish itself quickly when introduced into aquatic systems, as well as its ability to provide potential habitats for invertebrate and smaller vertebrate species within its dense rhizomous structure. However, the full ecological effects of water-willow have not been comprehensively studied. The focus of this study, is the ecological effects of water-willow on aquatic invertebrates. To do this water-willow plots established in Lake Conroe, Montgomery County, Texas were block netted and the biodiversity of invertebrates within the plots was observed. Random samples within the areas of water-willow stem growth were collected by cutting water-willow stems above the substrate level. The substrate within the random sample areas was also gathered to a depth of six inches. Random samples of the water column and substrate were also collected from the control sites which were absent of vegetation. Any invertebrates within the samples were gathered and catalogued. It was found that in the vegetated plots the water-willow stems were densely inhabited by bloodworms (Chironomidae larvae), and, the densities of various other invertebrates were much higher in the vegetated plot than in the control plots. As a result of the foraging nature of numerous fish species on aquatic invertebrate species, the invertebrate communities inhabiting established water-willow may work in conjunction with the increased cover afforded by the vegetation to increase fish production.

Use of side-scan sonar to identify and count Alligator Gar: potential for evaluating population density from sonar imagery

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Declines in the abundance and distribution of the Alligator Gar *Atractosteus spatula* have spurred the initiation of many management and research efforts to conserve remaining populations. However, inefficient sampling gears and low abundance in many systems often hamper the collection of sufficient data to inform management. We tested a consumer-grade, side-scan sonar system to determine if it could serve as an efficient, non-invasive means to identify and count Alligator Gar. We first conducted a replicated pond experiment in which six ponds were stocked with known numbers of Alligator Gar and other large-bodied fishes to determine if Alligator Gar could be accurately identified and enumerated. We then conducted a field-based evaluation by comparing abundance estimates derived from side-scan sonar images to those derived from mark-recapture sampling of a small isolated riverine population of Alligator Gar. In pond experiments, Alligator Gar density based on sonar image interpretation was consistently underestimated (52% - 92% of true abundance) and other fishes were seldom falsely counted as Alligator Gar (7% of possible occasions). Side-scan counts from the river population (mean = 70 fish, range = 59-77) were remarkably close to the mark-recapture population estimate of 76 fish (95% CI = 43-149). We concluded that side-scan sonar has much potential for efficiently identifying and

enumerating Alligator Gar with minimal effort. The technology may also prove useful for evaluating Alligator Gar habitat association and improving sampling efficiency using traditional gears.

Development of Fathead Minnow as a model organism for the study of immune function: characterization of molecular responses to pathogen infection

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It is well established that immune function in fishes can be altered by a number of external factors such as temperature, population density, salinity and water quality. Alterations in normal immune function due to such changes can reduce an organism's ability to defend itself against pathogen infection. In turn, reductions in pathogen resistance can possibly lead to increases in mortality within a population. In an effort to better study the effects of various stressors on the immune system, we are developing the fathead minnow (*Pimephales promelas*, FHM) as a model organism for the assessment of immune function. Achieving this first requires that basic aspects of immune function be characterized in FHMs. As such, the current study had two objectives: 1) to examine the differential tissue distribution of immune-related genes and 2) to determine effects of pathogen infection on the mRNA expression of immune-associated genes. The differential expression of immune genes was determined by measuring the expression of complement component 3 (C3), interleukin 11 (IL11), macrophage stimulating factor 1 (MSF), neutrophil elastase (Ela), myeloperoxidase (MPO), NADPH oxidase 2 (NOX2) and super oxide dismutase (SOD) in blood, spleen, kidney and liver samples collected from adult male FHMs with no known history of pathogen exposure. The expression of these genes was also evaluated in FHMs following exposures to the common freshwater pathogen *Yersinia ruckeri*. In response to *Y. ruckeri*, FHMs experienced significant increases in the expression of C3, IL11, MPO and NOX2 indicating that the upregulation of these genes is part of the normal immune response in FHMs. Future studies will focus on evaluating the responsiveness of these genes to pathogens among FHMs that have been exposed to chemical stressors in an effort to determine whether these genes could be used as molecular biomarkers for immune disruption.

TPWD's cross divisional efforts in the Llano River watershed to benefit aquatic resources

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The Llano River Watershed is a focal area for Texas Parks and Wildlife Department (TPWD), Texas Parks and Wildlife Foundation, Southeast Aquatic Resources Partnership, Texas Tech University, and several other agencies and regional groups. Through the Conserving Texas Rivers Initiative and Guadalupe Bass Restoration Initiative, we have been working with landowners to implement projects that restore and/or protect important riparian and aquatic resources. Projects have impacted ranches representing over 65,700 acres of the watershed with projects on 6,970 of these acres benefiting upland, riparian, and aquatic resources. Projects have been a collaborative effort between the Wildlife, Inland Fisheries, and State Parks Divisions at TPWD. This innovative partnership has been highly effective in providing conservation best management practices for a holistic management approach, identifying and implementing projects, and providing important outreach and educational opportunities. Efforts to protect and restore riparian areas within the watershed have also focused on providing

recreational opportunities like the newly developed South Llano River Paddling Trail, supporting scientific research to fill in data gaps, monitoring restoration projects to inform future activities, and providing watershed workshops.

Effect of interannual hydrological variation on fish assemblage composition in the central Amazon

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Hydrology is strongly seasonal in large floodplain rivers in the tropics. Fishes inhabiting floodplain habitats in the Central Amazon must respond to a very large but highly predictable annual flood pulse. During the flood period, many species migrate from the river channel or deep floodplain lakes into flooded riparian habitats, and when floodwaters recede they return to the channel or lakes. Other fish species may inhabit floodplain lakes throughout the year. Seasonal movements cause local lake fish assemblages to have dynamic structures. Over the past several decades, the intensity of floods and dry seasons in the Central Amazon has been increasing as a consequence of global climate change. The fish assemblage of a floodplain lake near the meeting of the waters (union of the blackwater Rio Negro and whitewater Rio Amazonas) in the Central Amazon, Brazil, was surveyed using gillnets over a 13-year period. We analyzed this dataset to assess interannual changes in fish assemblage composition based on flood and dry season samples. Fish assemblage structure reveals gradual directional change during this period that is correlated with interannual variation in hydrology. Fish assemblage composition was generally more consistent during flood seasons compared to the dry seasons. Years with larger flood pulses tended to have greater abundance of relatively large migratory fishes with high market value and that have been overfished in Central Amazon.

Determining viable host-fish species for *Fusconia askewi*, *Potamilus amphichaenus*, and *Pleurobema riddellii* in east Texas

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Freshwater Unionid mussels provide some of the most important ecosystem services in fresh water systems, yet are the most imperiled group of organisms in North America. In addition to anthropogenic and natural disturbances that contribute to their decline, the absence of their obligate host-fish species is also a cause of their diminishing diversity and abundance. The absence of host-fish species causes an interruption in mussels' unique life cycles that depend on the fish, and thus delays successful reproduction and stable population sizes. Because of this co-evolutionary relationship and dependence of mussels on their obligate host-fish species, it is extremely important to know the distribution of fish in fresh water ecosystems and their roles as hosts. With this, we can understand the distribution and successful reproduction of freshwater mussels. The Texas Pigtoe, Louisiana Pigtoe, and the Texas Heelsplitter are state threatened species of Texas with no known host-fish species on record. There have been various methods used to test for host-fish species including artificial infestations in lab studies and by collecting naturally infested fish from the field and examining the gills and fins for glochidial encystment. This study aims to determine naturally occurring and viable host-fish species for three state threatened mussel species by collecting naturally parasitized fish from the wild and collecting fully metamorphosed juvenile mussels that have naturally dropped off. These juveniles are being identified to species through DNA sequencing with amplification of the ND1 gene. The sequences are compared to an adult molecular key that has been created for all 37 mussel species that occur in East Texas. The predicted outcomes of this study is to confirm host-fish species for state threatened freshwater mussels in accurately representing the fish-mussel interactions that occur in nature that may aid in implementing conservation methods for fresh water mussels of East Texas.

Can river-reservoir interfaces serve as surrogate nurseries for riverine fishes?

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Anthropogenic modifications to riverine systems have reduced access to important off-channel nursery habitats, but the river-reservoir interface (RRI) may offer surrogate nursery habitat. We sampled ichthyoplankton assemblages in off-channel and main channel habitats of the Lake Livingston RRI and middle Trinity River to: 1) compare species composition and abundance in these different habitat types, and 2) evaluate the influence of abiotic and physicochemical characteristics on ichthyoplankton assemblages in these habitats. Ichthyoplankton was sampled using light traps and paired push nets deployed off jet-powered kayaks during February-July 2013 and 2014. A total of 43,518 larval fishes were collected, representing 29 taxa. During the second year of sampling, two sites from the middle Trinity connected to the main stem of the river resulting in an increased diversity index. A few taxa were dominant at all sites, however, less common ichthyofauna such as moronids, sciaenids, and centrarchids were captured more frequently in RRI habitats. Sites with frequent connectivity to the main channel had higher species richness, diversity, and overall abundance. Push net samples were more effective, however, species richness and diversity were similar between light traps and push nets. Multivariate analyses were used to compare species richness, diversity, and evenness among habitats which indicated all were greater in the RRI. These differences suggest RRI habitat may act as a surrogate nursery for some species when access to other off-channel habitat is limited.

Spatial and temporal distribution of catfish game species at the river-reservoir ecosystem scale

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Currently TPWD manages rivers and reservoirs independently to maintain a healthy diversity of aquatic organisms and a quality sport fishery. Catfishes are a recreationally important species group (Ictaluridae, ranked second in angler preference in Texas) that occur simultaneously in many Texas rivers and reservoirs. The Trinity River and Lake Livingston in Texas currently have self-sustaining populations of catfishes that support large recreational and commercial fisheries. The longitudinal connectivity of the river, river-reservoir interface (RRI) and reservoir in the Trinity River system may make it necessary to manage harvest regulations at this macro-scale. To better understand the spatial and temporal dynamics of ictalurid species across the river-reservoir ecosystem, we sampled three macro-habitats (river, reservoir, and RRI) in Lake Livingston and the Trinity River, Texas, using multiple gear types, seasonally from summer 2013 - spring 2014. A total of seven catfish species were collected, with Blue Catfish representing 61% of the total ictalurid species collected, followed by Channel Catfish (33%), and Flathead Catfish (5%). Each of these species were found across all macrohabitat types. Although there were some general trends in seasonality of catfish abundances across macrohabitat type, no significant differences were detected. Length frequency distributions of catfishes showed a significant difference by macrohabitat. Significantly larger Blue Catfish were collected in the river, and larger Channel and Flathead catfishes from the reservoir. The results of this study, at a macro-scale, provide a new perspective and useful information in managing the catfish populations.

Flow dynamics and temporal distribution in fish assemblage structure in two Texas Gulf Coast rivers

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Given increasing human demands for freshwater, it is imperative to identify environmental flows that maintain native species, their habitats, and key ecosystem dynamics. A major challenge is determining requirements for seasonal flow pulses that promote fish spawning, early life stage survival, dispersal, and other processes that maintain native stocks. Our study investigated hydrology, fish reproduction, larval abundance, survivorship, and community assemblage in the lower Brazos and middle Trinity rivers in Texas. From March 2013 to March 2014, abiotic environmental data were collected along with data on fish abundance, reproduction, and recruitment. Larval fish were collected bimonthly at night using three arrays of stationary driftnets arranged along transects perpendicular to the shoreline. Seine nets were used to sample fish assemblages in shallow littoral habitats. Multivariate statistical analyses based on seine samples revealed that several hydrological variables were associated with temporal variation of fish assemblages. Multivariate analyses of driftnet data indicated that temperature had the strongest association with patterns of larval fish abundance, based on evaluations at the family level. Cyprinid protolarvae, in aggregate, did not seem to be constrained by hydrology, as evidenced by their high abundance throughout the reproductive season (April–August). Ongoing work to identify larval fish to species level will elucidate how flow regime components influence reproduction and recruitment of fluvial specialists, such as *Macrhybopsis hyostoma*, *Notropis shumardi* and *Notropis buchanani*. This information will significantly augment our currently limited knowledge of the life histories of minnows inhabiting Gulf coastal rivers, which in turn will assist in evaluating environmental flow regimes.

Characterizing the benthic food resources and habitat utilization of Black Drum (*Pogonias cromis*) in Baffin Bay, Texas

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Black Drum, *Pogonias cromis*, are large-bodied sciaenid fish that occur throughout warm-temperate to subtropical estuaries in the northwest Atlantic and Gulf of Mexico. Black Drum constitute important commercial and recreational fisheries, with approximately 1.7 million pounds of Black Drum landed in Texas in 2010, earning ~\$1.6 million. The ecology of Black Drum remains poorly characterized across the vast majority of its range, particularly along the Texas coast. The Baffin Bay Complex (BBC) supports the highest catch per unit effort of Black Drum in Texas. However, in the past year, large numbers of fish have been observed with abnormal physical characteristics and emaciated morphology. The working hypothesis is that Black Drum exhibit strong fidelity to the BBC and may have been affected by changes in availability and identity of prey resources, which in turn exhibit distribution patterns related to local ecological and water quality conditions. Seasonal benthic surveys are being conducted to determine the distribution and abundance of potential prey items. Black Drum are also being collected from throughout the BBC for visual and stable isotope analysis of gut contents. Acoustic telemetry is being used to quantify Black Drum distribution and habitat use. The results of this study will provide a better understanding of the linkages between water quality, benthic prey, and Black Drum ecology in the BBC.

A historical summary of the fish assemblages of the Wichita River, Texas

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Habitat fragmentation caused by impoundments has led to altered fish assemblages in many streams. The effects of the alterations by impoundments can increase over time. The effects of habitat fragmentation are notably detrimental to species that must migrate in order to successfully reproduce. Fish assemblages of Great Plains streams have been affected by the impacts of impoundments. By using museum and literature records of fish collections from the Wichita River, we were able to assess changes of both species composition and species distribution. For each reach, we calculated percent relative abundance for ten 10-year intervals dating back to the 1920s. Previous studies have shown that since the 1950s, seven species of cyprinids have been lost from the Wichita River and two others have seen consistent declines in relative abundance. We sampled the Wichita River, Texas in 2006, 2011, 2013, and 2014. We used 11 sampling sites along the Wichita River, and compared species relative abundances across sites and years. We analyzed data for each stream reach; taking note of any significant changes in the percent relative abundance for each species. We used a detrended correspondence analysis to assess the changes in relative abundance and distribution. Across all sites and years, species diversity was greater in downstream reaches, than in upstream reaches.

Specific gravity of ova and fry of broadcast-spawning cyprinids

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Many cyprinids native to streams and rivers of the US Great Plains belong to a reproductive guild that broadcast spawn semi-buoyant ova into the current. Fertilized ova and early larval stages require current to remain within the water column and it is believed this is important in preventing them from settling to the bottom where they are susceptible to being buried by shifting sediments. Previous studies have measured the specific gravity of ova from a small number of broadcast spawning cyprinids, yet no study yet has measured the specific gravity of developing larvae. Developing ova hatch within one or two days, depending on water temperature, and larvae generally are incapable of maintaining themselves in the water by swimming until an age of five days. We measured specific gravity of fertilized ova and larvae of five broadcast-spawning cyprinids using a calibrated, graded density-column ranging from 0 to 30ppt (ova) or 35 to 130 (larvae). Fertilized ova and larval fish were inserted into the column and the height of the ova and larvae within the column allowed us to estimate specific gravity, which is a surrogate measure of the amount of current required to keep them afloat. Fertilized ova were semi-buoyant, with specific densities ranging from 1.0043 to 1.01. However, fry of the five cyprinid species examined had specific gravities that were significantly denser than the ova, ranging from 1.027 to 1.05. Given that larvae are weak swimmers until an age of 5 days and are significantly denser than ova, we suggest that hypothesized effects of river discharge on survival of early life-history stages of broadcast-spawning cyprinids is most likely attributable to survival of early larval stages.

Does water chemistry limit the distribution of New Zealand mud snails in Redwood National Park?

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New Zealand mud snails (NZMS) are exotic mollusks present and very abundant in many waterways of the western United States. In 2009, NZMSs were detected in Redwood Creek in Redwood National Park in Northern California. Although NZMS are noted for their ability to increase rapidly in abundance and colonize new habitats, after more than 4 years in the Redwood Creek, their distribution remains limited to a ca. 300 m reach of the estuary. Recent literature suggests that low specific conductivity and environmental calcium can limit NZMS distribution within watersheds. We conducted laboratory experiments, exposing NZMS collected from Redwood Creek to both natural waters and artificial culture media, to determine if low conductivity and calcium

concentration limit the distribution of NZMS in Redwood National Park. For natural water exposures, we held NZMS in water from their source location in the estuary (conductivity 135 $\mu\text{S}/\text{cm}$, calcium 20 mg/L) or water from one of four other locations in the Redwood Creek watershed that encompass a range of conductivity (77 -158 $\mu\text{S}/\text{cm}$) and calcium concentration (8-28 mg/L). For artificial media exposures, we manipulated both conductivity (range 20-200 $\mu\text{S}/\text{cm}$) and calcium concentration (range 5-17.5 mg/L) in a factorial design. Response variables measured included mortality and reproductive output. Adult NZMS survived for long periods (> 4 months) in the lowest conductivity waters from Redwood Creek and all but the lowest conductivity artificial waters, regardless of calcium concentration. However, reproductive output was very low in low-calcium natural water and artificial media. Our results suggest that water chemistry may limit the spread of NZMS in Redwood National Park by reducing their reproductive output.

Pattern of invasion of a nonindigenous cyprinid and potential shifts in the native fish assemblage structure

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Invasive species increasingly threaten global biodiversity and are of specific concern in the Southeast United States which contains the highest fish diversity in the country. However, patterns of invasion and variables influencing invasion success remain poorly understood. This study had the unique opportunity to follow the introduction, establishment, and invasion processes of the non-indigenous Weed Shiner (*Notropis texanus*, Family: Cyprinidae) following introduction from the Mobile Basin via the Tennessee-Tombigbee Waterway, and to investigate potential shifts in the native fish assemblage in Bear Creek, Alabama and Mississippi, USA. The Weed Shiner's invasion pattern, based on historical and contemporary fish assemblage surveys from 1998 to 2014, was established, and shifts in total assemblage structure were evaluated via similarity indices and non-metric multidimensional scaling ordination. Since first observed in Bear Creek in 2007, Weed Shiner rapidly expanded in range and abundance until 2012 when its range contracted and 2013 when its abundance declined. Weed Shiner currently persists at the most human-impacted, downstream sites in Bear Creek. Despite the rapid proliferation of Weed Shiner during 2007 – 2012, the native fish assemblage has not significantly changed. Rather, the native fish assemblage structure in Bear Creek is highly variable temporally and influenced largely by land-use in the watershed, most notably by high intensity development, mixed-hardwood forest cover, and pine monoculture cover. Limiting future Weed Shiner impacts in the system and successful conservation of the Bear Creek fish assemblage will rely on managing land use changes and mitigating the effects of development in the watershed on the stream.

Selecting strategic habitat areas to help protect North Carolina's coastal fisheries

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Strategic Habitat Areas (SHAs) represent priority habitat areas for protection due to their exceptional condition or imminent threat to their ecological functions that support coastal fish and shellfish populations. Identification and designation of SHAs is a primary goal of the North Carolina Coastal Habitat Protection Plan. The identification of SHAs was conducted in a two-step process: 1) using GIS-based habitat and alteration data in a computerized site-selection analysis and 2) verifying and modifying information based on input from a scientific advisory committee. North Carolina Division of Marine Fisheries staff and an external scientific advisory committee specified representation levels for multiple unique habitat types referred to as natural resource targets. There are also several types of alteration factors that are represented geospatially (i.e., hydrologic alterations, water quality degradation, and physical disturbances). The site selection program Marxan was used to select areas that met representation levels while limiting the selection of highly altered sites. The scientific advisory committee modified the computer results based on their expert knowledge and experience. The resulting SHA nominations encompass 19% of the Region 3 focus area (i.e., riparian targets within 500 m of the shoreline, open waters, and the Atlantic Ocean out to 3 nmi). Many of the SHAs overlap with lands that are already managed for

conservation or are protected through Primary Nursery Area designations. Strategic Habitat Areas nominations were corroborated with biological data, ecological designations, and specific knowledge of the area and will be incorporated into future conservation and restoration planning efforts.

Using ongoing fishery monitoring to predict the relationship between seagrass habitats and fish CPUE and diversity

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Seagrasses play an integral role in the aquatic community; they oxygenate the water, stabilize sediments, increase water quality, and provide habitat for important fish and invertebrate species. Recent efforts have been made by Texas Parks and Wildlife, UTMSI, and other organizations to map and monitor seagrass distribution in Texas bays. This study compares these maps to fisheries data, including CPUE and diversity, from the ongoing fisheries monitoring work of Texas Parks and Wildlife in an attempt to find a correlation between fish distribution and seagrass habitats. Catch per unit effort for some juvenile sportfish, including Red Drum (*Sciaenops ocellatus*) and Black Drum (*Pogonias cromas*), was not different between seagrass and non-seagrass habitats, while CPUE of Spotted Seatrout (*Cynoscion nebulosus*) was significantly higher in non-seagrass habitats than in seagrass habitats. In contrast, adult Red Drum showed a higher CPUE in seagrass vs non-seagrass. Diversity was not significantly different between non-seagrass and seagrass habitats, but there was an insignificant trend indicating a higher total finfish density in seagrass versus non seagrass habitats. It is possible that this is due to a comparable amount of habitat complexity in our adjacent “non-seagrass” habitats, such as macroalgae or oyster reef habitat. Alternatively, this could imply that our mapping and fisheries monitoring are not at the resolution required to assess impacts of seagrass habitats on fisheries. The results of this study can be important in identifying the future needs of monitoring and management of fisheries and seagrass habitats.

Establishment of native aquatic vegetation in conjunction with an integrated pest management program

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Planting native vegetation in the empty niches of disturbed ecosystems, without a propagule bank, can deter establishment of invasive plants. Native vegetation establishment can be delayed by herbivory resulting in the need for protection of plants. Although there are herbivores suspected of feeding on the native plants, specific herbivore damage has never been documented. Lake Raven was chosen as the study site because it contains multiple invasive aquatic plant species. An integrated pest management approach using chemical (fluridone), biological (grass carp) and mechanical (physical removal) means has been implemented to control the invasive aquatic plants. Native plant restoration was conducted in niches opened from fluridone application and mechanical removal of exotic species. Twelve species of native aquatic plants were planted in 120 protective exclosures along the shoreline with each exclosure containing 5 plants of a single species. Plants were allowed to establish for 1 month before the treatment cages were opened. Control and treatment exclosures were monitored weekly for vegetation damage. Submersed game camera took photos every 2 from dawn until dusk to determine herbivore species associated with predation damage. Herbivory pressure was determined through comparison between control and treatment cages using plants survival. Additionally, effect of fluridone on plant species was evaluated using percent chlorosis of plants in each exclosure. Preliminary results indicate influence of fluridone on establishing submerged and floating aquatic plants, low herbivory pressure and successful establishment of emergent plant species.

Adaptive management of Eastern Oysters (*Crassostrea virginica*) in Texas – implementation of emergency closure guidelines in Copano Bay, Texas

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In 2012, the Texas Parks and Wildlife Department and the commercial oyster industry formed a cooperative workgroup to develop guidelines and sampling protocols to determine if public oyster reefs were being overworked during the commercial oyster harvest season (November 1 - April 30). The metric to consider was the percentage of undersized oysters. The workgroup defined a threshold that, if exceeded, would justify closing the area to harvest. Undersized oysters were defined to be 51 - 76mm and the percentage of 51 - 76mm oysters was to be calculated from the overall number of oysters greater than 50mm. In August, 2012 the percent undersized threshold was set to 90. In December, 2012 it was lowered to 85. In March, 2014 it was reduced to 70, and most recently (May, 2014) it was set to 65 percent. In 2014, extensive sampling of oyster reefs in Copano Bay, Texas was initiated as a result of reports of high percentages of undersized oysters from sacks of commercially harvested oysters. Reefs sampled were selected based on their size, depth and presence of actively fishing commercial oyster boats. Results from February, 2014 indicated the mean percentage of undersized oysters in Copano Bay was 70.2. Data collected during April, 2014 indicated 72.6 percent were undersized. In October, 2014 following a six month closure, 70.3 percent of oysters >50mm were undersized. Since the percentage of undersized oysters exceeded the pre-established closure threshold in April, and again in October, Copano Bay was subsequently closed to harvest of oysters. This was the first time this adaptive fisheries management protocol was implemented in the history of oyster management in Texas.

Aquatic food-web structure varies longitudinally with natural and anthropogenic influences in the Pecos River, Texas and New Mexico

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Understanding how aquatic communities change with natural variation along longitudinal gradients, and how they respond to anthropogenic impacts, is critical for effective riverine management. In addition to natural shifts along its continuum, the Pecos River is impacted by a variety of anthropogenic influences that affect water availability, salinity, and riparian and instream habitat structure. We assessed variation in main-stem river food webs by estimating carbon sources, trophic positions, niche breadth, and resource use by consumers at twelve sites with stable isotope analysis. We found that across physiographic regions, fish species richness, food chain length, and assemblage-wide niche breadth were inversely related to specific conductivity. IsoError mixing models revealed differences in sources of dietary carbon supporting fish production along the longitudinal fluvial gradient, with a shift toward reliance on algal production in the Permian Basin region. Trophic niche breadth was greatest for assemblages in less degraded sites with higher fish species richness. Our analyses also suggest that anthropogenic inputs may be enriching baseline nitrogen isotope ratios at one Permian Basin site. Across seasons, isotope signatures remained fairly constant in five common fish species. Characterizing changes in food-web structure in relation to natural and anthropogenic factors is important for habitat assessment, stream restoration, and management and conservation strategies.

Early development of Mexican Snook *Centropomus poeyi* (Teleostei: Centropomidae)

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The family Centropomidae is a small group (1 genus, ~12 species) of inshore marine percomorphs that are both recreationally and commercially important in the US and Mexico. Despite this importance, detailed information on early development is currently available only for a single species, the common snook (*Centropomus undecimalis*). A fledgling captive propagation program for Mexican Snook (*Centropomus poeyi*) at the Laboratorio de Acuicultura Tropical (Universidad Juárez Autónoma de Tabasco) has provided access (for the first time) to early developmental material for this species and also an opportunity to further our knowledge of centropomid early development. Based on this material (300 specimens; 0-21 days post hatch), we provide precise data on the age (DPH) and the size (notochord and standard length) at which major developmental landmarks occur in the development of *C. poeyi*, including: yolk-sac absorption, flexion, completion of median and paired-fin development, and larval fin-fold regression. We then make comparisons with the early development of *C. undecimalis* in order to facilitate easier larval identification between the two species.

Evaluation of community-level physiological profiling for monitoring microbes in fish hatchery ponds

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Microbial communities of aquaculture ponds play pivotal roles in pond productivity and fish production success. Nonetheless, culturists do not consider this variable in pond management decision-making likely because of lack of practical assessment tools. We evaluated the community-level physiological profiling (CLPP) technique for characterizing microbial community function in aquaculture ponds for potential use in pond management. Un-filtered water samples collected from various plastic-lined ponds over time were incubated on Biolog™ EcoPlates to determine the best incubation period and replicates required for proper assessment of microbial community function in fish hatchery ponds. The repeatability and within-pond variability of the CLPP metrics were also evaluated. During cooler months and in ponds with no fish and low apparent microbial activity, a 96-h incubation period was required to differentiate microbial community functional characteristics. During warmer months and when ponds were stocked with fish and had significant phytoplankton blooms, incubation periods of 72 h or less were sufficient to distinguish microbial communities. For routine monitoring, a single pond-water sample on one Biolog™ EcoPlate was adequate for detecting changes in microbial community function. The CLPP revealed low heterogeneity in the microbial community function within a single pond. This technique appears to be robust and enables assessment of heterotrophic microbial community functional characteristics such as relative diversity, similarity, and activity. Employing CLPP in Channel Catfish *Ictalurus punctatus* fingerling rearing ponds under two water-use regimes (treatments: high and low water exchanges) at three fish hatcheries revealed temporal changes in microbial community function. Differences in microbial communities were greatest when differences in chlorophyll *a* or diel dissolved oxygen concentration were largest. Differences in microbial communities were greatest between hatcheries, yet the rates of water exchange did not produce large or sustained microbial community functional differences between treatments within hatcheries. Community-level physiological profiling of the two water-use strategies in Channel Catfish ponds produced results consistent with water quality and fish production characteristics. The technique revealed that sustained water exchange in rearing ponds did not substantially improve fish production. The CLPP method provided evidence that conservative use of water in study ponds was best when water supply was limited because of the reduced cost of lower water consumption.

Spatial patterns in Texas lotic fish communities

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Spatial patterns in Texas lotic fish communities have been influenced and restructured by anthropogenic modification. These modifications and pursuant changes are well documented in the literature. The need for a statewide (and national) assessment to evaluate the status of freshwater streams using fish communities and their habitats was most recently addressed by the EPA National Rivers and Streams Assessment (NRSA). During the summers of 2013 and 2014, the Environmental Institute of Houston (EIH) used a probabilistic sampling design to survey various reaches of rivers and streams across Texas, sampling fish at nearly all sites through electrofishing. Utilizing GIS software (ArcMap), watershed analysis was conducted relative to these sites. We examined the relationship between major river basins, drainage basin size, and fish community metrics (abundance, richness, and diversity). Additionally, the relationship between streamflow and the aforementioned fish community metrics was examined. Further analyses are being conducted to evaluate the relationship between fish assemblages and paired physicochemical data collected during NRSA. When feasible, comparisons to historical data will also be conducted to evaluate temporal trends in habitat modification and fish community composition.

POSTER SESSION ABSTRACTS

Long-term changes in the fish assemblage of the upper Brazos River, Texas

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We sampled the Upper Brazos River, upstream from Possum Kingdom Reservoir, Texas, over a 25-year period. During this period, average annual discharge has decreased several fold, an impoundment was constructed on one tributary, and the system experienced record drought in 2011. All fishes native to the Upper Brazos River, except Silver Chub *Macrhybopsis storeriana*, have persisted despite these changes. Also, introduction of Sheepshead Minnow *Cyprinodon variegatus* in 2011 now threatens the local form of Red River pupfish *C. rubrofluvialis* through introgressive hybridization. Otherwise, the fish assemblage is intact and superficially appears to be stable, except for reduced abundances of some species as a result of the drought of 2011. However, our data show there has been a long-term decrease in abundance of cyprinid species that reproduce by broadcast spawning ova into the current. Conversely, there has been a general increase in abundance of substrate-spawning species. This change likely is related to the observed decrease in discharge in the Upper Brazos River.

Discharge from the Rio Conchos (Mexico) drives streamflow, salinity, and fish diversity in the Big Bend area of the Rio Grande/Rio Bravo del Norte (USA/Mexico): a retrospective analysis

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We quantitatively examined long-term changes in fish assemblages, river discharge, and salinity, and defined hydrological drivers of fish diversity in the Trans-Pecos region of the Rio Grande/Rio Bravo del Norte (USA/Mexico). Historical (1977-1989) and current (2010-2011) fish assemblages were analyzed by rarefaction analysis (species richness), nonmetric multidimensional scaling (composition and variability), multiresponse permutation procedures (composition), and paired *t*-test (variability). Trends in hydrological conditions (1970s-2010s) were examined by Kendall tau and quantile regression, and selected associations between streamflow and specific conductance (salinity) were examined by generalized linear models. Since the 1970s, species richness and variability of fish assemblages decreased in the Rio Grande below the confluence with the Rio Conchos (Mexico), its major tributary, but not above it. There was increased representation of lower-flow/higher-salinity tolerant species, thus making fish communities below the confluence taxonomically and functionally more similar to those above it. While Rio Conchos discharge was > 2-fold higher than Rio Grande discharge above their confluence, Rio Conchos discharge decreased considerably during the study period causing Rio Grande discharge below the confluence to also decrease. Rio Conchos salinity is lower than Rio Grande salinity above their confluence and, as Rio Conchos discharge decreased, it caused Rio Grande salinity below the confluence to increase (dilution effect). Since the 1970s, decreasing streamflow and increasing salinity in the Rio Grande below the confluence with the Rio Conchos have been driven by decreasing discharge from the Rio Conchos. This spatially uneven desertification of the Rio Grande has led to a Trans-Pecos region-wide homogenization of hydrological conditions and, consequently, of taxonomic and functional attributes of fish assemblages.

Angler effort determined from camera images and a creel survey on a Texas reservoir

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Use of digital game cameras to determine angler effort is becoming an important and potentially cost-effective method for fisheries managers. Game cameras have recently been used by TPWD to evaluate angler

effort at Neighborhood Fishing Program lakes and a statewide evaluation of the 9-inch channel catfish stocking program on small community fishing lakes. My objective was to determine if angler effort estimated from game camera images on a larger reservoir would differ from angler effort derived from a standard creel survey. The study was conducted from March-August 2013 at Lake Leon, a 1,590-acre reservoir with two boat ramps, limited shore-fishing access, and limited recreational-boating activity. One Cuddeback game camera was installed at each boat ramp in a location that covered most of the ramp's parking area. Photos were taken every 30 minutes during daylight, and angler effort was determined by recording arrival and departure time for every trailer at each ramp. Total trailer hours were determined for each day at each ramp and summed for the entire period, correcting for missing days. A standard access-point creel survey (23 days) was conducted from March-August 2013. Game camera trailer counts were completed for 89% of days at the Dam ramp and 92% of days at the Chock-o-Block ramp. Estimated angler effort determined from camera images was 11,696 h, expanded for missing days, at 1.75 anglers/boat. Angler effort from the access-point creel survey was 11,038 h (RSE = 22). In addition to estimation of angler effort, images from game cameras documented 27 distinct largemouth bass tournaments. Angler effort was remarkably similar between the two methods, both verifying that images from game cameras could be a valid and likely cost-effective methodology to determine angler effort on a larger reservoir and that our creel survey design/analysis provided a reliable estimate of angler effort.

Size-selective predation by Gulf Killifish on endangered Sharpnose Shiner

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Gulf Killifish *Fundulis grandis*, native to the Texas Gulf Coast, is established in the middle Brazos River as a result of baitfish releases. The Gulf Killifish is a large, up to 180-mm TL, fundulid that feeds aggressively on smaller fishes. To assess the potential impact of Gulf Killifish in the upper Brazos River, should the species be released into Possum Kingdom Reservoir or farther upstream, we conducted a number of feeding trials using Gulf Killifish as predators and Sharpnose Shiner as prey. Gulf Killifish consumed an average of 4.5 Sharpnose Shiner over a 48-hr period. Gulf Killifish selectively preyed on Sharpnose shiner smaller than 28-mm TL. Our results indicate that Gulf Killifish can feed on age-1 and age-2 Sharpnose Shiner, but are most likely to feed on young-of-year fish.

Challenges of fish surveys in an arid environment

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Arizona is home to 36 species of native fish, 20 of which have been federally listed as endangered or threatened, mostly due to habitat loss and the introduction of non-native species. While struggling to cope with anthropogenic challenges, these natives represent striking examples of aquatic adaptation. Periods of drought punctuated by flash flooding quickly change fish habitats from small desert pools to torrential flows. Encompassing four major deserts which receive approximately 5-13 cm of rain per year on average, Arizona is one of the driest states in the US, but it is also heavily affected by a monsoon season which peaks between mid-July and mid-August. Adaptations of native fish to this challenging climate are varied. Desert pupfish (*Cyprinodon macularius*) exhibit tolerance to extreme oxygen depletion (as low as 0.13 mg O₂/L), salinity (as high as 140 ppt), and temperature ranges (freezing in winter to 44 °C in summer). Gila topminnow (*Poeciliopsis occidentalis*) instinctively respond to high discharge by rapidly moving to shoreline areas as water rise, and several species of chub and sucker have anterior humps and flattened heads that provide hydrodynamic stability during turbulent flow. Fish biologists seeking to survey these desert species are confronted by some of the same challenges of variable water availability. Surveys are often frustrated by shallowness, poor visibility, difficulty of access (e.g. narrow gorges, large obstructions), and quickly changing water flows. A combination of dipnets, seines, minnow traps, hoop nets, and backpack electrofishing units are adapted to arid surveys, with multiple methods often used

within a short stretch of sampling site. In arid environments, heavy vegetation often conspires with stagnant water of poor visibility to render both visual and net/trap surveys impractical, especially when sampling sites consist of holes or pools with limiting dimensions. In these cases, dipnets can prove useful tools for cursory sampling, where general characterization of the sampling site is sufficient. Whatever the scenario, fish biologists must consider a suite of site parameters before choosing the most effective sampling methods in an arid environment.

Structure and dynamics of fish communities in the upper Uruguay River, Brazil

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Longitudinal river gradients are a continuum of varying environmental conditions and ecosystem process ("river continuum concept") that influence the structure and dynamics of species assemblages of fish and other aquatic organisms. Construction of hydroelectric dams causes major environmental impacts that alter fluvial environmental gradients and, consequently, aquatic communities. We present findings from a study aimed at evaluating the structure of local fish assemblages in the Upper Uruguay River in Brazil, a river that has been impounded by three hydroelectric dams. From 2006 to 2010, experimental gill nets were deployed seasonally within reservoir and lotic reaches of four sectors along the river's longitudinal gradient. Survey data were converted to catch per unit effort (CPUE). Surveys produced a total of 82 fish species, and multivariate statistical ordination revealed differences in fish assemblage structure along the river's longitudinal gradient. Several water quality variables were significantly associated with the longitudinal gradient. Conductivity was higher and water transparency was lower in more downstream reaches. Water temperature was associated with a seasonal environmental gradient that also influence fish assemblage structure. Fish assemblages in the lower reach were dominated by *Pachyurus bonariensis*, *Paraloricaria vetula* and *Loricariichthys anus*. *Acestrorhynchus pantaneiro* was common in upstream reach samples, especially during summer. *Rhamdella longiuscula* was common in upstream reach samples during winter. Eleven species were only captured in lotic habitats, and two species (*Crenicichla tendybaguassu* and *Loricariichthys sp.*) were captured exclusively from lentic habitats. Large spatial and temporal variation of fish assemblages in the Upper Uruguay River is probably has multiple causes, including environmental influences of dams on both lentic (impounded) and lotic reaches, differences in the ages of dams that determines stages of community assembly.

Are river-reservoir interface habitats operating as fish nurseries for Lake Texoma?

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The river-reservoir interface (RRI) is a dynamic habitat associated with reservoirs where fish species diversity and abundance can be very high. Reservoir fragments, backwaters and coves within the RRI may become isolated due to sedimentation, experiencing connectivity to the reservoir or river intermittently. These habitats may provide nurseries for riverine guilds of fish displaced by reservoir construction and for desirable fisheries taxa, such as *Morone* species. We selected Lake Texoma for its abundant reservoir fragments and to examine differences between the Red and Washita river arms. We sampled larval and juvenile fishes in seven reservoir fragments and two riverine sites twice monthly from March through July, and once a month from August through November 2014. We used push nets and light trapping in the spring and summer and modified mini-fyke nets in the fall. Local habitat characteristics, particularly conductivity and turbidity, varied substantially between river

arms. Connectivity between reservoir fragments and the reservoir was limited due to ongoing drought conditions, making it difficult to assess the degree that reservoir fragments interact with other RRI habitats. Families captured in RRI habitats included: Lepisosteidae, Clupeidae, Cyprinidae, Catastomidae, Atherinopsidae, Ictaluridae, Moronidae, Centrarchidae and Percidae. Atherinopsids and clupeids were present earlier in the sampling season, and remained in high abundance throughout. Other families were patchier in their distribution across reservoir fragments and time. An additional season of sampling is scheduled to begin March 2015. This research is expected to provide managers with important insights into the role RRI habitats play in supplementing reservoir fish assemblages and providing displaced floodplain reliant species with nursery habitats.

Investigating predation impacts of non-native Gulf Killifish *Fundulus grandis* on Pecos River fishes

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Gulf Killifish (*Fundulus grandis*) is a species native to estuaries and lower reaches of rivers along the Gulf of Mexico coast that has become established in the Pecos River, likely as a result of bait-bucket introductions. In the Permian Basin region, it is now one of the most abundant fish species in the river. Non-native, inland populations are also established elsewhere in the Rio Grande and Brazos basins, but little is known about the ecological impacts of these invasions. First, we investigated trophic resource use of non-native *F. grandis* in the Pecos using stomach contents analysis. We found that they primarily consumed other fishes (*Cyprinodon variegatus*, *Lucania parva*, and *Menidia beryllina*). Up to 18 fish were found in individual *F. grandis* stomachs, with prey fish size ranging from 8 to 25 mm TL. To investigate piscivory further, we carried out timed feeding trials in which *F. grandis* were presented with ten juvenile *C. variegatus* and *L. parva* of various sizes in laboratory aquaria. We found that *F. grandis* consumed an average of four fish (from 21-34 mm TL) within 30 minutes of feeding. Our results suggest that predation impacts of *F. grandis* could be significant in the Pecos and other rivers where the species has invaded.

Effects of experimental warming on stream ecosystem structure and function

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We conducted a 90-day field mesocosm experiment to test the potential effects of global warming on stream ecosystem structure and function. We implemented an elevated temperature treatment (eT) of +4C using infrared quartz heaters and measure the response in watercolumn nutrients, periphyton, leaf litter decomposition, benthic invertebrates, and fish growth to increased water temperature. Effects of experimental warming on stream ecosystem properties were mixed. We found no effect of increased water temperature on watercolumn nutrients or benthic periphyton. However, elevated temperature increased leaf litter decomposition and reduced benthic invertebrate density. Finally, increased water temperature increased fish growth. Our data suggested that global warming could have significant effects on stream ecosystems by altering interaction strength of important food web processes that regulate stream structure and function.

Basic aspects of immunity in two teleost model organisms, the Fathead Minnow and the Sheepshead Minnow

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It has been well established that environmental stressors, including contaminants, can alter the immune function of fishes leading to increases in diseases susceptibility and even death. While several teleost models have been developed for use in acute, chronic and reproductive toxicity tests, few teleost models are available for immunotoxicity assessments. The goal of the current project is to develop the fathead minnow (*Pimephales promelas*, a freshwater species) and the sheepshead minnow (*Cyprinidon variegatus*, an estuarine species) as model organisms for immunotoxicity testing. Both species are considered environmental sentinels, are frequently used in routine toxicity evaluations and easy to maintain in the laboratory making them ideal model organisms. However, there is a paucity of information regarding basic immune function in both species. Therefore, the primary objective of this study was to characterize basic aspects of immune function in each species. This was accomplished by: 1) characterizing and enumerating leukocytes, 2) determining spleen index and 3) assessing pathogen resistance in adult fathead and sheepshead minnows with no known history of pathogen or contaminant exposure. Results of this study demonstrate that common metrics of immune function can be easily measured in both fathead and sheepshead minnows indicating that both species offer promise as models for immunotoxicity testing. Future studies aimed at evaluating the immune responses of each species to known immunotoxicants are needed to identify appropriate test endpoints and to further validate the use of these species in immunotoxicity evaluations.

The Fathead Minnow fish embryo toxicity test: an alternative method for evaluating whole effluent toxicity and surface water quality

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In an effort to protect surface water quality, any facility that discharges effluent is required to conduct routine toxicity tests to evaluate the safety of the effluents being discharged. The fathead minnow (*Pimephales promelas*) larval growth and survival (LGS) test is the most commonly used test for these assessments; however, the fathead minnow fish embryo toxicity (FET) test has been proposed as an alternative to the LGS. The objectives of this study were to evaluate the sensitivity of the fathead minnow LGS and FET tests and to determine if the inclusion of sublethal metrics as test endpoints could enhance test utility. The LGS and FET tests were conducted using four reference toxicants and two mock effluents. For half of the chemicals/effluents tested, the sensitivity of the FET and LGS tests were similar; however, for the remaining test compounds, the FET test was significantly less sensitive than the LGS test. The inclusion of sublethal endpoints in the FET test was found to enhance test sensitivity and utility. For example, minnows exposed to mock municipal wastewater treatment plant effluent in a FET test experienced an increased incidence of pericardial edema with increasing effluent dose indicating that the inclusion of pericardial edema as a FET test endpoint could improve test sensitivity. Additionally, alterations in the expression of genes related to growth (i.e., insulin-like growth factor) and toxicity (i.e., heat shock proteins) were observed suggesting that molecular-level changes could be used to predict the chronic impacts associated with effluent exposures. Overall, the results demonstrate the utility of the fathead minnow FET test as a replacement for the LGS test, but also provide evidence that inclusion of additional endpoints could improve the predictive power of the FET test in evaluating the toxicity of contaminants being discharged into aquatic systems.

The effects of a ubiquitous aquatic plant contaminant, PBDE-47, on growth and thyroid function in fish and amphibians

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The growth rate of fishes is a critical factor in assessing fisheries health as it is a determinant of biomass and can influence recruitment potential. As such, environmental stressors capable of reducing growth rate are of particular concern. Here, we evaluate the potential for polybrominated diphenyl ether 47 (PBDE-47, a flame retardant), a ubiquitous aquatic contaminant with suspected thyroid-disrupting activity to alter growth, development and thyroid function in two aquatic model organisms, the fathead minnow (*Pimephales promelas*) and the African clawed frog (*Xenopus laevis*). Fathead minnows were exposed to two environmentally-relevant concentrations of PBDE-47 via maternal transfer (i.e., they were produced by females exposed to PBDEs) and via their diets until 30 days post hatch. Prometamorphic tadpoles were exposed to three environmentally-relevant concentrations of PBDEs via their diets for 21 days beginning at developmental stage 52. The mass and length of minnows were evaluated on days 0, 2, 15 and 30 of the exposure period, while tadpole mass, body length and developmental stage were evaluated on days 0, 7, 14 and 21. Both the mass and length of minnows exposed to the highest concentration of PBDEs was significantly lower than that of minnows in the control group suggesting that exposures to PBDEs can impair fish growth. Similarly, *Xenopus* tadpoles exposed to the highest PBDE concentration were significantly smaller and less developed than controls. These results add to the growing body of evidence indicating that exposures to PBDEs can impair the growth and development of aquatic organisms. As such, the presence of PBDEs in aquatic systems may pose a threat to the overall health of fisheries. Future studies aimed at characterizing the presence and biological impacts of PBDEs in Texas waterways and the fishes that inhabit them are warranted.

Encroachment of Common Reed in the Canadian River and its effect on the river channel from 2008 through 2012

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The Canadian River in Texas and New Mexico between Ute Reservoir and Lake Meredith used to be characterized by large sand flats and sand banks that allowed the channel to meander during low flows and spread laterally into the flood plain with increased discharge. However, in recent years the bank has begun to stabilize with Common reed (*Phragmites australis*). Common Reed is an invasive grass species, known to stabilize river banks, that spreads by means of rhizomes and stolons that can measure up to 18-m in length. To examine the extent of *Phragmites* along the Canadian River, we obtained Orthoimagery in the form of National Agriculture Imagery Program (NAIP) imagery mosaics from the United States Department of Agriculture Natural Resources Conservation Service Geo Spatial Data Gateway for 2008 and 2012. Data were classified using an unsupervised classification system in ERDAS IMAGINE 2014. A change analysis comparing the different classified dates showed a temporal change of common reed. Our results show that a decrease in channel width of up to 50% in some areas, due to bank stabilization, has altered the river and could affect upstream migration of fishes if encroachment of common reed continues. We hypothesize the encroachment of *Phragmites* has been facilitated by reduced river flows in recent years, especially during 2011.

Distribution, abundance, and habitat use of the Saltmarsh Topminnow (*Fundulus jenkinsi*)

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The saltmarsh topminnow, *Fundulus jenkinsi*, occurs sporadically along the coast of the Gulf of Mexico and is listed as a species of concern by many of the gulf coast states. *Fundulus jenkinsi* utilizes the edge of the saltmarsh habitat and prefers low to mid- salinity water. Not much is known about *F. jenkinsi*'s range or abundance within Texas. Land development, levee and canal construction, sea-level rise, land subsidence, and pollution all threaten the availability of *F. jenkinsi*'s habitat and, consequently, its abundance. Given the limited knowledge of the extent of the minnow's range it is important to document the population and occurrence of the saltmarsh topminnow in order to better understand the extent of *F. jenkinsi*'s range into Texas and determine their habitat needs. This study was conducted in within the Galveston Bay and Sabine Lake systems. Sites were chosen that were tidally influenced as well as received some freshwater input to account for the salinity gradients that have been reported in the literature as being preferred by *F. jenkinsi*. Fish communities were sampled using seines and Breder traps. Water quality parameters were collected at each site as well as dominant vegetation cover. When collected, specimens of *F. jenkinsi* were identified, counted, and measured (standard length). In addition, total fish community abundance (N), species abundance (N), relative abundance (%), catch-per-unit-effort (CPUE), richness (S), diversity (H') and evenness (J') will be calculated for each site. Habitat and conspecific fish species data will be used to identify environmental and biological factors that influence spatial and temporal trends in *F. jenkinsi* across sites.

Quantifying the dietary tryptophan requirement of juvenile Red Drum

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The red drum, *Sciaenops ocellatus*, is cultured in the United States for both stock enhancement and food production. Ongoing studies in this laboratory are quantifying optimum dietary levels of indispensable and dispensable amino acids of red drum in order to compile a complete set of nutritional requirements. The present study was being conducted to determine the optimum dietary tryptophan requirement of red drum. Twelve red drum fingerlings, of initial average weight of 1.5- 2.5 g each were placed in each of 28, 38-L aquaria containing brackish water (7ppt) prepared from well water and a mixture of stock salt and commercial synthetic seawater. Seven diets containing incremental levels of tryptophan: 0.15%, 0.25%, 0.35%, 0.45%, 0.55%, 0.65%, and 0.75% inclusion levels were given to triplicate groups of fish. Fish in each aquarium were group weighed every week to observe health and growth as influenced by dietary tryptophan. Water quality samples were also observed multiple times per week. At the end of the 39-day period, the optimal tryptophan requirement of red drum was estimated based on weight gain, feed efficiency and protein conversion efficiency. Red drum fed the basal diet without adequate tryptophan exhibited significantly ($P < 0.05$) reduced weight gain, feed efficiency and survival compared to fish fed adequate levels. Based on non-linear regression analysis of these responses, the minimum dietary tryptophan level will be determined in analysis this coming semester. This information can be used in formulating diets for red drum to ensure adequate levels of tryptophan are provided.

Conservation assessment and mapping products for Great Plains priority fish taxa

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Strategic conservation planning for broad, multi-species landscapes benefits from a data-driven approach that emphasizes persistence of all priority species' populations and utilized landscapes, while simultaneously accounting for human uses. This study presents such an assessment for priority fishes of the Great Plains of the United States. Species distribution models for 28 priority fish taxa were created and incorporated into a prioritization framework using the open source software Zonation, accounting for species-specific connectivity needs and current fish habitat condition. Multiple additional assessments were then produced that i.) identify distinct species management units based on distance and compositional similarity of stream segments containing priority taxa, ii.) compare results of ranking taxa conservation values at the local (state) and global scale, and iii.) provide 'bang-for-buck' perspectives, emphasizing richness of priority taxa, at state and major basin scales. Together, these analyses are intended to aid managers in effective allocation of conservation action with regards to imperiled fish taxa of the Great Plains. Implementation of a broad-scale multi-species approach such as this complements traditional reactive management and restoration by encouraging cooperation and coordination among stakeholders and partners, increasing efficiency of future monitoring and management efforts.

Morphological divergence in multiple *Notropis oxyrhynchus* populations

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Brian Langerhans

The Sharpnose shiner *Notropis oxyrhynchus* has been detrimentally affected by habitat alterations and was recently listed as federally endangered. It remains extant in the Brazos River but specimens have not been taken in the Colorado River basin (where believed to be introduced) since the mid-1950s. Based on a visual assessment of differences in body shape morphology among museum specimens and the discovery of formerly mis-identified specimens collected from the Colorado in 1884, we proposed that populations in the two rivers might be separate or incipient species, and used geometric morphometric methods to assess that hypothesis. Four populations were analyzed, two from each the Colorado and Brazos. A MANCOVA test of relative warp scores of shape variables with river as a main effect and centroid size as a covariate revealed that the shape of specimens differed significantly ($p < 0.002$) between the two river basins. Thin plate spline graphs show that fish from the Brazos are more shallow-bodied than Colorado fish, particularly in the head region. Brazos fish have a smaller head with a more acute snout angle, more subterminal mouth and a posteriorly shifted maximum body depth. With clear evidence of distinct morphological separation between the two rivers' populations, we consider the Colorado form to represent a previously undescribed native species that unfortunately is likely extirpated, though we recommend renewed efforts to find remnant individuals.

The "Fluviageny" - analyzing temporal river fragmentation using phylogenetics

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Analyses of the consequences of damming on aquatic biota have historically focused mostly on single, and generally large, dams in conjunction with snapshots of pre- and post-impoundment biotas. However, the effects of dams on watersheds are undoubtedly cumulative and scale-dependent over both time and space, and the evolution of communities isolated in dam-produced watershed fragments can be expected to evolve as predicted by island biogeography and community ecology theory. Thus, analytical methods that allow rigorous exploration of general patterns of evolution of biotic communities in river fragments over broad geographic and temporal scales, as well as across replicates of varied sets of river damming scenarios, should have great power to improve our knowledge of how anthropogenic watershed fragmentation affects aquatic biotas. Inspired by the "terragenies" of Ewers, et al. (2013), I wrote R code that applied phylogenetic methodology to data from the National Anthropogenic Barrier Dataset (NABD), which combines dam data from the National Inventory of Dams (NID) and the National Hydrography Dataset (NHDPlus, version 1) to produce what I call 'fluviagenies', or phylogenetic tree-like depictions of the history of watershed fragmentation by dams. Then, using data from the Fishes of Texas (FoTX - fishesoftexas.org) database, a comprehensive geospatial database of Texas fish occurrences aggregated and normalized from 42 museum collections, I mapped fish communities over time onto the fluviageny to provide a visualization of the shared histories of river fragments and fish communities for the Colorado River Basin in Texas. Future work will build on this preliminary example to automate creation of fluviagenies across a broader geography to enable more rigorous testing of hypotheses of the relationships between fish communities and river fragmentation and better leverage the rich toolsets of phylogenetics.

Evaluating the effects of drought and anthropogenic alterations on the growth of stream fishes on the Edwards Plateau, central Texas

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Both drought and landscape-level anthropogenic alterations, such as alterations of stream channel morphology and flow regime, have the potential to affect fish growth. However, it is not clear how drought and anthropogenic alterations interact. Our objectives were to evaluate the influence of this interaction between drought and anthropogenic factors influence on the growth rates of a suite of stream fishes within a pair of adjacent river systems in Texas. The North Llano River (NLR) and South Llano River (SLR) both recently experienced a historic drought. However, the flow regime of the NLR was heavily altered while the SLR was not because of stronger spring contributions to base flows. We collected otoliths from eleven species common to both the NLR and the SLR and back calculated estimated lengths at age. We will be presenting growth data analyzed using several different models that will 1) identify if there are differences or similarities between the NLR and SLR and their individual species, and 2) if an overall difference is present among individual species we will test for differences between several covariates (age class and species) that will be allowed to vary over all specimens. We will present the preliminary results evaluating the effects of drought and altered flow regime on the growth of eleven species. Results from this study will provide biologists with a better understanding of how drought coupled with anthropogenic alterations affects the overall growth rate of stream fishes and will help improve decisions made for the management and conservation of stream fishes found within similar river systems.

Potential morphological response of Guadalupe Bass populations to hydrologic alteration and urbanization within the Colorado River Basin, Texas

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The Colorado River Basin in Texas has experienced major alterations to the hydrologic regime due to changing land and water use patterns. These anthropogenic influences on hydrologic variability have had major implications for riparian and aquatic ecosystems and the species dependent upon them, such as Guadalupe Bass *Micropterus treculii*. Our objective was to evaluate the relationship between the degree of hydrologic and landscape alteration changes in Guadalupe Bass morphology in portions of the Colorado River Basin that were previously or are currently inhabited by Guadalupe Bass. Hydrologic data were obtained from the U.S. Geological Survey stream gauge stations and U.S. Geological Survey National Hydrography Dataset. The Indicators of Hydrologic Alteration (IHA) method was then used to calculate flow metrics for select streams for two periods, pre-1979 and post-1979. U.S. Geological Survey North American Landscape Characterization data and Texas Parks and Wildlife ecoregion data were used to characterize land use and land cover changes within the watersheds of the selected streams. Relationships between hydrologic alteration and landscape changes were compared to landmark-based morphometrics for Guadalupe Bass in the late 1970's and present. Discriminant function analysis results show that present-day individuals have deeper bodies and shorter head lengths than those individuals collected 35 years ago from the same locations. These locations vary in the degree of alteration to flow regime and anthropogenic disturbance across the landscape that they have experienced since the late 1970's. We will present the effects of landscape and flow regime alterations on the morphology of Guadalupe Bass within Colorado River Basin below Austin, Texas. Comparison of the present flow regime and ecomorphological traits to historical collections and hydrologic data will facilitate the assessment of future hydrologic alterations due to increases in urbanization and water withdrawals on Guadalupe Bass populations.

The role of sexual selection in hybridization between pupfishes (genus *Cyprinodon*)

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Hybridization is a driving force for the loss of biodiversity worldwide, and is of particular concern for freshwater fishes. Reproductive isolating mechanisms play a role in hindering hybridization, but for closely related allopatric species, reproductive isolating mechanisms can break down when the species come into secondary contact with each other. Pre-mating isolating mechanisms include those related to sexual selection. Typically, sexual selection includes female mate choice and male-male competition. This may not only occur within a species but also between species. To identify any break down in reproductive isolation that may facilitate hybridization, experimental studies of female preferences and male competition were conducted on two *Cyprinodon* species. *Cyprinodon rubrofluviatilis* is a common species in the Red and Brazos river watersheds, but the introduction of *C. variegatus* poses a threat to the status of *C. rubrofluviatilis*. *Cyprinodon variegatus* has been introduced to habitats of other *Cyprinodon* in the southwest United States, where hybridization and introgression has been extensive. Female preference trials quantifying association time were used to identify if either species prefer conspecific males to heterospecific males. Male-male competition trials replicated secondary contact and quantified aggressive behaviors. Males of many *Cyprinodon spp.* defend territories to attract females, therefore if one species is more aggressive, they may control more or higher quality territories at spawning sites. Understanding behavioral interactions that may promote heterospecific matings is critical to management strategies in systems threatened by hybridization.

Territoriality and 'dear enemy' recognition between heterospecific pupfishes (genus *Cyprinodon*)

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Territorial animals are aggressive towards other individuals, but territorial aggression can vary among species or based on the identity of the competitor. Some territorial species exhibit "dear enemy" recognition; where lower levels of aggression are directed at neighboring, territorial individuals compared to intruders or unfamiliar individuals. The sheepshead minnow, *Cyprinodon variegatus*, is more aggressive than and can outcompete closely related species. Territorial males of this species also exhibit 'dear enemy' recognition. Recently, *C. variegatus* has been introduced into the home range of *Cyprinodon rubrofluvialis*, leading to hybridization between the species. We test the hypothesis that territorial males of these two *Cyprinodon* species differ in expression of dear enemy recognition. We also examine territorial formation between heterospecifics and evaluate if heterospecific neighbors express 'dear enemy' recognition towards each other. We present preliminary data from laboratory experiments testing these hypotheses. Understanding the dynamics between territorial males of different species may help identify what is driving hybridization and ultimately inform conservation strategies.

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