

ANNUAL PROCEEDINGS  
of the  
TEXAS CHAPTER

**AMERICAN FISHERIES SOCIETY**



**Pottsboro, Texas**

**13-15 February 2014**

**Volume 36**

# **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  
13-15 February 2014  
Pottsboro, Texas

2014-2015 Officers

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Texas Parks and Wildlife Department

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Texas Parks and Wildlife Department

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## 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

## 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 – Joshua 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.) – Joshua 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)  
 Best Professional Poster Presentation – Rae Deaton (SEU)  
 Best Student Poster Presentation – Jacob Wadlington (TCU)  
 Scholarships, Undergraduate – Nathan Frey  
 Scholarships, Undergraduate – Mark Thomas  
 Scholarships, Graduate (M.S.) – Niki Ragan  
 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)  
 Fisheries Culture – Chris Thibodeaux (TPWD)  
 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 Kolodziejcyk  
 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)

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

## **TECHNICAL SESSION ABSTRACTS**

### **Surveys of Recreational Bow Anglers in Texas**

Daniel L. Bennett (*Texas Parks and Wildlife Department, Inland Fisheries Division, 11810 FM 848, Tyler, Texas 75707*)

Richard A. Ott (*Texas Parks and Wildlife Department, Inland Fisheries Division, 11810 FM 848, Tyler, Texas 75707*)

C. Craig Bonds (*Texas Parks and Wildlife Department, Inland Fisheries Division, 11810 FM 848, Tyler, Texas 75707*)

Bow anglers are a historically under-studied angling constituency. To obtain baseline demographic information and fishing habits from bow anglers, we distributed mail surveys to 173 participants at three Trinity River bowfishing tournaments in 2011. In return, we received 15 completed surveys for a response rate of 9%. To compensate for low response from mail surveys, we conducted an online survey of Texas Bowfishing Association members in 2012 and received 82 returned surveys, resulting in a 46% response rate. Responses from the mail survey were pooled with responses from the online survey for a total sample size of 97 bow anglers. Survey respondents were primarily male (97%), and ranged from 10 to 67 years of age. Mean age of respondents was 34 years. Forty-six percent of respondents reported to have a college education or higher, and a median income of \$60,000 to \$79,000, which was similar to other angling groups in Texas. Anglers spent an average of 46 days bowfishing in the previous 12 months, and 76% of all fishing days took place between March and August. The most common species anglers targeted in Texas were Smallmouth Buffalo, gars, and Common Carp. Surveys also yielded important information specific to the management of Alligator Gar fisheries in Texas.

### **Effects of Water-level Reduction and Sedimentation on Crayfish in the Ouachita Mountain Ecoregion**

Joseph J. Dyer (*Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University*)

Shannon K. Brewer (*U.S. Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit*)

Two lab experiments were conducted to evaluate the effects of water withdrawals and sedimentation on the survival and growth of several Ouachita Mountain crayfish species. We designed the first experiment to test the interaction between water withdrawals (a control and three treatments: a 24-h water reduction of 15, 30 and 45 cm) and two substrate treatments (pebble and cobble substrate) on the burrowing ability and fitness of crayfish. The second experiment evaluated the effects of sedimentation (three treatments of 0%, 45% and 90% sediment) and the interaction with water-level reduction (45 cm reduction) on crayfish burrowing and weight loss depending on substrate type (cobble and pebble). Results indicated crayfish were able to burrow deeper into the simulated hyporheic zone in cobble substrates when compared to pebble. Crayfish in the pebble treatment that were not able to reach the reduced water level lost weight during the trials. Sedimentation reduced the ability of the crayfish to burrow, regardless of substrate treatment. Weight loss was highly variable in the sediment treatment across all sedimentation treatments. Results from this study suggest sedimentation and water withdrawals have the potential to impact crayfish fitness.

## **Do River-reservoir Interface Habitats Serve as Surrogate Nursery Habitats for Floodplain-dependent Riverine Fishes?**

Matthew R. Acre (*Department of Natural Resources Management and Texas Cooperative Fish and Wildlife Research Unit, Texas Tech University, P.O. Box 42120, Lubbock, TX 74909; 806-742-2851; matthew.acre@ttu.edu*)

Nate Smith (*Texas Parks and Wildlife Department, Inland Fisheries Division, Heart of the Hills Fisheries Science Center, 5103 Junction Highway, Mountain Home, TX 78058*)

Timothy B. Grabowski (*U.S. Geological Survey, Texas Cooperative Fish and Wildlife Research Unit, Texas Tech University, P.O. Box 42120, Lubbock, TX 74909*)

Anthropogenic modifications to riverine systems have reduced access to off-channel habitats that are important nursery habitat for many riverine fishes. The river-reservoir interface (RRI) may offer surrogate nursery habitat for these floodplain-dependent fishes. We sampled the ichthyoplankton assemblage in off-channel and main channel habitats of the Lake Livingston RRI and the middle Trinity River to: 1) compare ichthyoplankton abundance and species composition in different habitat types (off-channel RRI, main channel RRI, off-channel riverine, and main channel riverine), and 2) evaluate the influence of lateral connectivity and physicochemical characteristics on abundance and species composition of the ichthyoplankton assemblage in these habitats. Ichthyoplankton was sampled using light traps and paired push nets deployed off jet-powered kayaks during February-July 2013. A total of 537 samples were taken from 11 sites, and 32,335 larval fishes were collected, representing nine families. The dominant species at all 11 sites were Threadfin Shad *Dorosoma petenense* and Inland Silverside *Menidia beryllina*. However, less common ichthyofauna, such as moronids and centrarchids, were captured more frequently in RRI habitats. Sites with frequent connectivity to the main channel had higher species richness and diversity, and overall abundance of fishes was greater in these sites. Push net samples were overall more effective; however, species richness and diversity were similar between light trap and push net samples. We used multivariate analyses to compare species richness, diversity, and evenness among habitats which indicated all were greater in the RRI compared to natural off-channel habitats. These differences suggest that RRI habitat may act as a surrogate nursery for some species.

## **Snag Angler Use and Paddlefish Harvest in Northeast Oklahoma**

Jason D. Schooley (*Oklahoma Department of Wildlife Conservation, Paddlefish Research Center, 61091 E 120 Rd, Miami, OK 74354; jschooley02@sbcglobal.net*)

The popularity of snag angling for North American paddlefish (*Polyodon spathula*) in Oklahoma has increased since free fish cleaning services were made available at the Paddlefish Research Center (PRC) in 2008 on Grand Lake O' the Cherokees. Simultaneous with the opening of the PRC, Oklahoma Department of Wildlife Conservation instituted a system where a free paddlefish permit was mandatory for paddlefish angling. Though many permits issued were unused or unwanted, harvest data collected at the PRC were linked to permit data to investigate trends in individual harvest across the years 2009-2013. Largely due to the location of the angling opportunities in the far northeast corner of Oklahoma, nonresident anglers harvesting paddlefish outnumbered resident anglers more than two to one. Finer scale investigation on angler origins via zip code revealed a fishery dominated by a relatively small regional area within the corners of four neighboring states, yet attracting many anglers from great distances. Angler avidity was classified as experimental, intermediate, or traditional based on the number of harvest years within the study period. Regardless of residence, the fishery was dominated by experimental anglers indicating high turnover and recruitment. Angler retention was higher for nonresident anglers while this segment maintained steadily increasing numbers during 2009-2013. As expected, traditional anglers were responsible for higher individual harvest and a higher proportion of nonresident anglers were classified as traditional. Data analyses identified high-harvest anglers within the demographic structure of the fishery. New harvest regulations enacted in January 2014 including an individual annual harvest limit of two fish and mandatory harvest reporting aim to limit only high-harvest individuals while preserving opportunity for all anglers.

## **Identification of Native Fish Conservation Areas in Drainages of the Edwards Plateau, Texas, USA**

Benjamin J. Labay (*Texas Natural History Collections, Texas Natural Science Center, University of Texas, 10100 Burnet Rd., PRC176 EAST/R4000, Austin, Texas 78758*)

Dean A. Hendrickson (*Texas Natural History Collections, Texas Natural Science Center, University of Texas, 10100 Burnet Rd., PRC176 EAST/R4000, Austin, Texas 78758*)

Adam E. Cohen

Timothy Birdsong (*Texas Parks and Wildlife Department, Inland Fisheries Division, 4200 Smith School Road, Austin, TX 78744*)

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. We initiated such a strategic conservation area assessment for stream fishes within the Edwards Plateau, Texas. We utilized the open source software Zonation to perform a spatial prioritization analysis that explicitly incorporates species' response to fragmentation, upstream-downstream connectivity, and various landscape cost and risk parameters that account for past habitat loss or current degradation. Finally, we processed the assessment to identify distinct, high-priority landscape management units based on distance and compositional similarity of prioritized areas. Implementation of a broad-scale multi-species approach such as this complements traditional reactive management and is intended to provide i. maintenance of processes that create habitat complexity, ii. protection of all life stages and long-term persistence of priority species, and iii. a framework for sustainable management over time.

## **Implementation of Native Fish Conservation Areas as an Approach for Conserving Endemic Black Basses of the Southern US**

Timothy Birdsong (*Texas Parks and Wildlife Department, Inland Fisheries Division, 4200 Smith School Road, Austin, TX 78744*)

M. Bean (*Texas Parks and Wildlife Department, Inland Fisheries Division, Heart of the Hills Fisheries Science Center, 5103 Junction Highway, Mountain Home, TX 78058*)

G.P. Garrett (*Texas Natural History Collections, Texas Natural Science Center, University of Texas, 10100 Burnet Rd., PRC176 EAST/R4000, Austin, Texas 78758*)

D. German (*Texas Parks and Wildlife Department, Inland Fisheries Division, 4200 Smith School Road, Austin, TX 78744*)

Dean A. Hendrickson (*Texas Natural History Collections, Texas Natural Science Center, University of Texas, 10100 Burnet Rd., PRC176 EAST/R4000, Austin, Texas 78758*)

Benjamin J. Labay (*Texas Natural History Collections, Texas Natural Science Center, University of Texas, 10100 Burnet Rd., PRC176 EAST/R4000, Austin, Texas 78758*)

Of the nine described species and subspecies of black bass, six are endemic to the southern US: Guadalupe Bass *Micropterus treculii*, Shoal Bass *M. cataractae*, Redeye Bass *M. coosae*, Florida Bass *M. salmoides floridanus*, Alabama Bass *M. henshalli*, and Suwannee Bass *M. notius*. Additional undescribed species and subspecies also exist, all in need of conservation measures to prevent them from becoming imperiled. The Native Fish Conservation Areas (NFCAs) approach offers particular utility in supporting the long-term persistence of endemic black bass populations. NFCAs are defined as watersheds with a management focus on the conservation and restoration of native fishes and other native aquatic species, as well as the habitats on which they depend. As such, NFCAs promote landscape-scale considerations and offer integrated and holistic conservation strategies that emphasize the long-term persistence of native aquatic species while allowing for compatible human uses. This approach seems especially relevant to the conservation of recreationally important species such as endemic black basses that are keystone species within their biological communities and that have experienced population declines, primarily associated with anthropogenic changes in watersheds where large-scale preservation opportunities are limited. This presentation will highlight case studies of efforts to implement NFCAs in three watersheds located within the Edwards Plateau Ecoregion of Texas to conserve Guadalupe Bass and 14 other regionally-endemic fishes. Additionally, this presentation will provide an overview of recent efforts to establish a network of NFCAs throughout the southern US with the specific goal of preserving black bass diversity.

## **Evaluating the Efficiency of a Collection Device for Quantifying Densities of Early Life Stages of Smallmouth Bass in Streams**

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Brandon Brown (*Oklahoma Department of Wildlife Conservation, Porter, Oklahoma 74454;*  
*madtom@itlnet.net*)

Shannon K. Brewer (*U.S. Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit, 007*  
*Agriculture Hall, Oklahoma State University, Stillwater, Oklahoma 74078;*  
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Quantification of early life-history stages of fishes is an important component in understanding recruitment dynamics in streams. Counting eggs and larvae of fishes is difficult in a field setting because of the varying environmental conditions under which nest construction takes place. We designed a device for sampling early life stages using a 500 gph 12 v bilge pump attached to a 4" pvc collection chamber and 3/4" x 4' clear suction hose. A mesh bag serves as an inline filter and collects the eggs and fry. The objective of this study was to evaluate the efficiency of the sampler under varying velocity (moderate and low) and substrate conditions (sand, gravel, and cobble). We artificially constructed nests using the three different types of substrate, making them similar in appearance to nests constructed by centrarchids. We mixed a known quantity of gellan beads into each treatment (n=X of each substrate type and flow combination) and beads were sampled from each constructed nest using a standard approach. Results indicate the constructed device was at least 85 % efficient at collecting the beads under the different treatments. We also used the device in preliminary trials to collect fry and results indicate high efficiency. Additional testing to understand the bias associated with fry collection is warranted but the device appears to work well under relatively benign streamflow conditions.

## **Assessing Habitat Use Patterns of the Endangered Snail, Pecos *Assiminea Assiminea pecos*, at Bitter Lake National Wildlife Refuge**

Elizabeth L. Roesler (*Department of Natural Resources Management, Texas Tech University, Lubbock, Texas*  
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David Rogowski (*Department of Natural Resources Management, Texas Tech University, Lubbock, Texas 79409;*  
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Timothy B. Grabowski (*U.S. Geological Survey, Texas Cooperative Fish and Wildlife Research Unit, Texas Tech*  
*University, P.O. Box 42120, Lubbock, TX 74909*)

Pecos *assiminea Assiminea pecos* is an endangered, semi-aquatic snail endemic to two spring systems located in eastern New Mexico and west Texas. Basic biological information needed for effective conservation is currently lacking for this species, particularly, understanding its habitat use patterns and response to management initiatives. The objectives of this study were to characterize the habitat use of Pecos *assiminea* at Bitter Lake National Wildlife Refuge in Chaves County, New Mexico. We conducted monthly tile and quadrat surveys during February 2013-January 2014 to gauge the presence of Pecos *assiminea*. Snails were encountered on 74.0% of the tiles surveyed (n = 427) and 24.7% of the quadrats (n = 336) sampled, suggesting that tiles may be a more effective means of determining the presence of this species. Of the 25 habitat features measured within a quadrat, results from a preliminary discriminant function analysis indicated the variables that tended to predict snail presence the best were resistance, measured in the soil as a proxy of determining soil moisture content, difference in height from water to quadrat placement, percent of common reed *Phragmites australis*, percent of kochia *Bassia scoparia*, percent of bare ground, percent of saltgrass *Distichlis spicata*, soil temperature, and month of the year. These data evaluating monitoring tools and habitat associations will provide information for the effective management for this endangered species.

### **GoMEXSI: a Resource for Fisheries Modelers, Fishermen, and Science Educators**

James D. Simons (*Center for Coastal Studies, Texas A&M University-Corpus Christi, 6300 Ocean Drive, Corpus Christi, TX 78412*)

May Yuan (*Geoinformatics and Center for Spatial Analysis, 3100 Monitor Ave., University of Oklahoma, Norman, OK 73072*)

Cristina Carollo (*Harte Research Institute, Texas A&M University-Corpus Christi, 6300 Ocean Drive, Corpus Christi, TX 78412*)

Marie Eugenia Vega Cendejas (*Centro de Investigacion de Estudios Avanzados del Instituto Politecnico Nacional, Unidad Mérida, Km. 6 Antig. Carretera a Progreso. C. P. 97310, Merida, Yucatan*)

Jorrit Poelen (*Data Analysis and Visualization Consultant, 400 Perkins St Apt 104, Oakland, CA 94610*)

Dave Reed (*Florida Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, 100 Eighth Avenue SE, St. Petersburg, FL 33701-5020*)

Much attention has been devoted to the measurement and cataloguing of biodiversity throughout the world and in the Gulf of Mexico over the past 30 to 50 years. However, the systematic recording and cataloguing of species interactions has received far less attention. Nevertheless, it is this biostructure that defines and governs the flow of energy through the ecosystem. The Gulf of Mexico Species Interaction (GoMexSI) database and web application, which was officially released on 3 September 2013, is striving to rectify this situation in the Gulf of Mexico. Collecting, extracting, and archiving data from published and un-published resources and data contributors, we now have trophic interaction data for fishes from 49 sources, with a total of 69,571 interactions from 1,513 unique interactors. For these trophic interactions we are assembling diet and habitat data of fishes in the Gulf of Mexico proper, and its estuaries from 747 references. We will soon be adding trophic data for other taxa to include sea and shore birds, marine mammals, sea turtles, crustaceans, and others. Beyond trophic interactions we will include other interactions such as parasitic, amensal, commensal, and mutualistic relationships. Response so far has been excellent with approximately 215 registered users to the webpage (i.e. those seeking to query the data). Data can be examined in three ways – by a taxonomic, spatial, or exploratory query. The trophic data will be invaluable to fisheries modelers using Ecopath or Atlantis models, which require large amounts of highly resolved diet data. We are planning to develop a page devoted to fishermen where they will be able to examine the names and proportions of organisms that their favorite game fish has preyed upon where they fish. In addition, educators from California and Florida have contacted us with an interest in using GoMexSI in their classrooms.

### **Relationships between Spring Run Discharge and Spring-associated Fishes in the Karst Edwards Plateau Region**

Cody A. Craig (*Department of Biology / Aquatic Station, Texas State University, San Marcos, TX 78666*)

Kristy A. Kollaus (*Meadows Center for Water and the Environment, Texas State University, San Marcos TX 78666*)

Kenneth P.K. Behen (*Department of Biology / Aquatic Station, Texas State University, San Marcos, TX 78666*)

Timothy H. Bonner (*Department of Biology / Aquatic Station, Texas State University, San Marcos, TX 78666*)

Ground and surface water discharge ( $\text{m}^3/\text{s}$ ) sufficient to maintain sound ecological environments in streams and rivers is a primary goal of water quantity management. Once a sufficient amount is determined, the surplus is available for municipal, agriculture, and industrial use. Purpose of this study was to estimate the relationship between base flow and spring-associated fishes within a karst region of Central Texas to address the question: how much base flow is sufficient to maintain the community of the spring-associated fishes? We compiled spring-associated fish abundances and densities from six spring-influenced headwater streams, systems minimally disturbed by anthropogenic modification and ranging naturally in base flow discharge from 2 to 125 CFS. Relative abundances of spring-associated fishes ranged from 20 to 40% among spring runs with 2 to 7 CFS and 80 to 95% among spring runs with 30 to 125 CFS. Densities of spring-associated fishes ranged from 0.07 to 0.25 fish/ $\text{m}^2$  among spring runs with 2 to 7 CFS and 0.96 to 1.51 fish/ $\text{m}^2$  among spring runs with 30 to 125 CFS. Relative abundance ( $P < 0.01$ ) and density ( $P = 0.02$ ) were positively and non-linearly related to base flow. To maintain the integrity of the spring fish community (i.e., sound ecological environment), the model predicts that base flow  $>24$  CFS would support  $>80\%$  relative abundances of spring-associated fishes and base flow  $>27$  CFS would support  $>0.96$  spring-associated fishes/ $\text{m}^2$ . Our findings are consistent with Hugueny's Unsaturated

Stream Community Theory and suggest that base flows can be substantially reduced in large spring run streams (i.e., Devils River; 125 CFS) and yet maintain an intact spring fish community. If true and if other fish communities have similar relationships to base flows, we caution the establishment of water quantity standards based on the soundness of the ecological environment.

### **Fish Community Responses to Drought in an Aging Great Plains Reservoir**

Evan C. Cartabiano (*Oklahoma Cooperative Fish and Wildlife Research Unit, 007 Agriculture Hall, Oklahoma State University, Stillwater, OK, 74078-3051*)

James M. Long (*US Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit, 007 Agriculture Hall, Oklahoma State University, Stillwater, OK, 74078-3051*)

Siltation in reservoirs can reduce fish habitat and affect the reservoir's ability to sustain fish populations, particularly in response to drought. Great Salt Plains Lake (GSPL) has undergone substantial siltation since its construction in 1940, such that storage capacity in 1978 was decreased by 39,335,000 meters<sup>3</sup>. This decreased storage capacity combined with drought has resulted in numerous fish kills, likely affecting the entire fish community over time. We sampled with a number of methods both in the lake and tributaries and compared to previous studies to determine the extent to which the fish community has changed. Species composition has changed since impoundment in 1942, with several species being extirpated (e.g., Arkansas River Shiner). Between 2012 and 2013, during an extreme drought and subsequent fish kills, we failed to find channel catfish and river carp sucker. Common carp were still present, but mostly represented by small juveniles. Inland silversides have become the most numerically dominate species since their introduction sometime in the past 70 years and seem to be ideally suited to the saline habitat of GSPL. Most surprising was the documentation of gravid female Plains Minnows post-drought, suggesting the reservoir may serve as a refuge for this river species during drought.

### **Using Fish Traits to Effectively Detect and Predict Changes in Stream Fish Assemblages**

Robert Mollenhauer (*Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University, Stillwater, OK*)

Shannon Brewer (*US Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University, Stillwater, OK*)

The alarming trends in the loss of fish species diversity require that stream researchers and managers act with a sense of urgency to devise sound conservation strategies. Aquatic organisms possess combinations of morphological, behavioral, and physiological traits that have evolved together for adaptations that maximize fitness. Applying a trait-based approach to stream-fish conservation can increase the long-term success of management and monitoring programs. Understanding relationships between fish traits and the stream environment can assist in directing habitat protection and restoration efforts and allows stream managers to better assess the likelihood that individual fish species will persist with changing climate and land use. Linking stream fishes through common traits broadens the applicability of studies and provides insight into rare and poorly-studied species. Fishes that have similar combinations of behavioral and morphological traits will also likely have similar sampling-gear catchability. The objective of this study was to use hierarchical clustering to group stream fishes of the Ozark Highlands based on common ecomorphological (e.g., relative size of fins, mouth, eye, etc.) and life-history (e.g., reproductive and feeding strategies) traits. Fish species were grouped into different numbers of clusters, but we simplified groups based on 24 traits hypothesized to be meaningful to issues threatening lotic ecosystems (e.g., flow alteration). We demonstrate how these groups are useful for both standardizing stream-fish sampling methods and identifying potential future fish species of conservation concern.

## **The Effects of Aquatic Vegetation on Foraging Efficiency and Predator Avoidance of Juvenile Largemouth Bass**

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State and federal agencies introduce native aquatic vegetation with the goal of increasing recruitment of sport fishes, particularly largemouth bass. Submersed macrophytes often provide a predation refuge, but can also reduce the foraging return of juvenile fishes. However, this has yet to be evaluated for juvenile largemouth bass. Therefore, the objectives of this study were to 1) determine if aquatic macrophytes increase survival of juvenile largemouth bass when exposed to predation and 2) determine if aquatic macrophytes reduce the foraging ability of pre-piscivorous largemouth bass. To address the first objective, juvenile and adult largemouth bass and American water willow were collected from nearby reservoirs. Water willow was planted within a study tank at natural stem densities. A second tank, void of any structure, was used as a control. Behavioral trials were conducted with one adult largemouth bass and 10 juvenile largemouth bass in the same tank. Each adult largemouth bass was tested once in each treatment (vegetation present or absent). Water willow significantly reduced the attack to capture ratio of adult largemouth bass, and decreased the number of follows and captures. To address the second objective, pre-piscivorous juvenile largemouth bass were tested individually at each of four vegetation densities (0, 100, 250 and 500 stems/m<sup>2</sup>) of artificial macrophytes (green nylon twine) within 5-gallon aquaria. Thirty frozen bloodworms were used as prey during each 15-min foraging bout. Foraging return was greatest at the 100 stems/m<sup>2</sup> vegetation density and higher vegetation densities tested did not reduce foraging return compared to the vegetation-less control treatment. Overall, our results suggest aquatic macrophytes may reduce predation risk of juvenile largemouth bass with no negative effects on foraging return.

## **State-listed Threatened Mussels & TPWD Regulatory Requirements: What You Need to Know for Construction Projects**

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In 2010, the Texas Parks and Wildlife Department (TPWD) listed 15 native freshwater mussel species as state “threatened.” State law prohibits “take” of state-listed species. State-listed mussels are known to occur in the Red, Neches, Sabine, San Jacinto, Trinity, Colorado, Guadalupe, San Antonio, Nueces-Frio, Brazos, Rio Salado, Pecos, and Rio Grande river basins. Construction projects that have proposed impacts to rivers, tributaries, and/or reservoirs within these river basins, may require mussel presence/absence surveys and associated relocation activities prior to construction. These activities must be coordinated with the applicable TPWD Kills & Spills Team representative. If mussel relocation activities are necessary, a TPWD-approved Aquatic Resource Relocation Plan and Public Stocking Permit are required, and mussel relocation activities must be completed prior to construction activities. In addition, zebra mussels have been recently documented in Lake Texoma, Lake Ray Roberts, the Elm Fork of the Trinity River below Lake Ray Roberts, Lewisville Lake, Lake Bridgeport, and Lake Belton; therefore, zebra mussel presence should be taken into consideration when performing TPWD-required activities near these areas. Depending on the size, scale, location, and proposed schedule of the construction project, mandatory mussel compliance activities may require 1-4 months for completion. From 2012-2013, the City of Dallas, Dallas Water Utilities conducted rehabilitation and structural maintenance on three dams along the Elm Fork Trinity River for the Western Dams Rehabilitation Project in Dallas County, Texas. Required mussel surveys identified 20 species, including three state-listed threatened species, the Texas pigtoe (*Fusconaia askewi*), the Louisiana pigtoe (*Pleurobema riddellii*), and probable Texas heelsplitter (*Potamilus amphichaenus*). This project will be discussed as a case study in order to demonstrate TPWD-required mussel compliance activities for a construction project.

### **Predation by Juvenile Longnose Gar on Brazos River Fishes**

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Longnose gar *Lepisosteus osseus* are common in the upper Brazos River, upstream from Possum Kingdom Reservoir, where they may be important predators on fishes confined to pools during periods of drought. We conducted a series of laboratory and field feeding experiments to assess feeding rate and size-selectivity of juvenile longnose gar. We collected 21 juvenile longnose gar, ranging in length from 118- to 208-mm total length, from the upper Brazos River in August 2013. In the laboratory, we assessed size-selective predation by placing one gar each into 21 replicate 17-L aquaria. Fifteen prey of known length then were added to each aquarium. After 24 hours, gar were removed and the remaining prey were measured. In two trials, one using only red shiner *Cyprinella lutrensis* as prey and another using a variety of Brazos River fishes as prey, we found that juvenile longnose gar fed on prey of all sizes, except for those greater than 50-mm standard length. There was a significant ( $P < 0.001$ ) negative relationship between prey length and probability of being eaten, suggesting that juvenile gar may be important predators of juvenile fish. In the field feeding trial, we placed five 5 juvenile gar into each of four replicate 152-L aquaria. We then added 60-90 g of prey (primarily minnows), collected from the Brazos River to each of the replicate aquaria. We placed similar amounts of prey into each of four 152-L control aquaria. Juvenile gar were allowed to feed for 48 hr, after which prey were removed and weighed. Compared with controls, there was a significant ( $P < 0.0001$ ) decrease in total prey mass in the experimental aquaria. Our results show that juvenile longnose gar consumed prey equivalent to 25% of their body weight, per day.

### **Managing Anthropogenic Influences to Fisheries in Southeast Oklahoma**

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Fisheries managers work across the country to enhance fish habitat, mostly to help anglers target desired sportfish at marked fish attractors i.e. brush piles, stumps, spider blocks, etc. Now we find ourselves fighting to preserve vital necessities to sustain aquatic life. At the bare minimum, water is needed to protect fish and wildlife diversity in Southeast Oklahoma. Some of which are already listed as threatened or endangered. Our part of the state averages more annual rainfall than other parts of the state: Smithville, OK receives 55.71 inches/year. However, dilution does not solve pollution issues. The methyl-mercury concentrations in fish tissue exceed safe consumption limits for many popular species due to higher deposition via rainfall; some advisories in SE OK caution the general population from consuming more than two meals of fish each month. Largemouth bass tissue samples from 15 SE lakes in 2011 resulted with 59% > advisory levels of 0.5  $\mu\text{g/g}$  Hg,  $N = 166$ . Caution is especially urged to children younger than age 15 and women who are pregnant, nursing, or planning to become pregnant. Primary productivity calculated using Carlson's trophic state index ranges from hypereutrophic to oligotrophic in the region. In LeFlore County, rich nutrients feed harmful algal blooms and make it difficult for water managers to treat for human consumption without producing carcinogenic disinfectant byproducts. Water availability for the future is at risk due to water conveyance systems piping water away to cities hundreds of miles away and water permitted for irrigation within the region. Lake level plans are needed to protect reservoir fisheries from extreme fluctuations during critical life-stages. Reservoir releases should also protect environmental flow-ecology relationships downstream. Identifying beneficial solutions to these issues is the responsibility of all natural resource agencies. Implementing solutions will require support from policymakers and all stakeholders.

### **Identification of Potential Fish Hosts Utilized by East Texas Mussels**

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Fish have an ecological significant role in the development of freshwater mussels (Unionidae). A mussel starts its life as an obligate ectoparasite, known as glochidia, which must attach to a fish species to survive. Yet, even with these vital ecological interactions, little is known about fish host specificity among mussel species. Naturally parasitized fish were collected and examined for glochidia infestations to evaluate host use by the 37 mussel species located in East Texas, including six state threatened species (*Fusconaia askewi*, *Fusconaia lananensis*, *Lampsilis satura*, *Obovaria jacksoniana*, *Pleurobema riddelli*, *Potamilus amphichaenus*). Fish were collected from the Sabine River biweekly in the months of March to August, and from the Neches River at the beginning and end of mussel spawning season (June and August). A molecular identification key sequencing the mitochondrial NADH dehydrogenase subunit 1 gene was created to identify glochidia to the species level. One thousand six hundred and eighty fish representing 43 species were collected from the Sabine River and 142 fish representing 12 species were collected from the Neches River. Laboratory work and data analysis is ongoing to confirm fish hosts found in previous laboratory studies and to identify new potential fish hosts. Fish will be examined for any correlation between body size and infestation rate as well as a comparison between native and introduced fish species.

### **Monitoring Paddlefish Movement with Ultrasonic Telemetry in the Grand River System**

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Since the opening of the Oklahoma Department of Wildlife Conservation (ODWC) Paddlefish Research Center (PRC) on Grand Lake in 2008, more than 20,000 adult paddlefish have contributed to studies on morphology, physiology, population demographics, and angler use, among other investigations. Though the PRC data are valuable in many respects, there are unanswered questions concerning the ecological requirements of the species. The objectives of this study are identifying paddlefish swimming depths and determining movements and successive year spawning of adult females. In January 2011, 30 sexually mature (gravid) female paddlefish were captured with gill nets and surgically implanted with ultrasonic transmitters. The transmitters consist of two varieties: 15 depth and 15 temperature with extended battery life (~48 months). Twenty submersible underwater receivers (SUR) were installed and equally distributed at fixed locations in the Grand Lake main pool to maximize coverage. The 4 lower most SUR's are relocated up into the rivers from January thru May. To-date there has been over 260,000 total detections. However, due to transmitter malfunction and the harvest of study fish, detection rates have drastically fallen over the last two seasons. In 2011 all functional transmitters were detected in the rivers during spring migration, as well as being recorded moving back down into the lake. In 2012 half of the study fish were detected in rivers, while the other half was detected no higher than Gray's Ranch (Mid-Lake). In 2013 all functional transmitters were detected in the rivers. Ninety-five percent of the depth detections were within 10 meters of the surface, regardless of total depth.

### **The Occurrence and Amount of Microplastics Ingested by Fish in the Watersheds of the Gulf of Mexico**

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Due to the increasing proliferation of plastic pollution in aquatic environments mounting scientific interest has produced expanding research into its effects on fish and other aquatic organisms. The majority of plastic debris is microscopic (<1mm) and fishes likely consume microplastics mistakenly while foraging. Toxins within the microplastics and new toxins absorbed by the 'sponge-like' microplastic fibers in the aquatic environment bioaccumulate in fish having negative biological effects. Objectives of this study are to quantify

extent and occurrences of microplastics in marine fishes of central Gulf of Mexico, an area predictably high in terrestrial based pollution because of converging gulf currents and runoff from USA and Mexico and to quantify and compare occurrences of microplastics in freshwater fishes taken from highly urbanized watersheds (San Antonio River, TX; Rio Grande, TX and Mexico) and non-urbanized watersheds of east, central, and west Texas. Preliminary results show that microplastic ingestion appears to be common in relatively small quantities across a range of fish species, irrespective of trophic level. The opportunity of exposure to microplastics increases with the amount of amount of waste generated, hence more research into and implementation of effective waste policy and management is necessary.

### **Harvest and Angler Behaviors Associated with a Flathead Catfish Fishery in East Texas**

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In 2011, the Texas state legislature legalized hand fishing as a new harvest method for catfish in Texas. Although Flathead Catfish are suspected to be vulnerable to this angling method, we have relatively little quantitative information about harvest efficiency, demographics, and behaviors of hand fishermen (as compared to other angling methods). This information is needed to make informed management decisions. Therefore, we evaluated exploitation (total, gear-, and size-specific) of Flathead Catfish in Lake Palestine, Texas, and administered statewide surveys to characterize demographics and angling behavior of hand fishers. In April 2013, we tagged 255 Flathead Catfish within three size groups (457–599 mm,  $N = 46$ ; 600–761 mm,  $N = 98$ ; >762 mm,  $N = 111$ ) with Carlin dangler reward tags. At 10 months, overall harvest was low; total exploitation (all gears combined) was 2.8% and size-specific exploitation was < 3.3% for all size groups. We found no significant differences between the size distribution of tagged fish and total ( $P = 0.18$ ) and gear-specific ( $P = 0.35$ ) exploitation; thus, the decision to harvest was not biased by fish size. About 49% of anglers surveyed ( $N = 49$ ) considered hand fishing their most important fishing activity, but only 8% exclusively hand fish. Hand fishers also indicated they fish an average of 18 to 19 days per year and harvest about 18 to 38 Flathead Catfish annually (about 1 to 2 fish per day). Anglers reported their average catch size was 842 mm and average harvest size was 796 mm. Despite moderately high catch rates and harvest of large fish, low exploitation coupled with a lack of detectable size selectivity observed in our study suggest hand fishing will have little to no effect on population density and size structure of Flathead Catfish populations.

### **Relative Abundance and Size Structure of Red Snapper among Natural and Artificial Habitats of the Northwestern Gulf of Mexico**

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Artificial reef development is a popular management tool used to enhance fish stocks, provide additional recreational fishing and diving opportunities, and increase the quality or quantity of existing habitat for marine species. Despite the popularity of artificial reef programs, the impact of this new structured habitat on economically and ecologically important species is not fully understood. Specifically, few fishery-independent surveys comparing the ecological performance of fish on artificial and natural habitats have been conducted. The goal of this study was to evaluate the relative abundance and size structure of Red Snapper (*Lutjanus campechanus*) across three different habitat types (3 standing petroleum platforms, 3 artificial reefs, and 3 natural banks) in the northwestern Gulf of Mexico. Between October 2012 and July 2013, we conducted 58 vertical longline sets and captured 690 fish representing 11 species. Red Snapper accounted for 630 of these fish (91% of

catch) and ranged in size from 282 to 855 mm TL. Red Snapper CPUE was similar among habitat types. Mean TL of fish from artificial reefs was greater than that of fish caught on standing platforms (One-way ANOVA,  $F=3.02$ ,  $p=0.049$ ). Evaluation of TL and total weight (TW) distributions suggested differences between natural banks and standing platforms (K-S test,  $D=0.13$ ,  $p=0.05$  and  $D=0.15$ ,  $p=0.02$ , respectively). No differences in TL or TW distributions were evident between the artificial reefs and natural banks. These results have important implications for artificial reef development and may suggest that artificial reefs are providing similar habitat functions as natural banks for Red Snapper. Further use of standardized, fishery-independent surveys and additional data regarding habitat specific age, growth, and recruitment will help elucidate the role artificial reefs play in maintaining reef fish stocks in the region.

### **Oklahoma Sucker Gigging: Are There Fewer Suckers Than There Used to Be?**

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Sucker gigging is an Ozark tradition and popular activity on many Oklahoma streams. Six sucker species are commonly harvested and although no population or harvest data exists, there is a consensus among fishermen, landowners and biologists that sucker numbers may be declining. During spring 2013 the Oklahoma Department of Wildlife Conservation (ODWC) began investigating gigging harvest and sucker abundance in Oklahoma Ozark streams. Despite limited habitat and stream resources, Oklahoma's sucker regulations are much more liberal than neighboring states. Preliminary observations indicate that relative to population size, harvest is high for some sucker species. Efforts to manage suckers in Oklahoma will require support from the the Oklahoma Giggers Association and Cherokee Nation. The ODWC is working with those organizations to develop management plans and determine if additional regulations are needed.

### **Diets of Larval Fishes between Slack Water Habitats during the Day and Swift Water Habitats at Night**

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Larval fishes typically exhibit diel migrations in small to large streams and rivers. During the day, larval fishes are sedentary in slack water habitats and at night drift in swift water habitats. One often cited mechanism to explain this phenomenon is food acquisition. Larval fishes enter the drift to consume drifting macro- and microinvertebrates while minimizing predation risk under the cover of darkness. If true, we predict that gut fullness would be greater at night than during the day for mesolarvae and metalarvae. Alternatively, larval fishes could enter drift at night to consume a diversity of food items with nutritional values that differ from the food items in slack water habitats. As such, we compared specific food types in the foregut between fish taken during the day from slack water habitats and those taken at night from swift water habitats. We sampled larval fishes once (Fall and Winter) or twice (Spring and Summer) per month for one year from four sites on the Guadalupe and San Antonio rivers. Mesolarvae and metalarvae mean gut fullness differed ( $P<0.05$ ) between those taken during the day and those taken at night. Mesolarval mean gut fullness was 38% ( $9.1 \pm 1$  SE) taken during the day and 5.1% ( $1.69 \pm 1$  SE) at night. Metalarval mean gut fullness was 44% ( $10.1 \pm 1$  SE) taken during the day and 17% ( $5.6 \pm 1$  SE) at night. Although some differences in diet items consumed between day and night were noted, our findings did not support the food acquisition hypothesis or that larval fish increase their food diversity by feeding at night.

## **An Investigation into the Nutritional Value of Aquatic versus Terrestrial Prey for Freshwater Fishes**

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Ecological subsidies are materials and energy that cross a boundary between two ecosystems such as leaf litter that falls into a stream to become the basis of the stream food web. Terrestrial arthropods that fall into streams are an important resource for fishes but differences in their nutritional quality have not been fully assessed. Carbon and nitrogen ratios in invertebrates roughly reflect relative amounts of structural chitin and since chitin is in large indigestible to fishes, it can be an indicator of food quality where a greater amount of chitin (or greater C:N) indicates lower quality. To better understand potential differences in the food quality of terrestrial versus aquatic arthropods, we sampled terrestrial and aquatic arthropods during winter, spring, and summer and measured their molar C:N values. We tested terrestrial and aquatic C:N values for origin (terrestrial versus aquatic), taxonomy (order level), and time of year (winter, spring, and summer). We did not detect significant differences in any of these comparisons and aquatic and terrestrial arthropods had very similar mean molar C:N values and variability around these means. The average molar C:N ( $\pm 1$  SD) for aquatic arthropods (N = 81 samples) was  $5.0 \pm 0.6$  and ranged 4.7-5.6 and for terrestrial arthropods (N = 42 samples) was  $5.1 \pm 0.7$  and ranged 4.4-5.6. Molar C:N values were not different among aquatic and terrestrial arthropods (Df = 74.3, T = -0.995, P = 0.418) and did not differ across arthropod taxa ( $F_{7,50} = 1.9$ , P = 0.087). Any trends in molar C:N variability in arthropods, whether they be aquatic or terrestrial, are probably due to the amount of and since chitin is largely undigested in fish diets, molar C:N might be an important factor in considering the energy assimilation, and therefore true benefits of terrestrial subsidies on fish life histories.

## **Characteristics of Two Self-sustaining Populations of Paddlefish in Northeast Oklahoma**

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James M. Long (*U.S. Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit, Stillwater, OK, 74078*)

Oklahoma has several self-sustaining populations of paddlefish (*Polyodon spathula*) that support sport fisheries. The most important of these is in Grand Lake O' The Cherokees (Grand Lake). The Oklahoma Department of Wildlife Conservation (ODWC) established the Paddlefish Research Center (PRC) on Grand Lake in 2008. This installation increased communication with paddlefish anglers who complained of decreased fish size on Grand Lake. Simultaneously, population monitoring on Keystone Reservoir (Keystone) showed that paddlefish there tended to be larger than from Grand Lake. Our objectives for this study were to: 1) estimate and compare characteristics of these two paddlefish populations, and 2) attempt to attribute these differences to any site specific factors. Paddlefish gillnetting data from winter 2010 and 2011 showed no significant difference in relative abundance between the populations however, differences in length frequencies, relative weights, growth and reproductive condition were observed. Mean lengths (at age 12), relative weights and gonadal fat indices for both male and female fish from Keystone were significantly greater than those from Grand Lake, while gonadosomatic index values were significantly greater for females from Grand Lake.

## **Captive and Wild Observations of the Courtship and Spawning Behavior of Guadalupe Bass *Micropterus treculii***

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The Guadalupe Bass *Micropterus treculii* is native to the Texas Hill Country of central Texas. It is distributed across portions of the Brazos, Colorado, Guadalupe and San Antonio River basins. The Guadalupe Bass is threatened by hybridization with non-native smallmouth bass, *M. dolomieu*. Guadalupe Bass became

increasingly harder to find where Smallmouth Bass had become established. Texas Parks and Wildlife Department developed a captive spawning program for Guadalupe Bass to counter the influence of hybridization. To identify potential mechanisms influencing hybridization in Guadalupe Bass populations, our objectives were: (1) characterize nesting habitat and behavior, (2) compare courtship behaviors in native and hatchery environments, and (3) identify behaviors influencing genetic diversity in offspring. Field studies included snorkeling and visual surveys conducted during the fall of 2012 in Gorman Creek, South Llano River, Pedernales River, and the Guadalupe River; no active nests or gravid Guadalupe Bass were observed. During the spring of 2013, visual surveys and recordings were repeated at Gorman Creek, and courtship and spawning behaviors of Guadalupe Bass were recorded at A.E. Wood Hatchery. Breeding-color patterns of males and females became more differentiated. Aggressive behavior of males included opercular flaring and jaw locking, and individual males courted multiple females syntopically at nest sites. Frequencies for several behaviors differed between hatchery and natural environments for both males and females. The prototypical courting and spawning sequence of Guadalupe Bass were represented in kinematic diagrams. Although behavioral sequences were similar in hatchery and natural sites, certain transition probabilities differed. Potential mechanisms for hybridization were identified as: similar reproductive color-pattern changes between species for males and females, female preference in both species for larger males, use of similar nesting habitat by both species, similar repertoires of reproductive behaviors, and monopolization of nesting sites and females by a few males.

### **An Evaluation of Texas Fish Assemblages in USEPA Ecoregion 34**

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Texas fish assemblages in 2<sup>nd</sup> and 3<sup>rd</sup> order streams in United States Environmental Protection Agency's (USEPA) Ecoregion 34 were sampled between 2001 and 2012 via electrofishing and seining as part of the Texas Commission on Environmental Quality (TCEQ) biological assessment program. The 22 streams sampled were categorized as urban, suburban, rural, least disturbed, and one stream, Big Creek, maintained a category unto itself. The fish communities were assessed with the Texas Parks and Wildlife Regionalization of Index of Biotic Integrity (2003). The individual metrics and index of biotic integrity (IBI) scores were compared to the watershed characteristics and the physical habitat data from the streams. A total of 70 fish species were collected and the four metrics which had significant correlation with the categorized stream type were the number of species, the number of intolerant species, the number of sunfish species, and the percentage of non-natives. Physical habitat measurements which were most significantly correlated with the fish community were the width of the riparian corridor, the percentage of canopy cover, and the sites' aesthetics. Important watershed characteristics which correlated with the fish were percent developed, agriculture, wetlands, and pasture, and the densities of the road crossings in the watersheds. The data showed a trend of decreasing biological condition in streams as they moved from least disturbed to urban.

### **Finding Workable Solutions to Reservoir Habitat Manipulations during Low-Water Conditions**

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Low water/drought conditions in Texas's reservoirs provide controlling authorities with the opportunity to remove previously submersed timber from high-navigation areas. In 2011, Texas Parks and Wildlife Department (TPWD) fisheries biologists were given the opportunity to provide input on lakes Conroe and Dunlap regarding timber that could be cut or marked in order to decrease navigational hazards while preserving fish and wildlife habitat. The San Jacinto River Authority (SJRA; Lake Conroe) and the Guadalupe-Blanco River Authority (GBRA; Lake Dunlap) began or approved targeted timber cutting below the water's surface on these reservoirs while water levels were abnormally low. Shortly after, lake-front property owners on both reservoirs began unsanctioned cuttings of timber, permanently destroying fish and wildlife habitat. TPWD, having no regulatory powers to prohibit the rogue cuttings, relied upon SJRA and GBRA to halt the activities. Both controlling authorities imposed restrictions on specific areas of the reservoirs, immediately stopping all

unsanctioned cutting activities. Advisory workgroups were created and included individuals from each controlling authority, TPWD, lake-front property owner groups, anglers, Friends of Reservoirs groups, and recreational boaters. In each case, the workgroups reached consensus upon timber-removal guidelines and are working to replace habitat destroyed by unsanctioned cuttings.

### **Validating Environmental Flow Recommendations with Regards to CPOM, Macroinvertebrates, and Larval Fish Drift in the Lower Guadalupe and San Antonio Rivers**

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Sound ecological environments of aquatic fluvial systems in Texas are currently managed under the theories of the Natural Flow Paradigm. Specifically, natural characters of the historical hydrograph, such as subsistence, base, and pulse flows, are protected by managing water withdrawals and capture. The purpose of this study are to validate the relationship between organic drift (coarse particulate organic matter, macroinvertebrates, and larval fishes) and discharge under base flow conditions and various tiers (i.e., one per season, one per year) of pulse flows in the San Antonio and lower Guadalupe rivers. Information from this study will be used to establish baseline conditions of organic drift, which will provide measures to evaluate further anthropogenic modifications to the base flow and pulse flow within the San Antonio and lower Guadalupe Rivers.

### **Temperature Monitoring on Southeast Oklahoma Rivers**

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Jon West (*Oklahoma Department of Wildlife Conservation, 6733 SW Hwy 1 Wilburton, OK 74578*)

Methods and results from temperature monitoring on the upper Kiamichi River using 8 tidbits deployed at four sites from 29 March – 12 September, 2013. Data loggers determined dates and times where temperatures are meeting or exceeding the state water quality standard of 32°C for fish and wildlife propagation of warm water aquatic communities with the maximum temperature recorded being 36.3°C. Discussion includes future plans for expansion of temperature monitoring on the Kiamichi River, creating temperature monitoring sites on the Glover River and investigating temperature changes associated with specific depths and flows.

### **Effect of Artificial Light on the Drift of Aquatic Insects in Urban Central Texas Streams**

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Light pollution can reduce night time drift of larval aquatic insects in urban streams by disrupting their circadian rhythms. Previous studies on larval insect drift show that disruption in drift leads to changes in reproduction as well as intraspecific and interspecific interactions. The purpose of this study was to conduct a preliminary investigation into the effects of extreme artificial light and insect drift in urbanized, high water clarity spring systems of the karst Edwards Plateau, Texas. We quantified taxa richness, diversity, and abundance in aquatic insect night time drift under two treatments (ambient night time light and extreme artificial light) among five streams using a paired design. Richness and diversity of drifting aquatic insects were similar between treatments, but abundance was 37% less in extreme artificial lighting than that of the control. Effects of extreme

artificial light on mean abundance was more notable in large streams with a 58% decrease in Simuliidae (compared to that of the control) and 51% decrease in Baetidae. Reduced drift by artificial light conditions found in this study suggests the potential of artificial lighting disrupting insect drift and consequently community structure. Results of this experiment support a growing body of knowledge on how urbanized systems will influence stream communities.

### **The Mussel-Fish Association: a Host-Parasite Relationship**

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North America's waters are home to the most diverse freshwater bivalve fauna (Mollusca: Unionidae) in the world. However, of the nearly 300 native species, a large majority of them (>70%) are considered to be endangered, threatened or of special concern. Mussels are primarily declining from habitat destruction due to the creation of dams, channel modification, siltation, and the introduction of nonindigenous mollusks, coupled with their unique life history, which includes a larval stage that are obligate ectoparasites on the gills or fins of their hosts. Most mussels can only use a few organisms as hosts, and if their larva do not attach to the correct host, they do not survive. Because of this relationship, the identification of host fishes has become an increasingly important component for the successful conservation of endangered mussels. However, host data for mussels can often be difficult to locate, and are often simply a note in a larger paper on a particular mussel species. Texas historically had 52 species of freshwater mussels, and like elsewhere many of these species have experienced major population declines, and these are expected to worsen as the population of Texas continues to grow. To assist future efforts to preserve mussels in Texas we performed a through literature search of all known host data, including papers with only small amounts of data, and determined if the mussel and/or host mentioned were native to Texas. The results were then combined in a database of the known hosts of the mussels of Texas. This database highlights that both game and nongame fish can be hosts for mussels, and both need to be considered during a fish recovery/move. The database also indicates areas that are lacking in data and potential areas for future research.

### **Catch-and-Release Mortality of Paddlefish on Grand Lake**

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Snagging is the most common method of paddlefish take in Oklahoma. Paddlefish regulations in Oklahoma have tightened over the past 30 years, ranging from a daily creel of five to the current annual creel of two. Over this period, catch and release has been allowed (1981-1991, 2003-Present), prohibited (1992-2002), and is currently mandatory on Monday and Friday. Very little is known about catch-and-release mortality of snagged paddlefish as well as the effect of catch-and-release on the continuation of the spawning run. During March and early April 2013 19 paddlefish (8 female, 11 male) had ultrasonic telemetry transmitters attached. Fish were snagged by anglers in upper Grand Lake and the lower Neosho River and donated to ODWC for use in this project. When a fish was snagged the amount of time the angler spent fighting the fish and handling the fish was recorded. Once the fish was turned over to ODWC, length and weight were recorded, as well as notes and pictures of the snagging wound and any abnormalities with the fish. Once all data was taken an ultrasonic transmitter was attached to the dorsal fin. After being released fish movement was then monitored through Grand Lake and its tributaries for the life of the transmitter using active and passive tracking.

## **Long-term Changes in Seasonal Fish Assemblage Dynamics in an Adventitious Desert Stream**

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Tornillo Creek, a tributary of the Rio Grande in Texas, USA, has historically been an important nursery and spawning habitat for several native fish species in the Rio Grande system. A previous study suggested that seasonal fish assemblage patterns in Tornillo Creek from 1967 to 1970 were highly variable, and that *Fundulus zebrinus*, a non-native species, may have negatively affected native fish species. We hypothesized that after 40 years this non-native species, and perhaps others known to exist in the system, may have increased their relative abundances and persistence in the creek and replaced certain native species, leading to distinct changes and less seasonal variability in the structure of resident fish assemblages. To test this hypothesis, we examined variation in the seasonal fish assemblages in Tornillo Creek within and between two time periods (1967–1970 vs. 2009–2011). We also examined contemporary fish assemblage–environment associations in order to understand what environmental factors were associated with seasonal fish abundance and occupancy patterns. Our results indicated that fish assemblages were very different between the two time periods. This was largely due to the declining persistence and relative abundance of *Camptostoma ornatum*, a state-listed threatened species, and the increasing persistence and relative abundance of four other fish species (*Cyprinella lutrensis*, *Gambusia affinis*, *Cyprinus carpio*, and *Notropis braytoni*). Contemporary seasonal fish assemblage patterns in Tornillo Creek were less variable than historical assemblages and were linked to several environmental factors including water temperature, stream depth, and current velocity. We suggest that the maintenance of stream flow and connectivity are important for the immigration and emigration of certain riverine fishes in Tornillo Creek and that decreases in stream flow could accelerate the domination of the tolerant species in the creek.

## **Assessing Freshwater Threats from Oil and Gas Drilling on the Tallgrass Prairie Preserve**

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The 40,000-acre Tallgrass Prairie Preserve is located in Osage County, in northeastern Oklahoma. All of the mineral rights for the 1.47M-acre Osage County are held in trust by the US Government for the Osage Nation, with mineral rights being superior to surface rights. The preserve is located in the upper reaches of the Sand Creek watershed which flows northwest to southeast across the preserve. Six additional streams are located on the preserve as well. There are over 200 conventional oil and gas wells on the Tallgrass Prairie Preserve. In 2012, three unconventional oil wells were drilled vertically to a depth of 2,500 feet, and then drilled 3,000 feet horizontally. Increased road construction and traffic from drilling operations has the potential to affect streams. An estimated 1,920,000 to 2,560,000 gallons of water was used from groundwater located on the preserve to drill and then hydraulically fracture each unconventional well bore. A drilled disposal well was used to re-inject the salty-brine water underground at 4,000 to 5,000 feet, so no recycling of water is occurring. Additional unconventional vertical and horizontal wells are being considered for future drilling. The Nature Conservancy is assessing the possible impacts of oil and gas drilling and what the potential effects might be on the freshwater ecosystem..

## **Repeated Strip Spawning of Smalleye Shiner and Sharpnose Shiner from Captive Broodstocks**

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As a result of natural (drought) and anthropogenic (dams, water mining) modifications to rivers in the Great Plains, broadcast spawning cyprinids are becoming increasingly imperiled. Because of this, captive propagation techniques have been proposed for many species as a means to help them persist during times in

which natural reproduction is compromised or precluded. We conducted a series of spawning experiments with smalleye shiner *Notropis buccula* and sharpnose shiner *N. oxyrhynchus* to refine our previously described strip-spawning protocol. Twenty (20) female smalleye shiner and 19 female sharpnose shiner were injected with carp pituitary extract and strip spawned during ovulation. Mature ova from each female were collected and counted to determine fecundity. Females were then returned to a holding aquarium for two weeks, were fed, and allowed to recruit a new complement of ova. After two additional strip spawning trials (total = 3), survival rate for females was 75% for smalleye shiner and 52% for sharpnose shiner. An analysis of variance showed, between the three strip spawning events, the number of mature ova stripped from each female was not significantly different among smalleye shiner ( $P = 0.20$ ) and sharpnose shiner ( $P = 0.41$ ). These results show that smalleye shiner and sharpnose shiner can successfully be spawned in captivity by stripping and that fish can be repeatedly spawned during a single reproductive season.

### **Effects of Bycatch Reduction Devices on Commercial Blue Crab Catch Rates**

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The blue crab (*Callinectes sapidus*) fishery is one of the largest commercial fisheries in Texas. Highest blue crab landings occur within the Galveston Bay system. There are concerns that crab pots can cause high levels of mortality in Diamondback Terrapin (*Malaclemys terrapin*). Some states have required the installation of bycatch reduction devices (BRD) on crab pots to reduce terrapin bycatch. Currently, there are no BRD requirements for the Texas blue crab fishery. Past studies have found that BRDs reduce catch rates of the larger female terrapin and legal size crab. During 2012-2013 we conducted a field study in Galveston Bay, Texas to evaluate the effects of BRDs on blue crab and terrapin catch rates. Three secondary bay open water areas and two tidal creek areas with known terrapin and blue crab populations were chosen for this study. We deployed 36 modified commercial crab pots at each site for 5 days up to 4 different times during the blue crab fishing season in 2012 and 2013. Three treatment levels containing 12 replicates of 1) control traps, 2) traps with small BRDs and 3) large BRDs were used. Forty-five terrapin and 1913 blue crab were captured. Terrapin were never captured in any trap at open bay sites. Traps with small BRDs failed to capture terrapin. Legal size blue crab catches were lower in BRD fitted traps. These results suggest that requiring BRDs in crab pots in tidal creeks could directly impact the bycatch mortality of terrapin, but it would also reduce catch rates of legal size crabs. However we detected significant interactions with habitat type and seasons. Therefore it is unclear whether the requirement to add BRDs would make a significant impact on terrapin bycatch rates. We discuss additional factors that influence terrapin and blue crab catches.

### **Genetic and Morphological Diversity across the Range of the Texas Shiner *Notropis amabilis***

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The Texas shiner, *Notropis amabilis* (Girard, 1856), is a small minnow that inhabits spring-fed rivers and creeks across south central Texas (including the Edwards Plateau) and parts of adjacent Mexico. Preliminary analyses of mitochondrial (cyt b) and nuclear (S7 and RAG1) DNA sequence data obtained from individuals spanning the entire range of *N. amabilis* revealed unexpectedly high levels of genetic divergence between individuals from rivers west of the Edwards Plateau (Pecos, Devil's river and San Felipe Creek) and those from rivers draining the Edwards Plateau (Nueces, San Antonio, Guadalupe, and Colorado rivers). These data suggest that *N. amabilis* (as currently defined) may represent a multi-species complex, harboring cryptic diversity that is not currently recognized. In order to further explore this idea, we collected 27 morphometric and 10 meristic characters from 120 museum specimens of *N. amabilis*. Principal component analysis (PCA) of the morphometric data set failed to cluster individuals by genetic group (i.e., rivers west of Edwards Plateau vs. rivers draining Edwards Plateau), suggesting that there is little or no variation in the morphometric characters examined between

the two genetic groups. We were also unable to identify any consistent differences in meristic characters between the two genetic groups but discovered a number of consistent differences in pigmentation, the shape of the snout and mouth, and the curvature of the lateral line. Taken together, we conclude that *N. amabilis* (as currently defined) represents a multi-species complex, composed of two morphologically similar species. The name *Notropis socius* (Girard, 1856) is available and should be reinstated for populations of Texas shiner in rivers west of the Edwards Plateau. Given its highly restricted range, we recommend that *N. socius* be considered a high priority for future conservation efforts.

### **Bass Brigade, a Unique Aquatic Ecosystem and Natural Resource Management Youth Leadership Education Program**

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Bass Brigade is a youth leadership and educational program of Texas Brigades. Texas Brigades is a non-profit organization with a mission to educate and empower youth with leadership skills and knowledge in wildlife, fisheries, and land stewardship to become conservation ambassadors for a sustained natural resource legacy. Texas Brigades aims to develop conservation leaders in every community. Partnering agencies include Texas Parks and Wildlife Department, Texas A&M Agrilife Extension Service, USDA-NRCS, Texas Wildlife Association, and the Texas Wildlife Association Foundation. Bass Brigade focuses on educating high school age youth about aquatic ecosystems and natural resource management. Bass Brigade is a great outreach tool that allows fisheries professionals to pass knowledge, skills, and a conservation message to future generations. This unique educational camp takes place each summer on the Warren Ranch near Coleman, Texas. For five days, high-achieving youth learn about aquatic biology, botany (aquatic and terrestrial plants), river, pond and lake management, water quality and quantity strategies, and land and water stewardship. Bass Brigade cadets receive practical experience in the fisheries field and are instructed by fisheries professionals from the various partner agencies. There are also activities involving photography, journaling, and art. Fishing skills, safety, and ethics are covered. The other major components of the Bass Brigade are life-skills, such as leadership, team-building, critical-thinking, communication, and public speaking. The camp aims to instill a conservation legacy within youth and encourages them to deliver the conservation message in their communities.

### **Developmental Osteology of Two Species of Economically Important Sciaenids, *Sciaenops ocellatus* and *Cynoscion nebulosus* (Teleostei: Sciaenidae)**

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The family Sciaenidae is a large and diverse group of percomorph fishes with 70 genera and approximately 275 species. Though several species of sciaenid are economically important and are the subject of intense scientific study, very few studies have investigated sciaenid early development and even fewer have investigated aspects of sciaenid skeletal development. In order to further our understanding of the sciaenid skeletal system, we studied the development of the entire skeleton of the commercially important Red Drum (*Sciaenops ocellatus*) and Spotted Seatrout (*Cynoscion nebulosus*). Our investigation is based on approximately 200 individuals (2.6-26.0mm notochord length/standard length [SL]) of each species representing the first thirty days of development. Specimens were cleared and double stained for bone and cartilage investigation and scored for the presence or absence of 144 bones. Bones were considered present at the first sign of mineralization. Our data suggests that the earliest bones to ossify in both species are the cleithrum and maxilla (2.6mm NL). All bones of the cranial skeleton (excluding the basisphenoid and the sclerotic bones) are present by 12.8mm SL and 13.5mm SL in the Red Drum and Spotted Seatrout, respectively. The basisphenoid develops much later than other cranial bones at 24.4mm SL in the Red Drum and 19.2mm SL in the Spotted Seatrout, while the sclerotic bones are not present in our material and are assumed to develop at sizes over 26mm SL. Development of the axial skeleton is

complete by 14.4mm SL in the Red Drum and by 13.1mm SL in the Spotted Seatrout. Based on this data, we compile ossification sequences for the skeleton of the Red Drum and Spotted Seatrout and make general comparisons with the ossification sequence available for the skeleton of the zebrafish (*Danio rerio*), the only other teleost fish for which this information is currently available.

### **Assessment of Short-term Preserved Milt for Mass Production of Striped Bass Fry**

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Previous studies evaluated the viability of preserved (extended) Striped Bass *Morone saxatilis* milt on the basis of sperm motility. However, other studies revealed no correlation between sperm motility and egg fertilization rate, suggesting sperm motility is an unreliable measure of milt preservation success. We conducted two experiments to test the viability of extended milt, using egg fertilization and hatch rates as the measures of success. In the first experiment, we crossed each female with two male pairs to account for gender and treatment effects. Because the first experiment suggested no benefit from such a complex design, we crossed each female with a single male pair to examine treatment effects in the second experiment. Each male pair supplied both extended (treatment) and fresh (control) milt for fertilizing eggs from a randomly selected female. Fertilized eggs were incubated in McDonald egg hatching jars. We determined egg fertilization rates by counting samples 4 h after fertilization and hatch rates by counting samples of embryos 4 h before hatch and 4-d old fry. Overall, extended milt was better than fresh milt. In the first experiment, fertilization rates were similar between extended and fresh milt ( $P = 0.338$ ; 72.3% for extended milt, 68.0% for fresh milt) whereas embryo hatch rate was significantly higher ( $P = 0.002$ ) with extended milt (36.2%) than with fresh milt (19.6%). Fry hatch rate was 110% better with extended milt. In the second experiment, egg fertilization rate was higher ( $P = 0.038$ ) using extended milt (94.7%) than when using fresh milt (88.9%), but hatch rates were statistically comparable between extended and fresh milt ( $P = 0.17$ ; 36.0% for extended milt, 22.0% for fresh milt). Fry hatch rate was 44.5% better with extended milt. The extender protocol used in this study was effective in maintaining sperm viability and therefore suitable for mass production of Striped Bass fry.

### **Fish Diversity Loss among Fragmented and Dewatered Riverscapes in the Central Great Plains**

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Habitat fragmentation and water loss are primary threats to fish biodiversity and represent conservation challenges for a number of imperiled species. We combined two years (2011 and 2012) of intensive sampling on the Arkansas and Ninescaw rivers of Kansas with recent (2013) fish community data from 41 stream fragments in the Platte, Kansas, Arkansas, Canadian, and Red river basins of Nebraska, Kansas, Oklahoma, and Texas to assess broad scale patterns of imperiled fish distributions in the Great Plains. Our data indicate that fish species richness is lower (reduced by as much as half) in habitat fragments characterized by shorter lengths, lower average discharge magnitude, greater numbers of days with zero flow, and lower specific conductance. This pattern of

species loss is driven in part by punctuated extirpations of members of the pelagic-broadcast spawning reproductive guild (e.g., Federally Endangered Arkansas River Shiner *Notropis girardi*) during periods of stochastic disturbance (drought or otherwise dewatered streams). Our broad scale approach identified specific stream fragments where managers might prioritize maintenance of riverscape connectivity and discharge magnitude to enhance conservation of imperiled species, as well as fragments with sufficient connectivity in which discharge magnitudes might be manipulated to enhance native and imperiled species persistence.

### **Lower Mountain Fork River Trout Fishery: A Brief History**

Jay Barfield (*Oklahoma Department of Wildlife Conservation*)

Don Groom (*Oklahoma Department of Wildlife Conservation*)

The Oklahoma Department of Wildlife Conservation (ODWC) manages a year-round trout fishery in a 12-mile portion of the Lower Mountain Fork River (LMFR) between the Broken Bow Reservoir spillway and the US Highway 70 Bridge. One of three zones lays entirely within Beavers Bend State Park, which is only a 2.5 hr. drive from Dallas/Ft. Worth, TX. A socio-economic creel survey was conducted to evaluate the value of this fishery. Approximately 75% of the anglers on the trout stream are non-residents. Sixty-nine percent of those non-residents are Texas residents. This tailrace fishery has been quite successful since its inception in 1989 and now has an economic impact of approximately \$25 million. Flooding, Aquatic Nuisance Species, and hydropower demand create management challenges. Tailraces often lack suitable fish habitat due to reduced allochthonous inputs of sediment and woody debris coupled with frequent scouring flows. These deficiencies have significant impacts on fish populations and the management of the tailrace fishery. Reduced usable area limits the amount of productive stream for anglers because the fish are concentrated in fewer suitable habitat types. The lack of hydraulic checks limit flow dynamics and flow related habitat alternatives necessary for fish feeding, resting and moving. Although management of the fishery has proven difficult, significant habitat improvements were successful and necessary to improve physical and hydraulic habitat conditions and improving the angling potential of the system.

### **Size and Relative Abundance of Round Goby, *Neogobius melanostomus*, in Anthropogenically Modified and Natural Habitats in the Western Basin of Lake Erie**

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To determine if anthropogenically modified habitats possess greater numbers of round goby and serve as dispersal vectors, we used angling to compare size and relative abundance of round goby in 64 natural and modified habitat areas. In addition, a natural gravel habitat was seined to compare length frequency distribution with anthropogenically modified habitats. Natural habitats included gravel beaches and natural rubble and cliff wall, while modified habitats included artificial riprap, concrete sea wall, and metal sheet piling. No significant difference in relative abundance was observed in round goby preference among modified habitats. When habitat subcategories were compared, the natural gravel beach habitat was significantly different from the three artificial substrates and also from natural rubble and cliff wall substrates. No round goby were caught from gravel beach habitats while angling; thus, this habitat was removed from further analysis. No significant difference between habitats was found between the natural rubble and cliff wall habitat and the three artificial habitats. Gravel beach habitats were further evaluated to determine the reason for lack of goby capture. We seined gravel beach habitat and collected 328 individuals, with which we evaluated the length-frequency distribution and calculated length-weight relationships by sex. Our results indicated that only 5.2% of the goby population was available for capture by angling on the gravel beach habitat. A comparison of demographic attributes between individuals caught seining and angling indicated a significant difference between round goby length and weight for each method of capture. The regression slope indicated an ontogenetic habitat shift occurred near 62 mm standard length. Smaller round goby individuals were found in less structurally complex gravel beach habitat, while larger individuals were associated with complex habitat.

## **Variation in CPUE, Diet, and Parasite Prevalence among Fishes in the Brazos River across Drought and Non-drought Years, with Emphasis on Red Shiner *Cyprinella lutrensis***

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Fran Gelwick (*Department of Wildlife and Fisheries Sciences, 216 Old Heep Lab Building, Texas A&M University, College Station TX 77843-2258*)

We collected fish and macroinvertebrates samples during spring-summer 2010, 2011, and 2012 in the lower Brazos River near College Station, south of Highway 60 bridge. The study reach is a meandering bend of sand sediment and woody debris, 2.27 km long and 61.4 m wide. We seined to calculate fish CPUE for each hydraulic habitat: run/riffle, glide, point- and mid-channel bar, backwater, and pool. Diets of approximately 30 fish were sub-sampled from preserved fish > 30 mm TL. We calculated frequency of occurrence (%O; how often a particular prey item was consumed by the predator), absolute and proportional volume (index measuring proportion a single prey item contributes to the stomach content), and prey specific abundance (index describing feeding strategies and niche width of predators). In 2011 and 2012 fish with intestinal parasites were recorded for each seine haul and prevalence of infection was calculated. We calculated the percent of fish with food each year for each habitat. Redundancy Analysis and variance decomposition showed that diet composition for Red Shiner was uniquely related to habitat type (26%) and year (35%). During the drought of 2011, as compared to 2010 and 2012, we noted greater total fish CPUE, parasite prevalence, and % empty stomachs, and decreased relative abundance of benthic macroinvertebrates; whereas the diet of Red Shiner showed fewer number and different types of dominant taxa, and greater diet specialization among individuals. Results suggest that populations of the habitat specialist Red Shiner usually focus on one or two dominant taxa, as related to habitat type, but as resources decreased, individuals partitioned resources by specializing on particular prey.

## **Use of a Digital Trail Camera to Monitor Angler Participation Trends in a Small Urban Impoundment**

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J. Warren Schlechte (*Texas Parks and Wildlife Department, Inland Fisheries Division, Heart of the Hills Fisheries Science Center, 5103 Junction Highway, Mountain Home, TX 78058*)

We used a fixed-mounted digital camera to estimate angler participation at a small impoundment near Austin, Texas as part of a marketing evaluation for an urban fishing program. The camera took a photograph of most of the shoreline every 15 minutes for one year. We used on-site angler counts to ground-truth angler estimates and verify angler-type (i.e., youth:adult) identification. A regression model of expected counts based on the camera and observed counts based on the ground-truthing had an r-square of 0.84. Most anglers were adults; the highest youth to adult ratio (3.7:1) occurred on weekend afternoons. Interestingly, most angling effort occurred on weekdays and was between 10am – 5pm. We documented higher participation of youth during school holidays, in contrast to school days. December had the highest participation and August the lowest; however, no differences in participation were found between seasonal stockings of different species. We compared the cost and effectiveness of this technique against traditional roving creels. Digital trail cameras can be a valuable, cost-effective tool for managers looking to monitor angler participation trends or simply gather effort estimates in small impoundments, where traditional creel surveys would not capture these type of data efficiently.

## POSTER SESSION ABSTRACTS

### **First Year Survival and Dispersal of Neosho Smallmouth Bass**

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Few studies have addressed first year survival and dispersal patterns in streams, especially for genetically-distinct sportfish populations such as Neosho smallmouth bass *Micropterus dolomieu velox*. We measured survival and dispersal of young -of-year Neosho smallmouth bass in two Ozark streams during summer 2013. Mortality over the first growing season was determined via snorkel surveys beginning at nest dispersal and continuing bi-weekly through early October. Beginning and end of growing season abundance estimates were approximately 17,000 and 600 fish per kilometer in Buffalo Creek and 43,000 and 250 fish per kilometer in Spring Creek. Survival from the time fry dispersed the nest until early October was 3.40% and 0.56%, respectively for the two streams. Dispersal was estimated by recording the number of young found in each channel unit for the duration of the study. As expected, abundance estimates were much greater in the spawning channel unit, particularly pools, during the first several weeks following dispersal from the nest. Abundances increased in runs, backwaters, and slow riffles as fish grew and overall abundances declined over the summer. We observed differential use of low velocity off-channel habitats when discharge increased during particular sampling periods. This study suggests habitats perceived as unimportant to smallmouth bass may be very important to first-year survival during elevated discharge conditions.

### **Fishes of the Lower Pecos River: Who is Missing, and Why?**

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Tim Patton (*Department of Biological Sciences, Southeastern Oklahoma State University, Durant, OK 74701*)

The Pecos River has numerous impacts that have negatively affected the native fish community. However, the downstream-most 90 km, commonly referred to as the Lower Pecos River (LPR), is a spring-fed and canyon-bound section that appears relatively pristine. Nevertheless, while past sampling efforts in this section of river have been limited due to the remote location and difficult access, previous research has indicated that the native fish community has been altered. We conducted three sampling trips that consisted of week-long float trips during 2011-2013, seining systematically along the way. Our objectives were to (1) contribute data to an assessment of a larger section of the Pecos River, (2) provide an assessment of the current fish community in the LPR, and (3) provide a preliminary assessment of fish-habitat relations, with an emphasis on cyprinids, that may help explain the composition of the current fish community in the LPR. We made approximately 100 seine hauls at 23 sites and collected over 13,500 fish representing 22 species. We captured only two species that we believe to be introduced. At least six species of cyprinids that had been historically captured were absent from our samples. A qualitative assessment of reproductive guilds suggests that the absent cyprinid species are those that are characterized by buoyant and semi-buoyant eggs and broadcast spawning, while those cyprinids that utilize various other reproductive strategies remain present. Restricted flow and habitat fragmentation in the form of river sections that experience dewatering and altered water chemistry appear to be the greatest negative impacts on the native fish fauna of the Lower Pecos River.

## Genetic Analysis of Demographic Dynamics of Paddlefish in Grand Lake O' the Cherokees

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Recent analysis of age structure indicates that the present success of the North American paddlefish *Polyodon spathula* fishery in Grand Lake, OK, might be a transitory phenomenon based primarily on a single year-class from 1999. As fluctuations in population size have the potential to reduce the genetic effective population size and available genetic diversity, we assessed the level of genetic diversity and estimated genetic effective size over nine cohorts, including the 1999 year class. Results from 13 microsatellite loci suggest only moderate diversity relative to other fishes. The mean number of alleles across all cohorts is 4.04 ( $SE = 0.16$ ) and mean expected heterozygosity is 0.57 ( $SE = 0.02$ ). There was no signal heterozygote excess relative to the number of alleles, indicating that the population has not undergone a recent bottleneck ( $P > 0.05$  for Sign and Wilcoxon tests). The relatively lower variation in Grand Lake potentially reflects a historic population bottleneck for this reservoir, possibly associated with the construction of the Neosho River lakes (Grand, Hudson, and Ft. Gibson). Allele frequencies across cohorts were consistent from 1996 – 2004 (global exact test,  $\chi^2 = 24.1$ ,  $P = 0.34$ ), and there is no evidence of heterozygote deficiency in the pooled sample across cohorts. These results indicate that cohorts are products of random mating. Estimates of effective number of breeders from microsatellite DNA variation will be presented, and the results of these analyses will potentially determine if the success of the 1999 cohort is due to an unusually large spawning event (indicated by a larger effective number of breeders), or that the spawning event was unremarkable and the year-class success attributable to exceptional recruitment of the 1999 year-class. Also, the analysis will provide an overall estimate of effective population size that can be compared with observed census sizes.

## Sampling Results at Three Sites on the Glover River in Southeast Oklahoma during Summer 2013

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The Glover River is one of the last free flowing rivers in Oklahoma. It flows through some of the most rugged terrain in the state and converges with the Little River near Golden, OK. The topography shifts from the Ouachita Mountains to cypress swamps as the Little River runs east into Arkansas, eventually meeting the Red River. The Glover River watershed is managed by the U.S. Forest Service on portions of the Ouachita National Forest and public hunting and fishing land leased by the Oklahoma Department of Wildlife Conservation (ODWC) from the timber company Weyerhaeuser. Threats to the Glover/Little Rivers include: Water sales, water supply for International Paper, Tyson, Pine Creek dam maintenance, recent drought related mussel kills, timber industry in watershed, minimum flows set for water quality but likely used up by industry, wastewater treatment facilities, fish passage barriers and dam proposals. Spring floods are necessary to maintain bottomland forests and terrestrial and semi-aquatic vertebrates that require it for reproduction and survival. Aquatic species of concern in the Glover/Little Rivers include: Leopard darters (*Percina pantherina* - federally listed as threatened), Black-sided darters (*Percina maculata* - state listed as threatened), Scaleshell (*Leptodea leptodon* - federally listed as endangered), Ouachita Rock-Pocketbook (*Arkansas wheeleri* - federally listed as endangered), Winged Mapleleaf (*Quadrula fragosa* - federally listed as endangered), Rabbitsfoot mussel (*Quadrula cylindrica cylindrica* - federally listed as threatened) and Ouachita strain smallmouth bass (*Micropterus dolomieu*). Data from recent sampling efforts are intended to help protect this delicate ecosystem into the future.

## **Trophic Structure of Pecos River Fish Assemblages along a Longitudinal Gradient Assessed with Stable Isotopes**

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Allison A. Pease (*Department of Natural Resources Management, Texas Tech University, Lubbock, Texas 79409*)

Understanding and predicting the structure of local fish assemblages across riverscapes is a key challenge for lotic ecologists due to the complex relationships between processes at multiple scales. The Pecos River is impacted by a variety of anthropogenic influences that affect water availability, salinity, and riparian and instream habitat structure. We used stable isotope analysis to characterize changes in trophic positions, niche breadth, and resources used by fish assemblages at twelve sites along the main stem of the Pecos River in New Mexico and Texas. We found that across the basin, fish species richness and specific conductivity were inversely related. Stable isotope ratios revealed differences in sources of carbon supporting fish production along the longitudinal fluvial gradient. Nitrogen isotopes elucidated variation in trophic position among species. For example, the coastal nonnative killifish, *Fundulus grandis*, appears to feed at a higher trophic level than the native killifishes, *F. zebrinus* and *Lucania parva*. Assemblage-wide trophic niche breadth was greatest 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. 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.

## **First Record and Habitat Associations of *Spongilla cenota* (Class Demospongiae) within Streams of the Edwards Plateau, Texas, USA**

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We report the first record of *Spongilla cenota* occurrence among drainages of the Edwards Plateau, a large karst area within the western gulf slope drainages of central Texas, and provide the first quantitative habitat description for this species. *Spongilla cenota* was common in two rivers of the Edwards Plateau, occurring within 28% of the quadrates surveyed in the Devils River and 31% of the quadrates surveyed in the Llano River. Among multivariate gradients, *S. cenota* was positively associated with swifter current velocities and coarser substrates and negatively associated with vegetation. Majority (75%) of the quadrates with *S. cenota* had boulder or bedrock substrates with the remaining sponges attached to aquatic macrophytes and cobble substrate. Among univariate gradients, *S. cenota* were observed at water depths from 0.5 to 2.5 m and current velocities from 0.1 to 0.6 m/s. Occurrence and abundance of *S. cenota* potentially provides a novel bioindicator of a sound ecological environment within streams of the Edwards Plateau.

## **Reproductive Biology of Prairie Chub *Macrohybopsis australis* and Shoal Chub *Macrohybopsis hyostoma***

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Many cyprinids native to the highly variable streams and rivers of the US Great Plains belong to a reproductive guild that broadcast spawn semi-buoyant ova. Members of this guild release their gametes into the water column, with no prior substrate preparation. Fertilized ova remain suspended within the water column provided there is sufficient current, and ova and developing larvae then are dispersed downstream. Results of spawning experiments at Texas Tech have shown that both prairie chub, which is endemic to the upper Red River basin, and shoal chub, which is widely distributed throughout the Brazos River, are members of this reproductive guild. However, little is known of their reproductive biology. Fish were collected over a one-year period during 2011; prairie chub were collected at two sites on the Wichita River and shoal chub were collected at two sites on the upper Brazos River. We examined gonadal-somatic indices (GSI), and other indices of reproductive activity, to determine if spawning by these species is related to discharge, as has been reported in other broadcast spawning

fish. Both species have a protracted spawning season, from May through August, although there was no evidence of spawning during periods of no flow. There was no apparent relationship between the magnitude of discharge and spawning. Our results are in general agreement with those for other broadcast-spawning species, but showed obvious effects of the 2011 drought.

### **Preliminary Analysis of Spatial Patterns in Texas Lotic Fish Communities**

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Texas freshwater stream fishes have been subjected to the modification of their habitats at multiple levels. Various stressors including stream channelization, increased impervious surfaces within the watershed, and fragmentation by dams have led to significant changes in stream fish community composition. The negative impacts of these modifications are well documented. Recently, the Environmental Protection Agency (EPA) through the National Rivers and Streams Assessment (NRSA) program has attempted to accurately survey and assess the condition of our nation's streams and rivers. The approach utilizes probability based sampling of random reaches of rivers and streams throughout the United States, focusing a major portion of their assessment on fish assemblages. For our study, 31 sites across Texas were randomly selected and were surveyed through electrofishing in the summer of 2013. The Sabine, Trinity, Brazos, Colorado, and Nueces were among the river basins we visited. Physicochemical and fish community data were collected and analyzed in an effort to observe large scale patterns in flow regime, water quality, physical habitat, and resulting fish communities through a probabilistic sampling frame. Spatial trends in the abundance, richness, diversity, and community composition as well as potential causative factors based on this preliminary analysis of year one results are presented. Additional sample collection will be conducted throughout the summer of 2014. Data gathered from both years supplemented with historical data will be used to generate a more complete assessment of the status of Texas freshwater streams based on physicochemical and fish community data.

### **Potential Hydrologic Impacts of Urbanization on Guadalupe Bass Populations within the Colorado River Basin**

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Major alterations to the hydrologic regime have occurred throughout the Colorado River Basin 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 characterize the degree of disturbance to the portions Colorado River Basin currently or historically inhabited by Guadalupe Bass and evaluate the relationship between hydrologic alteration and other disturbances within the basin. In this portion we used Indicators of Hydrologic Alteration (IHA) method to calculate flow metrics for select streams for two periods, pre-1979 and post-1979. We used U.S. Geological Survey stream gauge data, U.S. Geological Survey National Hydrography data, U.S. Geological Survey North American Landscape Characterization data and Texas Parks and Wildlife ecoregion data to evaluate changes in land use and land cover within the watersheds of the selected streams. We will present results

describing the relationships between these two datasets to evaluate how the relationships vary with stream order, watershed area, and degree of groundwater influence. This work is the first part of a larger study evaluating changes in Guadalupe Bass populations throughout the Colorado River Basin over the past 35 years. Comparison of the present flow regime 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.

### **Effects of Extreme Drought on the Fish Assemblages of the Wichita River, Texas, Upstream from Lake Kemp**

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Fluctuations in the timing and magnitude of rainfall are known to alter the habitats of freshwater fishes in streams and rivers of the US Great Plains. Many of these waters have been subjected to an increase in the number no-flow occurrences in recent years due to anthropogenic habitat modifications and climate change. We sampled the Wichita River, Texas before (2007), during (2011), and following (2013) the 2011 drought of record. We used 11 sampling sites along the Wichita River, upstream from Lake Kemp, and compared species relative abundances across sites and years. We focused on species with a relative abundance >10% at each of the 11 sampling sites during each year to examine change in relative abundance among dominant species that might be attributable to drought conditions. Across all sites and years, species diversity was greater in downstream reaches, than in upstream reaches. There generally was a decrease in species diversity at all sites, but no species was lost from the system. The most obvious change in relative abundance was observed for Red River pupfish *Cyprinodon rubrofluvialis*, which increased in relative abundance at all sites, particularly in downstream reaches, and which increased in relative abundance across the period of sampling. Prairie chub disappeared from our samples at several locations, but generally was present at a small number of sites.

### **Classifying Saltmarsh Ponds and Fish Assemblages at the Aransas National Wildlife Refuge, Texas**

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In estuarine systems, inundation regime plays a vital role in shaping the physical and chemical characteristics of saltwater ponds. Along the Texas Gulf coast, saltwater ponds are scattered across the coastal marsh landscape, with each pond possessing a varying degree of hydrological connectivity to adjacent estuarine waters. The timing, frequency and magnitude of connection events can directly influence both the abiotic and biotic components of the ponds. To determine how the degree of hydrological connectivity impacts these systems at the Aransas National Wildlife Refuge (ANWR), we collected physical (e.g., edge type, soil cores) and biogeochemical (e.g., pH, dissolved oxygen, nutrient concentrations) data to characterize pond structure during the summer of 2013. In addition, fish assemblage data was collected via seining and minnow traps to determine what, if any, affect pond conditions and the timing of hydrologic connection events have on the composition of fish assemblages in ponds. To date, most efforts to understanding how altered hydroperiod impacts the marsh complex at the ANWR have focused on the marsh platform and not the saltmarsh ponds. Our focus here on the saltmarsh ponds, is an important step to linking hydrologic drivers to the greater marsh ecosystem, food web dynamics and the overall coastal management practices in the region.

## **Reproductive biology and age structure of *Pterygoplichthys* armored catfish in Landa Lake, New Braunfels, TX**

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There are over 700 species of armored catfish in the Loricariidae family which is native to South America. Due to popularity in the aquarium trade a few of the hardier genera of this family have been imported to many other countries, including the United States, where they have been released or escaped into new habitats. Established populations of armored catfish were first reported in Texas in the 1950's in the San Antonio River. The San Marcos and Comal Rivers in Central Texas now have sustainable populations of *Pterygoplichthys* and *Hypostomus* armored catfish. These established populations pose a considerable threat to native threatened and endangered fish and plant life through dietary overlap, incidental egg predation, and habitat degradation. Understanding how, and when these fish reproduce, fecundity, age at sexual maturity and growth rates would be beneficial to predict the timing of armored catfish expansion into new ecosystems and continued impacts in current ecosystems. This study focuses on the reproductive biology and age structure in the *Pterygoplichthys* population of armored catfish found in Landa Lake, on the Comal River. Fish will be collected monthly. They will be weighed, measured and dissected to remove gonads. The sex of each fish will be recorded and the gonads will be classified by maturity stage, later verified through histology. Fecundity counts will be made from ripe female gonads, and pectoral spines will be used to determine the age of all fish. Species at risk from armored catfish include the Comal Springs riffle beetle, fountain darter, and Peck's cave amphipod, and all are found in or near Landa Lake and all are either currently listed as endangered or have been proposed for endangered listing. Data will be compared to a similar study completed in 2005 for *Hypostomus* armored catfish in the San Marcos River.

## **A Photographic Atlas to the Early Development of the Bullhead Minnow *Pimephales vigilax***

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Information on early developmental is lacking for the majority of Texas minnows, including the Bullhead minnow (*Pimephales vigilax*), a cave spawning minnow with male parental care. In order to further our knowledge of early developmental in *P. vigilax*, we collected clutches of eggs from guarding males in the Navasota River, near Navasota (TX). Eggs and resulting larvae were maintained in laboratory aquaria at Texas A&M over a 60 day period, during which time individuals were sampled on a regular basis and preserved for subsequent investigation. Based on this material, we provide precise data on the length (notochord or standard length) at which important landmarks in the development of this species are reached, including: yolk-sac absorption, flexion, swimbladder separation, completion of median and paired-fin development, larval fin-fold regression, and scale development. Using high quality photographs, we also document physical changes in external development over the first two months in the life cycle of this species. This photographic atlas to the external development of *P. vigilax* will provide a useful tool for identifying larvae and early juvenile stages of this common species of minnow.

## **Feeding Ecology and Niche Overlap of Co-occurring Killifish Species in the Pecos River**

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Two native killifish species, *Fundulus zebrinus* and *Lucania parva*, commonly co-occur together along with non-native *Fundulus grandis* in the Pecos River. Little is known about the ecological impacts of *F. grandis*

invasion, but it has been suggested that interspecific competition has led to declines of native *F. zebrinus* where *F. grandis* is established. We examined dietary resource use of the three killifish species from sites on the main-stem of the Pecos River in summer and fall of 2013. Analyses of stomach contents revealed that *F. zebrinus* and *L. parva* consumed high proportions of aquatic invertebrates, whereas *F. grandis* was largely piscivorous. Trophic niche overlap was high between *F. zebrinus* and *L. parva*, but low for *F. grandis* with the native killifish species. Our results suggest that interspecific competition for trophic resources between adult *F. grandis* and native fundulids may not play a significant role in this system, but future research should examine the impacts of predation by *F. grandis* on declining native Pecos species.

### **Quantifying Fish Abundance and Oyster *Crassostrea virginica* Habitat within Texas Bays and Estuaries by Coupling Acoustic Technologies**

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Eastern oyster (*Crassostrea virginica*) reefs occur in shallow turbid waters along the Texas coast and are an important component of Texas estuaries. Oysters are the State's second largest commercial fishery and Texas Parks and Wildlife Department (TPWD) data indicate that the oyster industry contributed more than \$38 Million to the State's economy in 2012. Beyond the economic impact of the oyster fishery, oyster reefs are important components of the nearshore ecosystem providing habitat for fish and invertebrates. Mapping oyster reefs is an important component of managing oysters. The turbid waters in which oysters reside do not allow for use of remote sensing data from satellite imagery and LIDAR. To quantify the extent of oyster habitat within Texas estuaries, the TPWD aquatic habitat mapping program couples two hydro acoustic technologies: a bathymetric side scan sonar (Teledyne Benthos C3D) and a single and split beam echosounder, (Biosonics DTX). Simultaneously collected, we utilize the single beam echo sounder data to classify the objects identified in the side scan imagery. To accomplish the classification, we merge the single beam and side scan data by utilizing raster reclassification and point density analysis to identify areas of high and lower density oyster habitat. In addition to habitat classification, the split beam echosounder data was used to estimate fish abundance. Coupling habitat and fish abundance information has become an important tool in understanding the importance of oyster reefs as fish habitat. Coupling side scan sonar and digital echosounder for habitat quantification and fish estimations have become a valuable tool in managing the nearshore habitat of the Texas Coast.

### **The Use of Condition Factor Analysis to Assess an Emaciation Event for Black Drum, *Pogonias cromis*, in the Upper Laguna Madre, Texas**

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During fall 2012, large numbers of emaciated black drum were reported by anglers from the Baffin Bay system, a secondary bay system located in the Laguna Madre, Texas. To quantitatively assess these claims, Texas Parks and Wildlife Department staff calculated three condition factors (Fulton's condition factor ( $K$ ), relative condition factor ( $K_{rel}$ ), and relative weight ( $W_{rel}$ ; based on weight-length coefficients for Texas black drum)) for sub-adult and adult fish caught in the Baffin Bay system and compared them to fish collected from the northern Laguna Madre (control site) where no reports of emaciation had been received. Condition factor analysis was continued into the spring and fall of 2013 after reports of emaciated black drum ceased. While all condition factors were found to be consistently lower in the Baffin Bay system throughout each of the seasons sampled, the disparity between fish in the Baffin Bay area and the control site was greatest during the emaciation event. Baffin Bay  $K_{rel}$  values showed a steady increase from the fall 2012 emaciation event to spring 2013. Baffin Bay  $K$  and  $W_{rel}$  values showed a dramatic increase from the fall 2012 to spring 2013 then a slight decrease in fall 2013. Control site values for  $K$  and  $W_{rel}$  showed seasonal variation in condition presumably unrelated to the emaciation event.  $W_{rel}$  values also suggested that both Baffin and control fish for all seasons were underweight compared to the baseline selected for this factor.  $K_{rel}$  takes into account seasonal variation in the length-weight relationship by utilizing season specific regression coefficients while  $W_{rel}$  utilizes predetermined seasonally consistent coefficients.  $K$  does not utilize any regression coefficients in its calculation which explains its similarity with  $W_{rel}$ .

Overall,  $K_{rel}$  seems to best highlight the emaciation event and subsequent improvement in condition of black drum in the Baffin Bay system.

### **Age and Growth of Gray Redhorse in the South Llano River, Texas**

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Gray Redhorse is native to upland streams from the Brazos River in Texas to the Río Soto La Marina in Tamaulipas, Mexico. Populations of Gray Redhorse are stable across much of its range, but habitat degradation associated with dewatering of streams has led to the decline of some populations in the western portion of its range. We evaluated age structure and growth of a Gray Redhorse population in the South Llano River, Texas and evaluated the relationship between residuals from a Von Bertalanffy growth curve and annual streamflow parameters. Length-frequency histograms revealed a trimodal distribution with first two modes corresponding to age-1 and age-2 fish, respectively, and the third mode corresponding to age-3 and older fish as determined by aging of scales. The previously described size at maturation was typically reached by age-3 and the maximum age of an individual determined in this study was 8 years. Correlations between streamflow characteristics and residuals from the von Bertalanffy growth curve were weak and indicate little influence of streamflow variation on Gray Redhorse growth.

### **Early Development of the Arkansas River Shiner *Notropis girardi*, a Threatened Member of the Cyprinidae from the Great Plains Region**

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Early developmental stages are unknown for the majority of North American minnows, including the imperiled Arkansas River shiner (*Notropis girardi*), a species of minnow endemic to the Great Plains region. A successful captive rearing program for *N. girardi*, established at Texas Tech University, has provided, for the first time, access to early developmental stages for this species. Based on this material, we provide precise data on the age (DPH) and length (notochord or standard length) at which important landmarks in the development of this species are reached, including: yolk-sac absorption, flexion, swimbladder separation, completion of median and paired-fin development, and larval fin-fold regression. Using high quality photographs, we also document physical changes in external development over the first 30 days (egg to 29 days post hatch [DPH]) in the life cycle of this species.

### **Population Dynamics of Sharpnose Shiner and Smalleye Shiner in the Upper Brazos River**

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Kevin B. Mayes (*River Studies Program, Texas Parks and Wildlife Department, San Marcos, Texas 78667*)

Sharpnose shiner *Notropis oxyrhynchus* and smalleye shiner *Notropis buccula* have been proposed for listing as Endangered Species. Using nine years of standardized population monitoring, we have developed and refined population dynamics models for both species, in which reproductive success and first summer survival are related to mean summer discharge. These models provide reasonable descriptions of annual variations in the populations of both species. We also used the models to assess environmental flows recommended by the Brazos River Basin and Bay Expert Science Team (BBEST) and the Brazos River and associated bay and estuary system Basin and Bay Area Stakeholder Committee (BBASC), as well as those adopted by the Texas Commission on

Environmental Quality (TCEQ). Assuming no additional discharge beyond that recommended, the BBEST recommendations would support populations of both sharpnose shiner and smalleye shiner indefinitely. The BBASC recommendation, adopted by the TCEQ, could result in the loss of sharpnose shiner and smalleye shiner populations in fewer than 10 years.

### **The Fishes of Texas Project and Website: Overview and Future Directions**

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The Fishes of Texas Project ([www.fishesoftexas.org](http://www.fishesoftexas.org)) compiled Texas fish species occurrence records from 42 museum collections and applied rigorous quality control and data normalization/standardization to result in 124,415 specimen-based records collected between 1851 and 2010 by 5,924 collectors. 88,348 records from 7,868 unique Texas inland localities were manually georeferenced with placement error estimates. 8,460 Gulf of Mexico records and 18,923 inland records from neighboring Mexican and U.S. states have been partially processed. Georeferenced records were plotted and specimens and original data associated with 4,107 geographic outliers flagged as potential identification or location errors were examined and identifications corrected or confirmed. Immediate results from this comprehensive compilation and data normalization/cleaning included discovery of 31 species occurrences in major river basins where they were previously not believed to occur, a public online database that can be queried in diverse ways, mapped, and records downloaded, as well as provision of powerful species distribution models for most Texas freshwater fishes. We have used these models and data products in various ways, including projecting the impacts of climate change on fish distributions, finding and addressing knowledge gaps, exploring new ways to do bioassessment without reference sites, and comprehensive conservation planning based on fishes and many other factors. We plan to continue basic collection growth through acquisition of new specimens, museum specimen-based database compilation and website improvement work, but also to shift focus to direct more resources to diverse applications of the data. We plan to add new, partly non-specimen-based occurrences data to the website via new fieldwork that addresses priorities determined from analysis of the FoTX database and general TPWD needs. We anticipate future “bioblitzes” with public involvement that leverages our iNaturalist project and use of photos as vouchers, improved fish identification keys, updated and improved species accounts, and provision of new ancillary data sets.

### **Impact of a Hydroelectric Dam on Mussels in the Neches River**

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Dams are known to modify characteristics of the river downstream, such that unionid mussel diversity and abundance decline. We surveyed for mussels in the Neches River above and below the hydroelectric dam, B. A. Steinhagen. We sampled 7 sites from 80 km above down to the dam, and 30 sites below the dam to 55 km further downstream. We divided the sites downstream of the dam into 19 from the main stem of the river and 9 in oxbows and tributaries just off the main channel. We recorded 23 species below the dam, 312 total in the main channel, 572 in the oxbows. We collected 2432 total of 23 species upstream of the dam. The abundance of mussels was obviously much lower below the dam and most mussels were found in the oxbows, which apparently were refuges from the variable flow releases from the dam. The species found on the main channel were primarily those that can live in the shifting sands of that part of the river. However, two threatened species, sandbank pocketbooks and Texas Heelsplitter were found there. Two other threatened species, Texas pigtoe and Louisiana

pigtoe, were much more abundant above the dam. The habitat of the river was heavily impacted by the flow from the dam such that stable substrate was not available for mussels in the main channel.

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