ANNUAL PROCEEDINGS
of the
TEXAS CHAPTER

AMERICAN FISHERIES SOCIETY

Waco, Texas

23-25 January 2020

Volume 42

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 at the Chapter's web page (**https://1fjduf35czd41a05pgltrtej-wpengine.netdna-ssl.com/tx/wp-content/uploads/sites/19/2020/02/TCAFS-Membership-Form-2020.pdf**) or contact the Chapter Secretary-Treasurer:

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

ANNUAL PROCEEDINGS OF THE TEXAS CHAPTER AMERICAN FISHERIES SOCIETY

Annual Meeting
23-25 January 2020
Waco, Texas

2020 Officers

Kirk Winemiller, President
Texas A&M University

Dakus Geeslin, President-Elect
Texas Parks and Wildlife Department

Natalie Goldstrohm, Secretary-Treasurer
Texas Parks and Wildlife Department

Editorial Committee: Alice Best and David Buzan, Co-Chairs

2020

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Texas Chapter, American Fisheries Society

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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
2015	Bruce Hysmith	Tyler
2016	Kevin Storey	Kerrville
2017	David Buzan	Corpus Christi
2018	Randy Rushin	College Station
2019	Michael Homer	Galveston
2020	Dan Daugherty	Waco

TEXAS CHAPTER AWARDS RECIPIENTS

1977 Fish Culture - Don Steinbach (TAMU)
Fisheries Management - Edward Bonn (TPWD)
Fisheries Administration - David Pritchard (TPWD)
Fisheries Research - John Prentice and Richard Clark (TPWD)

1978 Fish Culture - Pat Hutson (TPWD)
Fisheries Education - Clark Hubbs (UT)
Fisheries Research - Clark Hubbs (UT)
Special Recognition - Edward Lyles (USFWS)

1979 Fish Culture - Robert Stickney (TAMU)
Fisheries Education - Richard Noble (TAMU)
Fisheries Management - Gary Valentine (SCS)
Fisheries Research - Phil Durocher (TPWD)
Special Recognition - Charles Inman (TPWD)

1980 None

1981 Fish Culture - Billy White (TPWD)
Fisheries Education - Bobby Whiteside (TXSTATE)
Fisheries Management - Steve Smith (TUGC)
Fisheries Research - Al Green (TPWD)
Special Recognition - Jim Davis (TAMU)

1982 Fish Culture - Roger McCabe (TPWD)
Fisheries Research - Clell Guest (TPWD)
Special Recognition - Bob Hofstetter (TPWD)

1983 Special Recognition - Robert Kemp (TPWD)

1984 None

1985 Fisheries Education - Donald Wohlschlag (UTMSI)
Fisheries Research - Connie Arnold (UTMSI)

1986 Fisheries Management - Billy Higginbotham (TAES)
Fisheries Research - Robert Colura (TPWD)

1987 Fish Culture - Kerry Graves (USFWS)
Special Recognition - The Sportsmen's Club of Texas
Best Presentation - Kerry Graves (USFWS)

1988 Honorable Mention (culture) - Loraine Fries (TPWD)
Fisheries Research - Gary Garrett (TPWD)
Special Recognition - Kirk Strawn (TAMU)
Best Presentation - Joe Fries (USFWS)
Honorable Mention (presentation) - Catherine Dryden (TAMU)

1989 Fish Culture - Robert Vega (TPWD)
Fisheries Management - Joe Kraai (TPWD)
Fisheries Administration - Gary Matlock (TPWD)
Fisheries Research - Roy Kleinsasser and Gordon Linam (TPWD)
Honorable Mention (research) - Bob Edwards (UTPA)
Best Presentation - Robert Smith (TAMU)

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

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

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

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

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

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

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

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

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

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

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

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

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

2004 Fisheries Culture - Lisa Griggs (TPWD)
Fisheries Education - Timothy Bonner (TXSTATE)
Fisheries Research - Dave Buckmeier (TPWD)
Fisheries Student - Casey Williams (TXSTATE)
Special Recognition - Deborah Wade (TPWD)
Best Presentation - Richard Kraus and David Secor (TAMUG)
Best Student Presentation - Tracy Leavy, coauthor Timothy Bonner (TXSTATE)
Best Poster Presentation - Brian Scott and Gary Aron (TXSTATE)

2005 Fisheries Administration – Roger McCabe (TPWD)
Fisheries Management – Todd Driscoll (TPWD)
Fisheries Student – Bart Durham (TTU)
Special Recognition – Jimmie Green (TPWD) and Kirk Green
Special Recognition – The Patsy B. Hollandsworth Family Foundation
Best Presentation – Gregory Stunz (TAMUCC), and coauthors Jay Rooker (TAMUG), Joan Holt and Scott Holt (UT)
Best Student Presentation – Julie Hulbert, and coauthors Timothy Bonner and David Pendagrass (TXSTATE), and Joe Fries (National Fish Hatchery – San Marcos)
Best Poster Presentation – Michael Baird (TPWD)
Scholarships, Undergraduate – Brian Bartram (TAMUCC), John Putegnat (TAMU)
Scholarships, Graduate – Megan Fencil (UTMSI), Casey Williams (TXSTATE)

2006 Fisheries Education – Kevin Pope (TTU)
Fisheries Management – Dave Terre (TPWD)
Fisheries Research – Loraine Fries (TPWD)
Technical Support – Todd Robinson (TPWD)
Special Recognition – Bruce Hysmith (TPWD)
Special Recognition – Joan Glass (TPWD)
Best Presentation - Richard Kraus and David Secor (TAMUG)
Best Student Presentation - Tracy Leavy, coauthor Timothy Bonner (TXSTATE)
Best Poster Presentation - Brian Scott and Gary Aron (TXSTATE)
Scholarships, Undergraduate – Chris Arredondo (TAMUCC), Josh Perkin (TXSTATE)
Scholarships, Graduate – Bart Dunham (TTU), Casey Williams (TXSTATE)

2007 Fisheries Administration – Larry McKinney (TPWD)
Fisheries Culture – Gary Garrett (TPWD)
Fisheries Management – Charlie Munger (TPWD)
Fisheries Research – Gary Garrett (TPWD) and Bob Edwards (UTPA)
Fisheries Student – Chris Chizinski (TTU)
Honorable Mention (Fisheries Student) – Brad Littrell (TXSTATE)
Technical Support – Reynaldo Cardona (TPWD)
Special Recognition – Robert Howells (TPWD)
Special Recognition – Fred Janssen (TPWD)
Special Recognition – Craig Scofield (TPWD)
Special Recognition – Sandy Henry (Science Spectrum, Lubbock)
Best Presentation – Craig Bonds, coauthors John Taylor and Jeremy Leitz (TPWD)
Best Student Presentation – Matthew Chumchal (OU), coauthors Michael Slattery, Ray Drenner, Matthew Drenner and Leo Newland (TCU)
Best Poster Presentation – Richard Ott and Timothy Bister (TPWD)
Scholarships, Graduate (M.S.) – Brian Bartram (Baylor)
Scholarships, Graduate (Ph.D.) – John Froeschke (TAMUCC)

2008 Fisheries Administration – Lance Robinson (TPWD)
Fisheries Education – Andre M. Landry, Ph. D. (TAMUG)
Fisheries Research – Bart Durham (TTU)
Fisheries Student – Preston Bean (TXSTATE)
Honorable Mention – Zachary Shattuck (TXSTATE)
Technical Support – Corey Clouse (TPWD)
Special Recognition – Chad Thomas (TXSTATE)
Best Presentation – Matthew Chumchal (TCU)
Best Student Presentation – Rodney Gamez (TAMUCC)
Best Poster Presentation – James Tolan (TPWD)
Scholarships, Undergraduate – JoHanna Weston (UD)
Scholarships, Graduate (M.S.) – Megan Bean (TXSTATE)
Scholarships, Graduate (Ph.D.) – Preston Bean (TXSTATE)

2009 Fisheries Administration – Phil Durocher (TPWD)
Fisheries Education – Michael Masser (TAMU)
Fisheries Research – Ray Drenner (TCU)
Fisheries Student – Joshuah Perkin (TXSTATE)
Honorable Mention –
Fisheries Management – John Moczygemba (TPWD)
Technical Support – Mike Gore (TPWD)
Special Recognition –
Best Professional Presentation – Ray Drenner (TCU)
Best Student Presentation – Ted Valenti (BAYLOR)
Best Professional Poster Presentation – Pat Bohannon (TPWD)
Best Student Poster Presentation – Brianne Kiester (TCU)
Scholarships, Undergraduate – Michelle Parmley (TXSTATE); Nicholas Bertrand (TXSTATE)
Scholarships, Graduate (M.S.) – Joshuah Perkin (TXSTATE)
Scholarships, Graduate (Ph.D.) – Bridgette Froeschke (TAMUCC)
Clark Hubbs Research Award – Ben Labay (TXSTATE)

2010 Fisheries Administration – Mike Ray (TPWD)
Fisheries Research – Aaron Barkoh (TPWD)
Fisheries Culture – Hugh Glenewinkel (TPWD)
Fisheries Student – Ben Labay (TXSTATE)
Fisheries Management – Richard Ott (TPWD)
Special Recognition – Mandy Scott (TPWD)
Best Professional Presentation – Michael Tobler (TAMU)
Best Student Presentation – Ben Labay (TXSTATE)
Best Professional Poster Presentation – Mike Stahl (TPWD)
Best Student Poster Presentation – Ben Labay (TXSTATE)
Scholarships, Undergraduate – Jake Wimberly
Scholarships, Graduate (M.S.) – Laura Bivins
Scholarships, Graduate (Ph.D.) – Gabriella Ahmadia
Clark Hubbs Research Award – Seiji Miyazono (TTU)

2011 Fisheries Administration – Art Morris (TPWD)
Fisheries Education – Fran Gelwick (TAMU)
Fisheries Culture – Juan Martinez (TPWD)
Fisheries Research – Kristy Kollaus (TXSTATE)
Fisheries Student – Katie Roach (TAMU)
Fisheries Management – Dan Bennett (TPWD)
Technical Support – Danny Lewis (TPWD)
Special Recognition – Craig Bonds (TPWD)
Special Recognition – Carl Kittel (TPWD)
Special Recognition – Brian Van Zee (TPWD)
Best Professional Presentation – David Buckmeier (TPWD)
Best Student Presentation – Sandra Bibiana Correa (TAMU)
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 Kolodzjcyk
Special Recognition – TPWD-Hatcheries: Dale Lyon, Carl Kittel, Daniel Field, Greg Polk
Special Recognition – Kevin Mayes (TPWD)
Best Professional Presentation – Brad Littrell (BIO-WEST)
Best Student Presentation – William Smith (TAMU)
Best Professional Poster Presentation – Raelynn Deaton (SEU)
Best Student Poster Presentation – Dan Fitzgerald (TAMU)
Scholarships, Undergraduate – Ruben Palacios (TAMUCC)
Scholarships, Graduate (M.S.) – Karen Drumhiller (TAMUCC)
Scholarships, Graduate (Ph.D.) – Larissa Kitchens (TAMUG)
Harry Tennyson Scholarship – William Smith (TAMU)
Harry Tennyson Scholarship – Matt VanLandeghem (TTU)
Clark Hubbs Research Award – Steven Curtis (TXSTATE)

2013 Fisheries Administration – Brenda Bowling (TPWD)
Fisheries Administration – Tim Birdsong (TPWD)
Fisheries Education – George Guillen (UHCL)
Fisheries Culture – Jennifer Butler (TPWD)
Fisheries Student – Rebecca Pizano (TAMU)
Fisheries Management – Mark Webb (TPWD)
Technical Support – Bill Hughes (TPWD)
Special Recognition – Randy Rushin (Water Monitoring Solutions)
Special Recognition – East Texas Woods and Waters Foundation
Special Recognition – Kirk Winemiller (TAMU)
Special Recognition – Loraine and Joe Fries (TPWD, USFWS)
Best Professional Presentation – Ashley Oliver (Halff and Associates)
Best Student Presentation – Tiffany Hedrick-Hopper (TTU)
Best Professional Poster Presentation – Kevin Mayes (TPWD), Brenda Bowling (TPWD)
Best Student Poster Presentation – Niki Ragan (SHSU)
Scholarships, Undergraduate – Lindsey Carey (TAMU)
Scholarships, Graduate (M.S.) – Virginia Eaton (TXSTATE)
Scholarships, Graduate (Ph.D.) – Alin Gonzales (TAMUCC)
Harry Tennyson Scholarship – Melissa Giresi (TAMU)
Harry Tennyson Scholarship – Michael Dance (TAMUG)
Clark Hubbs Research Award – Daniel Fitzgerald (TAMU)

2014 Fisheries Administration – Dave Terre (TPWD)
Fisheries Education – Reynaldo Patiño (TTU, USGS)
Fisheries Culture – Possum Kingdom Fish Hatchery Team (TPWD)
Fisheries Research – Warren Schlechte (TPWD)
Fisheries Student – Tony Rodger (TAMU)
Fisheries Management – Brad Littrell (BIO-WEST)
Technical Support – Patsy Berry (TPWD)
Special Recognition – Fishes of Texas Team (UT Texas Natural History Collections)
Special Recognition – Gary Garrett (TPWD)
Special Recognition – Todd Driscoll (TPWD)
Best Professional Presentation – Joshua Perkin (Kansas State University)
Best Student Presentation – Kole Kubicek (TAMU)
Best Professional Poster Presentation – Bryan Legare (TPWD)
Best Student Poster Presentation – Jessica Pease (TTU)
Scholarships, Undergraduate – Crystal Purcell (University of Dallas)
Scholarships, Undergraduate – Takona Tipton (TAMU)
Scholarships, Graduate (M.S.) – Jessica East (TTU)
Scholarships, Graduate (Ph.D.) – Landes Randall (TAMU)
Harry Tennyson Scholarship – Maelle Comic (TAMUG)
Harry Tennyson Scholarship – Lisa Havel (UTMSI)
Clark Hubbs Research Award – Jessica East (TTU)

2015 Fisheries Education – Dan Roelke (TAMU)
Fisheries Culture – Deborah Wade (TPWD)
Fisheries Research – Dan Daugherty (TPWD)
Fisheries Research, Honorable Mention – Tim Grabowski (USGS, TTU)
Fisheries Student – Jessica East (TTU)
Fisheries Student, Honorable Mention – Erin Bertram (UTT)
Fisheries Management – Marcos De Jesus (TPWD)
Technical Support – Karim Aziz (TPWD)
Special Recognition – Jimmie Green
Special Recognition – John Taylor (TPWD)
Special Recognition – Bass Brigade – Texas Brigade

Best Professional Presentation – B.P. Fleming, Dan Daugherty, Nate Smith (TPWD)
Best Student Presentation – D. Symonds (UTT)
Best Professional Poster Presentation – Gene Wilde (TTU)
Best Student Poster Presentation – Meriel LeSueur (TCU)
Scholarships, Graduate (M.S.) – Matthew Acre (TTU)
Scholarships, Graduate (M.S.) – Quentin Hall (TAMUCC)
Scholarships, Graduate (M.S.) – Danielle Macedo (TAMU
Scholarships, Graduate (Ph.D.) – Jenny Oakley (TAMU)
Harry Tennyson Scholarship – Erica Knowles (WTAMU)
Harry Tennyson Scholarship – Kenneth Zachary (TAMU)
Clark Hubbs Research Award – Aaron Urbanczyk (TTU)

2016 Fisheries Administration – Carl Kittel (TPWD)
Fisheries Education – Frances Gelwick (TAMU)
Fisheries Research – Tim Grabowski (USGS, TTU)
Fisheries Research, Honorable Mention – Gerald Kurten (TPWD)
Fisheries Student – Harlan Nichols (TXSTATE)
Fisheries Student, Honorable Mention – Eric Tsakiris (TAMU)
Fisheries Student, Honorable Mention – Greg Cummings (TPWD)
Fisheries Student, Honorable Mention – Dave Ruppel (TXSTATE)
Special Recognition – Greg Conley (TPWD)
Special Recognition – Jennifer Pollack (TAMUCC)
Special Recognition – Zoe Ann Stinchcomb (TPWD)
Certificate of Appreciation – Michele Nations (TPWD)
Best Student Presentation – Thomas TinHan (TAMUG)
Best Professional Presentation – Matthew Chumchal (TCU)
Best Student Poster Presentation – Amanda Pinion (TAMU)
Best Professional Poster Presentation – Matthew Chumchal (TCU)
Scholarships, Graduate (M.S.) – Kaylan Dance (TAMUG)
Scholarships, Graduate (M.S.) – Matthew Dzaugis (UT)
Scholarships, Graduate (M.S.) – Caroline Arantes (TAMU
Scholarships, Graduate (Ph.D.) – Thomas TinHan (TAMUG)
Harry Tennyson Scholarship – Gunnar Nystrom (TCU)
Harry Tennyson Scholarship – Jeffrey Plumlee (TAMUG)
Clark Hubbs Research Award – Ryan Vazquez (TTU)

2017 Fisheries Administration – Tom Lang (TPWD)
Fisheries Culture – Donovan Patterson (TPWD)
Fisheries Education – Dr. Matthew Chumchal (TCU)
Fisheries Management – John Tibbs (TPWD)
Fisheries Research – Dr. Timothy Bonner (TXSTATE)
Fisheries Technical Support –TPWD Inland Fisheries Data Analysis and Data Administration Group (DAAG) – Chris Cummings, Sarah Haas, Danny Lewis, John Taylor & Jimmy White
Fisheries Student – Matthew Acre (TTU)
Special Recognition – Abe Moore (TPWD)
Special Recognition – Randi Wayland (Texas Freshwater Fisheries Hall of Fame)
Special Recognition – Patsy B. Hollandsworth Family Foundation
Special Recognition – Sportsman's Club of Fort Worth
Best Professional Presentation – Dave Buckmeier (TCU)
Best Student Presentation – Matthew Acre (TTU)
Best Professional Poster Presentation – Ed Mager (UNT)
Best Student Poster Presentation – Ashley Seagroves (TXSTATE)
Scholarships –
TCAFS
Undergraduate (B.S.) –Taylor Cubbage (TAMUG)

Graduate (M.S.) – Hailey Boeck (TAMUCC), Elizabeth Hunt (TAMUCC)
Graduate (Ph.D.) – Cody Craig (TXSTATE), Kesley Gibson (TAMUCC),
Friedrick Keppeler (TAMU)
Harry Tennison (provided by the Sportsmen's Club of Fort Worth)
Graduate (M.S.) – Ethan Getz (UTRGV), Jennifer Morton (TAMU), Erin Reed (UTMSI)
Graduate (Ph.D.) – Matthew Acre (TTU)
Clark Hubbs Student Research Award
Matthew Acre (TTU)

2018 Fisheries Administration – Spencer Dumont (TPWD)
Fisheries Management – Alice Best (TPWD)
Fisheries Management – Niki Ragan-Harbison (TPWD)
Fisheries Technical Support –Carl Vignali (TPWD)
Fisheries Student – Luke Bower (TAMU)
Special Recognition – Dakus Geeslin (TPWD)
Special Recognition – Mike Morgan (TPWD)
Special Recognition – Paul Fleming (TPWD)
Special Recognition – Sarah Robertson (TPWD)
Special Recognition – TPWD Inland Fisheries Aquatic Habitat Enhancement Team (John Findeisen, Michael Mayo, Bill Johnson, Jeffrey Bowling, Ray Lenderman, Joe Moorhead, Shawn Malone)
Special Recognition – TPWD Inland Fisheries Division's Watershed Conservation Program: Megan Bean, Preston Bean, Beth Bendik, Tom Heger, Melissa Parker, and Ryan McGillicuddy
Best Professional Presentation – Joshua Perkin (TAMU)
Best Student Presentation – Brittany Harried (UNT)
Best Professional Poster Presentation – Melissa Casarez (UT)
Best Student Poster Presentation – Emily Richardson (TTU)
Scholarships –
TCAFS
Undergraduate (B.S.) – Loika Baille (TAMU)
Undergraduate (B.S.) – Elaine Shen (RU)
Graduate (M.S.) – Louisa Torrance (TAMUCC)
Graduate (Ph.D.) – Yasmin Quintana Morales (TAMU)
Graduate (Ph.D.) – Travis Richards (TAMUG)
Graduate (Ph.D.) – Andria Salas (UT)
Harry Tennison (provided by the Sportsmen's Club of Ft. Worth)
Graduate (M.S.) – Derek Bolser (UTMSI)
Graduate (M.S.) – Michelle Bromschwig (TAMUCC)
Graduate (M.S.) – Tyler Steube (TAMUCC)
Graduate (M.S.) – Jacob Wright (TTU)
Clark Hubbs Student Research Award
Amanda Pinion (TAMU)

2019 Fisheries Administration – Tom Lang (TPWD)
Fisheries Culture – Michael Matthews
Fisheries Management – Niki Ragan-Harbison (TPWD)
Fisheries Technical Support –Carl Vignali (TPWD)
Fisheries Student – Stephanie George (MS) and Cody Craig (PhD)
Best Professional Presentation – Josh Perkin (TAMU)
Best Student Presentation – Brittany Harried (UNT)
Best Professional Poster Presentation – Melissa Casarez (UT)
Best Student Poster Presentation – Emily Richardson (TTU)
Scholarships –
TCAFS
Undergraduate (B.S.) – Loika Baille (TAMU)
Undergraduate (B.S.) – Elaine Shen (RU)
Graduate (M.S.) – Louisa Torrance (TAMUCC)
Graduate (Ph.D.) – Yasmin Quintana Morales (TAMU)
Graduate (Ph.D.) – Travis Richards (TAMUG)
Graduate (Ph.D.) – Andria Salas (UT)
Harry Tennison (provided by the Sportsmen's Club of Ft. Worth)
Undergraduate (B.S.) – Laynie Funk
Graduate (M.S.) – Ethan Taulbee
Graduate (M.S.) – Polly Hijavsky
Graduate (Ph.D.) – Alex Sotola
Clark Hubbs Student Research Award
Kaylyn Zipp

2020 Fisheries Administration – Tom Lang (TPWD)
Fisheries Culture – Michael Matthews
Fisheries Management – Niki Ragan-Harbison (TPWD)
Fisheries Technical Support –Carl Vignali (TPWD)
Fisheries Student – Stephanie George (MS) and Cody Craig (PhD)
Best Professional Presentation – Ryan King (Baylor)
Best Student Presentation – Brittany Harried (UNT)
Best Professional Poster Presentation – Josh Perkin (TAMU)
Best Student Poster Presentation – Lauren Yancy (TAMU)
TCAFS Scholarships –
Undergraduate (B.S.) – Elizabeth Boshers (UT Tyler)
Undergraduate (B.S.) – Lauren Yancy (TAMU)
Graduate (M.S.) – Apria Valenza (TAMUCC)
Graduate (M.S.) – Hunter Bailey (UTMSI)
Graduate (Ph.D.) – Yasmin Quintana Morales (TAMU)
Graduate (Ph.D.) – Travis Richards (TAMUG)
Graduate (Ph.D.) – Andria Salas (UT)
Harry Tennison (provided by the Sportsmen's Club of Ft. Worth)
Undergraduate (B.S.) – Laynie Funk
Graduate (M.S.) – Ethan Taulbee
Graduate (M.S.) – Polly Hijavsky
Graduate (Ph.D.) – Alex Sotola
Clark Hubbs Student Research Award
Kaylyn Zipp

ABBREVIATIONS

ACE – Army Corps of Engineers
BAYLOR – Baylor University
NMFS – National Marine Fisheries Service
ODWC – Oklahoma Department of Wildlife Conservation
OSU – Oklahoma State University
SCS – Soil Conservation Service
SEU – St. Edwards University
SHSU – San Houston State University
TAES – Texas Agricultural Extension Service
TAMU – Texas A&M University – College Station
TAMUG – Texas A &M University - Galveston
TAMUCC – Texas A&M University – Corpus Christi
TCU – Texas Christian University
TCEQ – Texas Commission on Environmental Quality
TPWD – Texas Parks and Wildlife Department
TTU – Texas Tech University
TUGC – Texas Utilities Generating Company
TXSTATE – Texas State University – San Marcos
UD – University of Dallas
UHCL – University of Houston – Clear Lake
USFWS – U.S. Fish and Wildlife Service
USGS – U.S. Geological Survey
UT – University of Texas – Austin
UTMSI – University of Texas Marine Science Institute
UTPA – University of Texas – Pan American
UTT – University of Texas – Tyler
WTAMU – West Texas A &M University

ORAL PRESENTATION ABSTRACTS

Conservation Status of Texas Freshwater Fishes and Protected Species Recommendations

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Megan Bean, Stephen Curtis, Kevin Mayes, and Sarah Robertson, Texas Parks and Wildlife Department

Keywords: Species of Greatest Conservation Need, threatened, endangered, conservation

Texas harbors 191 species of native freshwater fishes, 91 of which are considered imperiled. A litany of regulatory and voluntary-based conservation measures are routinely implemented to restore and preserve the diversity of Texas freshwater fishes. Use of specific conservation tools, programs, funding, and other resources available for freshwater fish conservation are generally limited to specific sets of species designated on particular lists, such as the lists of Species of Greatest Conservation Need (SGCN) and State Threatened or Endangered Species (State T&E), among others. For example, freshwater fishes listed as SGCN are prioritized by TPWD for voluntary-based investments in research, monitoring, habitat restoration, and habitat protection. Those species also receive special consideration as TPWD provides conservation recommendations to other local, state, and federal agencies through regulatory-based consultations on projects that have the potential to alter freshwater systems. Additional regulatory protections are available for freshwater fishes listed as State T&E. This includes a substantial increase in the civil restitution value of State T&E fishes (considered a deterrent for responsible parties), with each State Endangered fish valued at US $1,000 per individual and each State Threatened fish valued at $500 per individual. Regulatory oversight by TPWD of scientific and zoological collection of freshwater fishes, stocking of fishes into public waters, commercial fishing activities in public waters, disturbances to State-owned streambeds, and exotic species management must also ensure that no adverse impacts occur to State T&E fishes. This presentation will profile State resources available for the conservation of freshwater fishes; discuss conservation implications for listing of species as SGCN or State T&E; describe the species status assessment approach and stakeholder input process used to identify species recommended for inclusion on these two lists; and outline the remaining steps and anticipated timelines for completing the next revisions of these two protected species lists.

New Tools for Environmental Flow Information

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Keywords: Environmental Flow Information Toolkit, environmental flow management, water rights

This presentation will provide a short overview on water law in Texas and new tools available for environmental flow information. Surface water rights are administered under a mix of prior appropriation and riparian doctrines by the Texas Commission on Environmental Quality (TCEQ) while groundwater pumping, under the rule-of-capture, is only regulated in areas with groundwater conservation districts. TCEQ recently launched an online portal to view water rights in Texas and access scanned permits. The Texas Parks and Wildlife Department released the Environmental Flow Information Toolkit focused on the Great Plains of Texas (GP EFIT). GP EFIT is a web-based geospatial platform that serves information on water rights and use; target flows based on hydrology, flow-ecology relationships, and flow standards; degrees of hydrologic alteration; and flow deficits. The GP EFIT objective is to inform efforts to identify opportunity areas for the protection and restoration of environmental flows and align potential environmental flow management strategies for those areas. Information on other available tools that serve ecological information will also be highlighted.

Do components of the natural flow regime paradigm predict occurrence of imperiled Great Plains fishes?

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Joshuah Perkin, Texas A&M University College Station,
Ryan Smith, The Nature Conservancy,
Kevin Mayes, Texas Parks and Wildlife Department,

Joe Trungale, Texas Conservation Science

Keywords: natural flow regime paradigm, Great Plains, Indicators of Hydrologic Alteration, Partial Dependence Plots, flow-ecology relationships

The natural flow regime paradigm (NFP) has contributed to ecological conservation and restoration on a global scale. Application of NFP principles to Great Plains rivers could serve to benefit fish conservation efforts such as restoring and protecting flow regimes. We used flow metrics from the Indicators of Hydrologic Alteration framework and fish occurrence data from three Great Plains river basins to establish relationships between fish and flows that might be used to establish streamflow targets to benefit pelagic-broadcast spawning (PBS) fishes. Flow metrics and gage identification were used as predictor variables and random forest models were fit to all suspected or confirmed PBS fish that occurred in each basin. Results revealed that NFP components related to magnitude, rate of change, and timing were useful for predicting PBS fish occurrence. We also found that gage location was an important predictor variable, indicating flow-ecology relationships are spatially explicit. Partial dependence plots for individual flow components identified thresholds in flow components associated with presence or absence of PBS fishes. These plot data can be used to identify flow component target values required for the persistence of PBS fishes. This study provides insight into flow-ecology relationships for some of the most imperiled stream fishes in Texas and contributes to conservation biology on a global scale by establishing empirical evidence for theoretical links between hydrology and ecology.

A model simulating interactions between hydrology, landscape, species traits and biotic interactions to predict food web dynamics in neotropical freshwater ecosystems

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Kirk Winemiller, Texas A&M University College Station,
Pitagoras Piana, Universidade Estadual do Oeste do Paraná, R. da Faculdade, 645, Toledo, PR, Brazil
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Keywords: Paraná River, food web model, Brazil

Understanding community dynamics is challenging because species respond differently to environmental conditions while interacting within networks of interactions with other species. Most food web models portray species populations or guilds as aggregate units, and thus have no capability to capture important interactions of organisms with their abiotic and biotic environments. This is a major shortcoming, because organism functional traits are known to have strong influences on population dynamics and population interactions. Building on previous research on individual-based modeling, we constructed a model that simulates fish population and food web dynamics for the last major un-dammed reach of the Upper Paraná River in Brazil. This model uses topographic information and hydrologic data to produce spatially explicit dynamics of food webs. The model incorporates general functions for biological processes and functional traits of species to simulate organism performance and population dynamics. The model simulates environmental conditions in each cell on a daily time step in response to hydrology, which is input as a regime. We set the rules for individual fish feeding, growth, reproduction and mortality based on conditions in its local environment. After validation of model components, we simulated contrasting scenarios of extreme wet years and extreme dry years in order to demonstrate the potential of the simulation model. We found, for example, that discrepancies in hydrologic cycle lead to large changes in fish assemblages. This is mostly because, during periods of dry years, fish spawning decreases due to reduction in habitat availability and species interactions are intensified (such as predation and competition). Such outcomes match general predictions based on consolidated literature about these ecosystems. This emphasizes the potential power for predicting changes on natural ecosystems and for directing conservation actions and supporting management plans for minimizing natural impacts.

Ephemeral habitat sustains high fish α and β-diversity during droughts in a subtropical semiarid wetland

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Eduardo Ribeiro Cunha and Kirk Winemiller, Texas A&M University College Station, Department of Wildlife and Fisheries Science

Keywords: assemblage, α diversity, β-diversity, Okavango Delta, Africa, intermittent flow

Globally, flow intermittence is increasing due to climate change and increasing water abstraction for human consumption. Even so, the role of hydrology in structuring aquatic communities in rivers with intermittent flow is poorly understood. Here, we investigated how fish α and β-diversity patterns in intermittent channels in the lower reaches of the Okavango Delta respond to seasonal flooding and drought. Under low water conditions, ephemeral habitat had higher α-diversity, and this was influenced by a combination of fish aggregation and possible transient legacy effects as habitat patches became smaller and more isolated. During low water periods, ephemeral habitat had high species turnover indicative of random changes in local species relative abundances. During low water periods, nestedness was high in permanent habitat, suggesting fish had dispersed among patches in that habitat in a non-random manner as water levels fell. Investigation of changes in community structure across different hydrological periods and habitat types showed significant species turnover when water levels fell, suggesting a strong influence from species sorting. During high water periods, species assemblages were homogenized both at local and regional scales, suggesting a greater influence of mass effects. Our findings support hydrology as a critical factor in regulating diversity patterns in intermittent rivers of a major ecosystem in a semiarid region of subtropical Africa. We infer from these findings that maintenance of a relatively natural flow regime will be necessary for conserving aquatic ecosystem structure and function in this system.

Overview of spring-associated fishes: distribution, ecology, structuring mechanisms, and future management

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Timothy Bonner Texas State University

Keywords: springs, Edwards Plateau

The Edwards Plateau region of the United States harbors many endemics and unique communities. Distinct fish communities exist where spring outflows form. The endemic fishes that occupy these spring complexes likely have a suite of morphological, life-history, and physiological traits that allow them to outnumber other fishes in spring complex environments. Spring fish species richness, relative abundance, and density are dependent on spring discharge quantity and quality. Although the exact structuring mechanisms are unknown, some evidence suggests that spring-associated performance is related to temperature. Spring fishes tend to be highly ranked in measures of rarity, and many are state and federally listed. The future of spring-associated fishes is likely dependent on the quality and quantity of spring discharge from the Edwards Aquifer, therefore, management of these species is directly linked to management of water quality and quantity.

A comparison of benthic invertebrate composition between ephemeral pools and permanent pools along upper Leon Creek

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Keywords: benthic invertebrates, ephemeral pools, Leon Creek

Ephemeral pools can be considered small natural aquatic habitats with large ecological roles. These habitats are common on most continents but are most prevalent and ecologically important in arid and semi-arid regions where water sources may be scarce. Ephemeral pools are characterized by their relatively small size, abundance across hydrologically influenced landscapes, and highly variable in shape, structure and depth due to hydrological changes. Due to extremes in hydroperiod, ephemeral pools harbor unique organisms with adaptations for highly inconsistent environmental conditions. Leon Creek within San Antonio, Texas, serves as a tributary within the San Antonio River Basin. It is composed of fragmented flowing water sections interspersed with isolated pools which connect during significant precipitation. These isolated pools are ephemeral and have been studied very little, if at all. This study examines the community composition of aquatic invertebrates within upper Leon Creek using a

semi-quantitative method. Benthic invertebrate samples and water quality parameters were collected from 10 pools of differing size, depth, and hydroperiod, and identified to genus. The results from this study will be discussed at the conference.

Assessment of impacts to mussel community structure from a new wastewater discharge in the upper Sabine River

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Adam Whisenant, Texas Parks and Wildlife Department

Keywords: mussels, wastewater discharge, Sabine River, ammonia

Freshwater mussels are considered the most imperiled taxa in North America. Because freshwater mussels are long-lived, slow growing, sedentary organisms they are susceptible to many threats that have contributed to their decline, such as habitat alteration, water quality degradation, impoundments, and loss of host fish. Understanding the impact of these threats that could lead to declines in mussel diversity and abundance is critically important for the conservation of these species. Wastewater effluent has been documented as a point source pollutant of concern impacting mussels. Ammonia is a common pollutant from wastewater treatment facilities and one in which mussels are known to be highly sensitive compared to other taxa. This study's objective is to assess mussel community impacts from a recently permitted wastewater discharge in the upper Sabine River with ammonia limits almost double the Environmental Protection Agency 30-day chronic exposure criteria for mussels.

Spatial distribution of demersal fish abundance across the continental shelf in the northwestern Gulf of Mexico

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Phillip Sanchez and David Wells, Texas A&M University Galveston
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Keywords: demersal fish, continental shelf, Gulf of Mexico, generalized additive models

The benthic environment of the continental shelf in the northwestern Gulf of Mexico (NW GoM) is mostly composed of large regions of unconsolidated bottom sediments, characterized by low habitat complexity and a lack of significant vertical relief. Determining the drivers of demersal fish abundance in these areas is complicated by both the expansive areal coverage of this habitat type and a persistent nepheloid layer near the bottom. In this study, an integrated video/acoustic survey method was employed to quantify fish abundance on unconsolidated bottom habitat in the NW GoM. Georeferenced estimates of fish abundance were obtained using traditional hydroacoustic transect surveys conducted using a single split-beam echo sounder. These estimates were validated with fish counts obtained from video and imaging sonar (ARIS) recordings collected simultaneously with the acoustic data. Fish abundance at each sampling station was then related to a suite of habitat and environmental variables using generalized additive models (GAMs) to determine which variables contribute to demersal fish habitat quality. Results of this study will provide insight into the spatial distribution of demersal fishes on the continental shelf as well as the biotic and abiotic factors that regulate abundance on unconsolidated bottom habitats. In addition, the protocols developed here will guide future efforts to characterize populations of demersal fishes in the NW GoM and other areas with habitats where visibility is reduced by a persistent turbid layer.

Influence of abiotic and biotic factors on the distribution and co-occurrence patterns of estuarine predators and prey

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Masami Fujiwara, Texas A&M University College Station,
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Keywords: Coastal Fisheries Monitoring, predator-prey relationships, habitat suitability models

Estuarine ecosystems are characterized by heterogeneity in environmental conditions and available habitats, which support diverse communities of predatory fishes and their prey. The distribution of a given species in an estuary is often influenced by their preference for certain physicochemical conditions (e.g., salinity, temperature, and dissolved oxygen), seabed type and complexity, and structured habitats (e.g., submerged vegetation and oyster reefs). However, ecological drivers such as prey availability likely act in concert with environmental forces to determine the movements and habitat use patterns of predators. A common challenge in examining the spatiotemporal relationships between predators and prey is a lack of synoptic long-term monitoring datasets. This study capitalized on the availability of data from a multi-decadal coastal monitoring program conducted by Texas Parks and Wildlife Department (TPWD), which includes gillnet, seine and trawl collections from each major bay system in coastal Texas since 1986. Using this dataset, the aim of this study was to develop species-specific habitat suitability models for multiple predatory fishes and common prey species in the Galveston Bay estuarine complex. In addition, we used these models to examine patterns of spatiotemporal overlap between predators and prey. These results allow for an examination of the abiotic and biotic drivers (environmental conditions and predator-prey interactions, respectively) influencing the distribution and abundance of ecologically-important fishes and invertebrates along the Texas coast.

Influences on the distributions of petroleum platform-associated fishes in the U.S. Gulf of Mexico

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Keywords: oil platforms, Gulf of Mexico, generalized additive models

Petroleum platforms in the U.S. Gulf of Mexico (U.S. GOM) are important habitat for fishes and support regional fisheries. However, drivers of the regional distribution of fishes associated with these artificial habitats are not fully understood at the scale at which platforms occur. To address this knowledge gap, we conducted 114 submersible-rotating drop-camera and water quality sonde surveys at 54 platforms throughout the U.S. GOM. We then fit two sets of binomial generalized additive mixed models (GAMMs) integrating environmental and structural predictors to encounter/non-encounter data for 17 fish species, so as to understand their horizontal and vertical distribution patterns around platforms. Significant predictors for horizontal distribution included distance from shore (Bermuda Chub *Kyphosus sectatrix*, Greater Amberjack *Seriola dumerili*, Vermilion Snapper *Rhomboplites aurorubens*), salinity (Bermuda Chub, Red Snapper *Lutjanus campechanus*), the number of platforms within five kilometers (Blue Runner *Caranx crysos*, Crevalle Jack *Caranx hippos*), and dissolved oxygen concentration (Red Snapper). Significant predictors for vertical distribution included salinity (Atlantic Spadefish *Chaetodipterus faber*, Bermuda Chub, Greater Amberjack, Red Snapper, Vermilion Snapper), dissolved oxygen concentration (Greater Amberjack, Red Snapper), and seafloor depth (Red Snapper). However, the majority of the study species were not influenced by the predictors included in the horizontal (11/17 species) and vertical distribution (12/17 species) GAMMs. Thus, many U.S. GOM fishes were found to associate with platforms over a relatively wide range of environmental conditions and platform characteristics. This suggests that gradients in environmental conditions may be less important than the simple availability of platform habitat in determining the biogeographic ranges of these species.

Flatlined Flatfish? Status, Trends, and Fisheries Management of the Southern Flounder in Texas

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Mark Fisher and Tiffany Hopper, Texas Parks and Wildlife Department Coastal Fisheries

Keywords: Southern Flounder, fisheries management

The Southern Flounder (*Paralichthys lethostigma*) is highly sought after in both the commercial and recreational fisheries sectors along the Gulf coast of Texas. Longtime downward trends have been observed in Texas Parks and Wildlife Department (TPWD) Coastal Fisheries fishery independent data (bag seines, bay trawls, and gill nets) showing declines in abundance and declining commercial and recreational landings in the fishery dependent data. Although TPWD implemented substantial changes to flounder regulations in 2009 and 2014 to help populations recover and saw small short-term improvements, overall flounder population numbers continue to be lower than they were historically. Population declines are being driven by poor recruitment as winter water temperatures continue to warm. The warmer water temperatures during the winter spawning season are especially problematic for larval fish which require a very narrow range of temperatures for the first three weeks of life for optimal survival. In an attempt to recover flounder populations, TPWD has considered multiple management options including a decrease in the bag limit, an increase in the minimum size limit, area closures, season or time closures, fishing gear restrictions, or a combination of these. TPWD is currently engaged in the statewide fishing regulations process and will be engaging stakeholders through public scoping to help frame a formal proposal option that will be presented to the Texas Parks and Wildlife Commission in January. Any new regulation changes as approved by the commission would go into effect September 1, 2020.

The Unfortunate Reality of Microplastics in our Local Ecology

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Julee Sanders, Grapevine High School
Cynthia Fox-Holt, Texas Parks and Wildlife Department

Keywords: microplastics

The presence of plastics in birds from Midway Atoll have been shown to cause microtears in the gastrointestinal tissue, abnormal appetite and even death. The purpose of this project was to examine the extent to which plastic waste has permeated through Texas lakes and waterways. This project explored whether microplastics and plastic fragments occurred in local fish species and if so, how the fish might be impacted. Our hypothesis was that most microplastics would be found in the gastrointestinal tract because the fish had ingested them while consuming their natural prey or by accident as a misinterpretation of prey. Multiple littoral, limnetic and benthic species of fish were collected using gill nets from Lake Ray Hubbard in Dallas, TX. Fish were identified and bagged separately by species and kept frozen until being processed. Individual fish were weighed, the gastrointestinal tract was removed, weighed, and examined for signs of damage. Gastrointestinal tracts were placed in labeled jars containing a solution of 30% hydrochloric acid to dissolve the soft tissue. Finally, the solution was filtered using filter paper and the remaining particles were examined using a compound light microscope. Microplastics occurred in all individuals (N = 16) of all seven species examined. Occurrence was highest in Gizzard Shad (*Dorosoma cepedianum*) and Common Carp (*Cyprinus carpio*). This project and these results could bring to light the unknown, yet far reaching effects that the everyday use of plastics is having on local fish populations. The applications of this work could help the world understand how plastics are impacting fish species globally. Furthermore, it directs us to ask more questions about plastic use in our society, as well as the impacts of plastics on all species, not just birds and fish.

Microplastic ingestion by juvenile silversides (*Menidia* spp.) in seven bays and estuaries along the mid-Texas coast

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Polly Hajovsky and Simon Geist, Texas A&M University Corpus Christi

Keywords: microplastics, estuaries

Microplastic pollution (small pieces of plastic <500 μm) has been documented to be present in the air, drinking water and in a variety of aquatic systems including oceans, bays, lakes and rivers in different parts of the world. For coastal bays along the mid-Texas coast, the abundance of microplastic pollution and its incorporation in the diets of aquatic organisms has not been well studied. Here we present the combined results on the ingestion of microplastic pollution by juvenile Silversides (*Menidia* spp.) collected in seven bays and estuaries along the mid-Texas coast ranging from Matagorda and Lavaca bays in the north, over San Antonio and Aransas bays to Corpus Christi Bay, the Upper Laguna Madre and Baffin Bay in the south of the study area. This study provides a baseline quantification of various colors and types of microplastics being consumed by these planktivorous fish. Since each of the studied bays are exposed to a different combination of potential sources of pollution, this study may detect differences in ingested microplastic quantity, color, and type between and within bays. For example, a higher ingestion rate is expected for Corpus Christi Bay, with its high population density and industrial development, compared to the rural dominated Baffin Bay and San Antonio Bay. This presentation combines results from a completed research project on microplastic ingestion by juvenile fish collected at six sites in Corpus Christi Bay and the Upper Laguna Madre funded through TAMU-CC and the Texas Seagrant Grants in Aid of Graduate Students program and an ongoing TGLO CMP research project studying fish collected at 3 sites in each of the five remaining bays. The majority of 39 Silversides collected in Corpus Christi Bay contained one or more suspected plastic items in their digestive tract, with the majority being fibers.

Effects of insecticides, fipronil and imidacloprid, on the growth, survival, and behavior of brown shrimp *Farfantepenaeus aztecus*

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Masami Fujiwara and Miguel Mora, Texas A&M University College Station

Keywords: fipronil, imidacloprid, Brown Shrimp, toxicology

Increased use of pesticide is causing detrimental effects on non-target species worldwide. In this study, we examined the lethal and sub-lethal effects of fipronil and imidacloprid, two commonly used insecticides, on juvenile brown shrimp (*Farfantepenaeus aztecus*), one of the most commercially and ecologically important species in the United States. The effects of six concentrations of fipronil (0.0, 0.005, 0.01, 0.1, 1.0, and 3.0 μg/L) and six concentrations of imidacloprid (0.0, 0.5, 1.0, 15.0, 34.5, 320.0 μg/L) were tested in a laboratory. We examined five different endpoints: growth, moulting interval, survivorship, behavioral change, and body color change. Growth of shrimp was reduced significantly under higher concentrations of both insecticides. Under fipronil exposure, shrimp in control showed the shortest inter-moult interval (7.57 ± 2.17 day) compared with other treatments; similarly, in the imidacloprid experiment, moulting increased from 8.43 ± 2.52 day in control to 11.95 ± 4.9 day in 0.5 μg/L treatment. Higher concentrations of fipronil (1.0 and 3.0 μg/L) showed a 0.0% survival rate compared with 100% survival in the control and 0.005 μg/L treatment. Under imidacloprid, survivorship decreased from 100% in the control to 33.33% in the 320.0 μg/L treatment. The 96-h LC50 of fipronil was 0.12 μg/L, which makes brown shrimp one of the most sensitive invertebrates to the pesticide. Changes in behavior and body color were observed under both insecticides after different durations of exposures depending on concentrations. We conclude that, at the corresponding EPA benchmark concentrations, fipronil had more lethal effects than imidacloprid, and imidacloprid had more sub-lethal effects than fipronil. Both effects are of serious concern, and we suggest monitoring is necessary in estuaries.

Stochastic species loss and dispersal limitation drive patterns of spatial and temporal beta diversity of fish assemblages in tropical agroecosystem streams

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Keywords: β-diversity, agricultural development, Brazil

Beta diversity quantifies changes in assemblages among sites and can identify how anthropogenic environmental changes affect patterns of species distributions and community assembly. We investigated how spatial and temporal beta diversity of stream fish assemblages in southeastern Brazil responded to recent environmental changes within an established agroecosystem and investigated whether the observed pattern of temporal beta diversity was different from null expectations. Native forest was replaced by agriculture more than a century ago and recent land use change is primarily the conversion of pasture to sugarcane cultivation for biofuel production. Previous research found changes in stream fish assemblages were not associated with degree of land-use change during the intervening period, but there was evidence of legacy effects on instream habitats and fish assemblage structure. The general lack of response was interpreted to be due to the previous loss of sensitive native species that are still found in remnant patches of Atlantic Forest. Thus, spatial and temporal beta diversity patterns were expected to be driven by stochastic processes. Fish assemblages in 38 agroecosystem streams were sampled in 2003 and 2013 and local and regional environmental variables were quantified in both periods. Species were classified into functional groups using ecomorphological traits, and spatial and temporal patterns of taxonomic and functional beta diversity and its components (turnover and nestedness) were related to environmental distances and degree of change. Spatial beta diversity in both periods was mostly due to turnover, remained relatively unchanged between periods, and was not associated with environmental distances. Temporal beta diversity was lower than expected by null models and not correlated with environmental changes. Deforestation and agricultural development homogenized habitats and assemblages by selecting for disturbance-tolerant and habitat-generalist species. Our results indicate that contemporary assemblage dynamics in these agroecosystem streams are driven primarily by stochastic processes, likely with dispersal limitation.

Here today, gone tomorrow? Assessing changes in stream fish assemblage in relation to habitat fluctuation

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Fernando Chavez and Joshuah Perkin, Texas A&M University College Station

Keywords: flood retention structures, community assemblage, White Creek

Decline of aquatic biodiversity is a global concern. In the United States, freshwater species are disappearing at a rate two to five times faster than native terrestrial species. The ability to identify why fish assemblages experience change over spatiotemporal gradients is crucial to managing sensitive populations effectively. The goal of this study was to identify potential drivers behind fish assemblage change in an anthropogenically affected stream. We studied fish assemblages at 62 sites and habitats parameters at 18 reaches across two years in White Creek, a headwater stream located on the Texas A&M University campus in College Station, Texas. We seined fish and identified them to species and measured stream depth, velocity, substrate type, instream cover, and overhead canopy cover. The factors we focused on in this study were habitat and fish assemblage fluctuations as a result of flood retention structures constructed to temper the hydrology of White Creek. We found fish assemblages were dynamic across the two years and were spatially segregated across the riverscape, while habitat changes most in close proximity to flood retention structures. Identifying a significant correlation could inform fisheries managers of the importance of flood pulses on aquatic habitats and the communities that rely on them.

Ecological impact of the invasive armored catfish (Loricariidae): implications for conservation of fishes in Northern Guatemala

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Keywords: armored catfish, invasives, Usumacinta Basin, β-diversity

Invasive species are considered one of the main causes of biodiversity loss and global change. The armored catfish (Family Loricariidae) has become one of the most invasive fishes in the world. Previous studies have shown that armored catfishes can modify their environment, and can disrupt ecosystem processes, alter nutrient ratios, cause biodiversity loss and damage fisheries. This catfish invaded the Usumacinta Basin, an area critical for conservation

because it harbors the richest ichthyofauna in Central America. The aim of this study was to evaluate the impact of invasive armored catfish on fish assemblages at multiple sites in two tributaries within the Usumacinta Basin. A total of 36 localities were sampled in the San Pedro River and La Pasion River. Physical and chemical parameters were measured at each location, including Total Nitrogen and Phosphorous. Fishes were surveyed systematically using seine and cast net. Fishes were identified, measured and weighed. The variation of abundance in the longitudinal gradient was analyzed with a multivariate linear model with environmental factors used as explanatory variables. The β-diversity was analyzed to identify community composition patterns. We found that armored catfish abundance was high in La Pasion River compared to San Pedro River. The armored catfish distribution was heterogeneous, with only a few sites having high numerical abundances. The river with the most armored catfish was less heterogeneous in terms of richness and species abundance distribution. Spatial turnover and richness patterns determine the fish assemblage composition in the river longitudinal gradient. Armored catfish occurrence and biomass were correlated with environmental factors, with Total Phosphorous being statistically significant for armored catfish biomass. Studying the armored catfish invasion at a large scale will contribute to understand what factors contribute may facilitate the invasion and how it is affecting local fauna.

Urban Fisheries Management in Dallas/Fort Worth, TX

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Thomas Hungerford and Raphael Brock, Texas Parks and Wildlife Department

Keyword: urban fisheries

Urban fishing programs were developed to increase fishing opportunities for citizens in large urban centers. The Dallas/Fort Worth (DFW) metroplex is one of the largest metropolitan populations in the continental United States. Fishing opportunities in DFW consist of large reservoirs, small impoundments, and stretches of channelized rivers. In recent years, the local Texas Parks and Wildlife Department Inland Fisheries management team has worked to increase the diversity of fishing opportunities available to anglers in the DFW area through intensive management approaches in smaller public urban impoundments. This presentation will summarize these efforts and discuss the future direction of urban management strategies in the DFW metroplex.

Northern Leon Creek Greenway user and fish population surveys to enhance urban fishing

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Keywords: Leon Creek, urban fisheries, ephemeral pools

The Leon Creek Greenway (LCGW) in San Antonio, Texas, follows its namesake and is about 32 km in length. A paved trail exists along the entirety of LCGW which is utilized by outdoor exercise enthusiasts (walkers, runners, bikers, etc.). Leon Creek itself is an ephemeral stream that receives ground and surface water runoff from northwestern Bexar County. Five waterbodies ranging in size from 0.12 to 0.89 ha exist along a 1.6 km reach of Leon Creek within the LCGW. One waterbody, Earl Scott Pond, is currently managed by Texas Parks and Wildlife Department as a community fishing lake and is stocked with Rainbow Trout (*Oncorhynchus mykiss*) and Channel Catfish (*Ictalurus punctatus*). Observations indicate the other four water bodies receive some degree of fishing pressure, but fish communities in these ponds have not been described. We conducted fish community assessments in all five waterbodies during 2019 using backpack and boat electrofishing and seines. Additionally, we quantified recreational use along the 1.6 km reach of LCGW using angler creel survey methodology and administered a questionnaire to LCGW users to estimate angling participation in general, identify factors constraining participation in angling, and determine satisfaction level and desires of Leon Creek anglers. Information from the fish community assessments, recreational use survey, and questionnaire will be used to formulate recommendations to improve and market Leon Creek angling opportunities.

Dynamic interdependence between anglers and fishes in spatially coupled inland fisheries

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Keywords: recreational angling impacts

The cumulative harvest pressure exerted by recreational anglers can be intense in some locations. Sustainable management and conservation of inland fisheries requires an understanding of the spatial ecology of fish-angler interactions (e.g., direct, indirect, feedbacks). Advancement towards this goal requires study of the complex interdependencies of human and natural systems, which can be achieved, in part, by looking beyond the wetted confines of individual waterbodies towards the broader angling landscape. It has been hypothesized that fish stocks should experience strong reductions in areas near large aggregations of recreational anglers where fishing effort is presumed to be greatest. To test this hypothesis, direct, indirect, and feedback effects among recreational anglers, Bluegill Sunfish *Lepomis macrochirus*, and Largemouth Bass *Micropterus salmoides* were examined across inland recreational fisheries (n = 29 reservoirs) using path analysis and structural equation modeling. Recreational anglers constituted 5.9 ± 3% (average ± SD) of a county's population. As a county's population increased, there was a corresponding non-linear increase in recreational anglers, with participation rates varying from <1-15%. I observed that recreational anglers imparted detectable effects on recreational Bluegill (direct) and bass (indirect) fisheries across the landscape, which we attributed to (1) short travel distances of individuals at local scales (<40 km), and (2) a spatially and numerically heterogeneous distribution of anglers (i.e., anglers within counties) at the regional scale. Our study identified the presence of an emergent landscape-scale feedback, driven by angler numbers, mediated via angling effects on Bluegill and bass populations, and which manifested as spatially variable movements of anglers. These dynamics collectively shaped inland fisheries across the landscape via a suite of direct, indirect, and feedback effects and highlight the complex relationships between fishes and anglers.

Assessing climate change vulnerability of Guadalupe Bass (*Micropterus treculii*): comparing bioenergetics and species distribution modeling

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Keywords: Guadalupe Bass, bioenergetics models, climate change

Warming and reduced flow under anthropogenic climate change is changing the physiology, population dynamics, and geographic distribution of freshwater fishes. The Guadalupe Bass (*Micropterus treculii*) is an endemic species of conservation and recreational significance, but its vulnerability to climate change has not been holistically assessed. We used bioenergetics models (BeMs) to project changes in energetic budgets of individuals and correlative species distribution models (SDMs) to project changes in reach occupancy of populations under historical and end 21st century climate scenarios. Because BeM parameters have not been measured for Guadalupe Bass, we compiled parameters of other black basses (*Micropterus* spp.) and used a novel parameter resampling algorithm to develop an ensemble of BeMs. SDMs were parameterized with open-source occurrence records, and landscape and climatic covariates using the Maximum Entropy algorithm. Both models were projected to 8,119 confluence-to-confluence stream reaches within occupied drainages. SDMs project a 17.8 to 42.2% decrease in reach occupancy under moderate and severe climate change scenarios, respectively. BeMs project a 14.4 to 23.3% increase in consumptive capacity which will be countered by a 5.6 to 10.2% increase in metabolic demand, suggesting a net improvement in physiological performance provided that increased prey demand can be met. Both methods revealed spatial heterogeneity, providing fisheries managers with a framework for spatial prioritization of management. Unknown physiology and air-water temperature relationships, as well as uncertainty in future climate trajectories contribute to uncertainty in these projections. Future research should (1) measure BeM parameters of Guadalupe Bass in the laboratory, (2) monitor air-water temperature relationships in Edwards Plateau streams and rivers, and (3) explore interactive impacts of stream desiccation.

Establishment of *Monopterus cuchia* in east Texas

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Keywords: Asian Swamp Eel, invasives

Asian Swamp Eel, *Monopterus cuchia*, are cryptic, predatory, amphibious eel-like fish native to southern and southeast Asia. They thrive in a variety of environmental conditions and aquatic systems and possess many characteristics found in other successful invasive fish species. *M. cuchia* is popular in the live-food trade in the United States and has been documented in markets nationwide and until recently had not successfully over-wintered when released. Recent field work has found a potentially established population in East Texas, with a single specimen captured in 2016 and 34 specimens documented in 2019. Specimens ranged from 144 mm to 762 mm, encompassing three size classes. The presence of juveniles, one of the size classes, suggest successful establishment of the population. All specimens were collected using boat-based, direct-current electrofishing. Collection of *M. cuchia* was most successful using sequential passes at 15hz and 30hz, and with two collectors on the bow of the electrofishing boat; one using a traditional dipnet and the other using a modified frog gig. A second likely-established population was discovered in New Orleans, Louisiana in 2019 and likelihood of future introductions is high with the ability to affect native fish population and management strategies.

Temporal patterns of spawning and fishing in Sheepshead (*Archosargus probatocephalus*) from Port Aransas, Texas

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Keywords: Sheepshead, public fillet stations

The Sheepshead (*Archosargus probatocephalus*) supports a popular recreational fishery during the winter and spring months in Port Aransas, Texas. By accessing the regular and high volumes of fish carcasses available at public fillet stations, we monitored temporal patterns of spawning and fishing activities for Sheepshead continuously from 2016 through 2019. Visual and microscopic examinations of gonads from sampled females indicated that spawning occurred from late February through late April each year and was associated with rising seasonal water temperatures. Actively spawning females were observed daily throughout the spawning season with no evidence of a lunar rhythm, and females were estimated to spawn every four days on average. Sheepshead were the most common species recorded at public fillet stations from January through April of all years, representing an average of 30% of the fish observed. The relative abundance of Sheepshead increased during the pre-spawning months of January and February, remained high during the peak spawning months of March and April. The relative abundance of Sheepshead declined quickly in May following the end of the spawning season and remained low throughout the summer and fall months. Sheepshead are sexually dichromatic during the spawning season, in which some females exhibit a golden coloration on the face, while males tend to show a darkened gray face coloration. The results of this study show that the recreational fishery for Sheepshead in Port Aransas is based almost exclusively on the harvest of pre-spawning and spawning adults that aggregate in large numbers within the Aransas Ship Channel from January through April. Moreover, it demonstrates the value of public fillet stations as a reliable and consistent source of information for monitoring the reproductive activity, population structure, and fishing pressure for Sheepshead and other shore-based, recreational fisheries in the region.

Habitat use and samping efficiency of low-frequency electrofishing for Blue Catfish

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Keywords: Blue Catfish, low-frequency electrofishing

Fisheries scientists have recently focused on creating standardized low-frequency electrofishing procedures for sampling Blue Catfish *Ictalurus furcatus*. However, sampling efficiency and size structure have not been assessed with regards to habitat use patterns. We conducted a telemetry study and compared the proportions of fish associated with distinct macrohabitats with the proportions of fish captured in the same habitats via standardized, low frequency electrofishing. We also compared capture efficiency and proportional size distributions (PSD) of

captured fish among the same macrohabitats. We conducted the study across two sample seasons on Lake Dardanelle, Arkansas (17,806 ha), and used a systematic random design to sample the length of the reservoir and all major haibitats to collect 8,067 Blue Catfish in 458 electrofishing samples. The proportions of fish captured by electrofishing compared to those tracked were similar indicating that sampling efficiency was directly related to habitat use ($\chi 2$ <0.01, P > 0.05). A generalized linear mixed model indicated sampling efficiency increased with conductivity (Z = 2.37, P = 0.018), and decreased with flow (Z = -3.22, P = 0.001). Sampling deeper main channel habitats resulted in different PSDs than shallow adjacent flat type habitats (F = 12.99, df = 1, 4, P < 0.001). We recommend that managers concentrate on sampling deeper channel-edge main-channel, and man-made structure when creating a standardized protocols. These habitats are not only heavily used by Blue Catfish, but when sampled, produce samples that are likely to be representative of the population.

Influence of traps equipped with bycatch reduction devices on Blue Crab catch and Texas Diamondback Terrapin bycatch

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Keywords: Diamondback terrapin, bycatch reduction devices, conservation,

The Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) inhabits coastal waters from western Louisiana to Baffin Bay and is a Species of Greatest Conservation Need (SGCN) in Texas. Because terrapins share coastal ecosystems with targets of commercial fisheries like Blue Crabs (*Callinectes sapidus*), bycatch mortality in crab traps poses a major threat. Study objectives include testing the impacts of bycatch reduction devices (BRDs) installed in crab traps on bycatch rates of the Texas Diamondback Terrapin as well as determining impacts of BRDs on Blue Crab catch in a manner consistent with real-world commercial fishing behavior. Monthly sampling took place at 3 sites in Chocolate Bay near Galveston, Texas in partnership with a commercial crab fisherman. At each location, 18 traps (9 regular and 9 BRD-equipped) were set and checked daily for 3 days with all catch and environmental parameters recorded daily. Sampling for the project is ongoing, but preliminary analyses show patterns in crab catch when comparing regular vs BRD-equipped traps, sampling month, and crab sex as well as monthly patterns in bycatch species.

To tong or not to tong: comparing gear types for measuring oyster density on degraded and restored reefs

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Keywords: oysters, patent tongs

The quantification of oyster density on reefs has historically been accomplished using diver quadrats, but this process can be labor intensive. Patent tongs are an alternative method for estimating oyster density without requiring diving surveys, but there is limited literature on the sampling efficiency of patent tongs as their use has not been widespread. We compared oyster density estimates from samples collected with patent tongs and diver quadrats with the objective of (1) comparing the efficiency of these two sampling methods and (2) establishing a conversion factor that can be used to compare data from both gear types. Because oyster reef consolidation likely impacts the efficiency of sampling gear, we stratified our sampling efforts by habitat type (e.g., restored versus degraded). A total of ten reef sites were selected in Galveston Bay, five of which were designated “degraded”, and five of which were designated “restored”. At each reef location, patent tong and diver quadrat samples were collected, and the density of live oysters (>25mm), dead shell, and length of live oysters were recorded. We observed differences in densities between gear types and degradation levels for live oyster and shell, though no significant interaction was detected between gear and degradation level. Catch rates were, on average, 16 oyster/m2 greater in quadrat versus tong samples. However, high variability among samples may hinder predictive performance of these conversions. Regardless, these findings could aid oyster monitoring and restoration efforts globally by allowing for the comparison of monitoring data collected with these different gears by decreasing personnel risk and labor hours previously associated with quadrat sampling.

Movement ecology of Red River endemic Prairie Chub

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Keywords: Prairie Chub, restricted movement paradigm, migration

Prairie Chub (*Macrhybopsis australis*) is a cyprinid endemic to the Red River Basin in Oklahoma and Texas. Prairie Chub is listed as imperiled because of streamflow modification and habitat fragmentation, and is suspected of making long-distance, upstream migrations to complete its life cycle. However, no empirical data for movement exists. The goal of this study was to quantify movements of Prairie Chub using mark-recapture to test competing hypotheses, including that Prairie Chub movement would match: (1) theoretical expectations from the restricted movement paradigm (RMP) in which most individuals are stationary and few move; (2) expectations from a "mass effects" model from large rivers in which most individuals move long distances without any directionality; (3) exhibit upstream bias because adults must counter downstream displacement of eggs and larvae during earlier life stages. We used visual implant elastomer to tag 2,499 Prairie Chub in three Red River streams during summer 2019 followed by recapture attempts over 5-km segments centered on release points. We recaptured 94 individuals (recapture rate = 4%) and quantified net displacement (total distance moved, m) and dispersal rate (m/d). Models fit using the package 'fishmove' in R revealed that most individuals were stationary (consistent with hypothesis 1) but some moved upstream and downstream over longer distances (e.g., >5 km) and at faster rates (e.g., 1,400 m/d) than expected under the RMP (consistent with hypothesis 2). Although we found limited evidence of synchronized, long-distance upstream movements (i.e., hypothesis 3 not supported), our results suggest Prairie Chub use a broad extent of the riverscape, including up to 100 km of stream over a 90-day spawning season. Our results provide better insight into the scales of habitats that should be protected for Prairie Chub in the Red River and aid in predicting movement patterns for other, poorly studied pelagic-broadcast spawning minnows.

Application of a hierarchical spatial framework to prioritize stream restoration for an endemic fish

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Keywords: conservation, stream restoration, habitat suitability model, species distribution model

Stream restoration, many times, requires an understanding of multiple scales at which landscape and habitats influence species persistence. However, absence of this information may result in misdiagnosis of the leading factors responsible for ecosystem degradation and lead to unsuitable restoration designs or poor restoration site selection. For instance, watershed-scale assessments of species distributions and habitat suitability are typically highly accessible, yet spatially contiguous in-stream habitat data is sparse. To facilitate multi-scaled restoration site prioritization efforts, we used an in-situ mapping system to collect high-resolution continuous in-stream habitat data from video interpretation and water quality sensors. These data were used to develop a micro-habitat suitability model (MHSM) for Tennessee Dace (*Chrosomus tennesseensis*), a threatened species of fish in Tennessee. We then paired the MHSM with a watershed-scale species distribution model (SDM) to develop a hierarchical characterization of coarse- and fine-scale habitat needs for Tennessee Dace. Suitability scores for both spatial extents were used to identify stressors and approaches to restoration, while guiding site selection and prioritization. Our approach yielded an ability to distinguish stressors operating at different scales to appropriately design restoration strategies for an endemic fish.

Low-level dissolved organic carbon subsidies drive a trophic upsurge in a boreal stream

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Keywords: dissolved organic carbon, trophic upsurge, food webs

Dissolved organic carbon (DOC) is generally viewed as a minor if not insignificant basal resource in streams because much of the DOC pool comprises high molecular weight, recalcitrant compounds that are inefficiently incorporated into biomass. Nevertheless, there is increasing evidence that the relatively small, labile fraction of DOC may indeed fuel microbial activity to a level that stimulates productivity across multiple trophic levels, resulting in a "trophic upsurge." Here, we tested the trophic upsurge hypothesis by subsidizing the labile DOC pool of a boreal stream that had relatively high nutrient availability but low levels of naturally occurring DOC. We continuously added ecologically relevant (0.250 mg C/L, ~10% increase above ambient bulk DOC) concentrations of labile DOC (acetate-C) for 62 d to a treatment reach that was statistically indistinguishable in its channel form and chemistry from an upstream reference reach. We measured responses of periphyton production and biomass, whole reach metabolism and nutrient uptake, benthic invertebrate abundances, and juvenile salmonid (Dolly Varden, *Salvelinus malma*) abundance. Measurements of basal ecosystem responses collectively indicated increased energy mobilization at the base of the food web in response to labile DOC addition. Throughout dosing, ecosystem respiration and dissolved inorganic nitrogen uptake was greater in the treatment reach. Benthic invertebrate counts, dominated by *Baetis* spp. and Chironomidae, were ~8x greater after 56 days. Dolly Varden fry and parr age classes were nearly 2x more abundant. Further, marked-recaptured Dolly Varden had significantly higher instantaneous growth rates. The strong consumer responses to small quantities of labile DOC mirrored significant treatment reach increases in basal ecosystem function and therefore demonstrated a response consistent with a trophic upsurge. We suggest that terrestrial DOC deserves more attention as a basal resource for whole food webs, akin to nutrients fueling green (autochthonous) pathways.

Incorporating indirect pathways in body size-trophic position relationships

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Keywords: food webs, ecological physiology, trophic status

Body size, trophic position (TP) and niche width are important elements of food webs, however, there is still debate regarding their interrelationships. Most studies have tested these correlations using datasets restricted to carnivores and simple bivariate models that disregard potential indirect effects of other factors, their interactions, and phylogeny. We analyzed relationships among TP, consumer size, food item size, and two functional traits (gut length and mouth width) using confirmatory path analysis of an extensive freshwater fish dataset. Models were consistent whether or not accounting for phylogeny. Fish size was associated with food size (mean and variance) and traits, all of which mediated indirect relationships between size and TP. Mouth gape was associated with food size, and fish that fed on larger food items had higher TP. Fish with longer guts fed on small and homogeneous food items near the base of the food web. Incorporation of functional traits and their intermediate pathways is critical for understanding trophic relationships of animal groups that encompass diverse feeding strategies. Consumer size, by itself, is a poor predictor of TP when higher plants and detritus are important food resources and should not be used as a surrogate for TP in food webs models.

Host selectivity and local environmental conditions determine cutaneous microbiome structure of North Texas stream fishes at the onset of drought

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Keywords: microbiome, drought, ephemeral pools

Fish species native to drought-prone regions are adapted for population persistence during drought or rapid recolonization after cessation of drought and return of flowing conditions. However, anthropogenic stressors such as increased demand for freshwater and global climate change are exacerbating the intensity and duration of drought events and will likely lead to species experiencing environmental conditions at the extremes of their

tolerances. Microbial communities living in or on an organism (host microbiome) are affected by environmental conditions and have consequences for host behavior and health. Thus, host:microbiome interactions may play an important role in mediating fish population responses to drought. Relatively little research to date has addressed the factors that affect the composition of the fish host microbiome and the functions that microbial communities play in host biology and ecology. We determined cutaneous microbiome structure for eight fish species in an intermittent stream in North Texas and analyzed the relative importance of host phylogeny and local environmental factors affecting the cutaneous microbiome at the onset of drought conditions. Fish cutaneous microbiome and environmental microbial samples were collected in the field from three upstream and three downstream sites. DNA was extracted and library prepped for next generation sequencing targeting the V4 region of 16S bacterial ribosomal RNA using the Illumina MiSeq platform. We found differences between environmental and cutaneous microbiomes, demonstrating host:microbiome selectivity. That said, there was a difference in microbiome composition of hosts between upstream and downstream sites with overlap among host species within sites, but little overlap within host species across sites, suggesting that local habitat conditions are important in structuring the cutaneous microbiome. Data collected during drought conditions will enable us to further assess factors affecting the host microbiome as assemblages are restricted to refugia pools (i.e. homogenizing habitat) and exposed to increasing abiotic and biotic stressors.

Flow alterations associated with changes in the fish fauna of the lower section of the Rio Grande River

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Keyword: Rio Grande, water availability, assemblage

The lower section of the Rio Grande river is an important source of water and feeds dense urban areas and agricultural land on both sides of the Mexico/USA border. An increase in agriculture and urbanization in the lower Rio Grande valley has resulted in management and manipulation of river flows. Along the lower section of the Rio Grande dams were built in 1953 (Falcon Dam), 1960 (Anzalduas Dam), and 1975 (Retamal Dam). Damming of the river and abstraction for human uses has resulted in reduced flows and reductions in the peaks and frequency of flood events. These alterations can have major effects on fish diversity, particularly in taxa with vulnerable life history characteristics such as drift spawners (i.e., some cyprinids). We conducted new fish surveys in 2017 – 2019 and gathered historical collection data from 1954 to the present. We analyzed how the community composition of the river has changed through time and specifically investigated changes in the species richness of the two most speciose primary freshwater families in this section of the river, the Centrarchidae and Cyprinidae. In the upper reaches of the Lower Rio Grande we found community compositional shifts through the study period. These community shifts correspond with strong evidence (posterior probability > 0.999) that Cyprinid diversity has been declining since the beginning of the sampling time corresponding to some of the earliest changes to river flow following the construction of the Falcon Dam. Concurrently, we found evidence (posterior probability = 0.954) of increasing diversity of Centrarchids over the same time span, following the modifications to the flow regime. Lower overall flows and dampening of flood severity and frequency likely benefit these species which are not fluvial specialists.

Abundance and distribution of larval fish off Galveston Bay post Hurricane Harvey compared to historic NOAA SEAMAP data

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Keywords: Hurricane Harvey, larval fish, SEAMAP

Hurricane Harvey was a major ecological disaster that hit the coast of Texas late August 2017. The storm sent thousands of gallons of eutrophic freshwater into the Gulf of Mexico (GoM), which persisted there as a freshwater

plume for several weeks. While studies on past hurricane-induced flooding events showed an alteration of the species composition and distribution of estuarine and oceanic phytoplankton and copepod communities, few studies have focused on the response of larval fish communities to hurricane-induced flooding events. As part of a collaborative NSF- funded research project which investigates the response of the plankton community to the flood plume, we present an assessment of the larval fish community in the GoM near Galveston, Texas. Here we show data on the distribution of larval stages of key fish families collected with NOAA SEAMAP Bongo and neuston nets one and two months after the storm along two transects off Galveston, Texas. These will be compared to historic abundance and distribution data from NOAA SEAMAP plankton surveys (2000-2014). Historic data suggest that typically members of five fish families (Sciaenidae, Engraulidae, Clupeidae, Carangidae and Gobiidae) characterize the nearshore larval fish communities during Fall months, and data from Fall 2017 suggest that the freshwater plume had a negative effect on larval fish densities at nearshore stations.

Climate change and diversity of fishes and invertebrates along the Texas coast

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Keywords: marine species, occupancy analysis, climate change

Climate change impacts several physical and chemical properties of the oceans, and these changes affect the ecology of marine organisms. One important ecological consequence of climate change is the distribution shift of marine species toward higher latitudes, which has been recorded extensively in temperate regions. Changes in species distribution, and thus community structure, will have profound effects on the integrity of ecosystems. Furthermore, overall fish and invertebrate production has been predicted to increase in temperate regions and to decrease in the tropics, which will impact the socioeconomics of people who depend on marine resources. Here, we investigated the prevalence of 130 species of fish and invertebrates to demonstrate changes in their distributions over 35 years along a subtropical coast within the Gulf of Mexico using occupancy analysis. The results suggested that diversity increased across the coast, the majority of species increased in prevalence, and the ranges of many species expanded. Climate-mediated environmental variables were related to these changes and suggested a variety of species-specific responses to climate change. Overall, warmwater associated species increased their prevalence whereas the cold-water associated species decreased their prevalence. The diversity increased because it is high in lower latitude than higher latitude, and species are invading from the south along the Texas coast. Although increased diversity may have positive effects on ecosystems, such changes in a short term will likely impact the ecology of these systems by introducing new species interactions or altering existing ones.

Climate effects on fish diversity in the bays of Texas

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Keywords: marine communities, climate change

Climate-driven variables have the potential to affect fish distribution and community structure. In Texas, climate change has led to increasing temperatures, rising sea level, and changing salinity, all of which may be expected to affect fish distributions. In order to assess the impact of climate change on the marine fish communities of Texas, fish diversity response to climate variables was modeled. Leveraging 33 years of gillnet survey data from eight major bays along the coast of Texas, diversity was estimated for each bay, season, and year, allowing for the estimation of spatial, temporal, and seasonal trends in fish diversity. In order to assess the impact of climate related driving variables on the fish communities of Texas, we associated the diversity index with environmental variables using a repeated measures model approach. We found significant increasing trends in fish diversity across all eight bays in fall, and six of eight bays in spring. Mean sea level, temperature, salinity, and dissolved oxygen were

identified as important drivers of increasing fish diversity. Our results suggest that observed increases may be attributable to changing habitat availability resulting from sea-level rise and increasing winter temperatures. Mangrove expansion and warmer winters are likely allowing for an invasion by tropical species, driving the observed increase. Our results provide evidence for climate effects on the structure of fish communities in Texas.

Conservation genetic analysis of captive breeding strategies of two endangered Great Plains minnows

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Keywords: strip spawning, genetic diversity, Sharpnose Shiner, Smalleye Shiner

Recovery of imperiled fishes has at times relied on captive breeding. One strategy that is used in captive breeding is strip spawning. Recently, strip spawning methods were developed by Urbanczyk et al. (2019) to successfully breed two imperiled Great Plains minnows, the Sharpnose Shiner (*Notropis oxyrhynchus*) and the Smalleye Shiner (*Notropis buccula*). This method could be utilized to help conserve both species; however, without considering the genetic risks associated with captive breeding this method could pose problems for the future of both species. To reduce the loss of genetic diversity in captive spawned larvae using the method developed by Urbanczyk et al. (2019), we tested how different gametic combinations could affect the genetic variation of the larvae. We tested four gametic combinations, we combined the gametes of 2 males (M) to 1 female (F), 4M:2F, 8M:4F, and 16M:8F. We tested each combination for each species in triplicate and genotyped the broodstock and 10 larvae from each combination with five microsatellite loci. We assessed the mean observed heterozygosity and the effective number of alleles of the larvae and broodstock of each gametic combination. We observed a reduction in genetic variation found in the progeny as compared to the broodstock for all treatments. We also observed that the intermediate gametic combinations had higher levels of genetic variation. However, it may be that a different combination not tested would be even better at preserving the genetic variation of captive spawned Sharpnose Shiner and Smalleye Shiner.

Evaluation of a novel slow-release spawning aid, OvaNext™, in marine finfish reproduction

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Elizabeth, Silvy, Texas A&M University College Station

Keywords: OvaNext, aquaculture

OvaNext™ is small-volume, injectable, time-released spawning aid containing salmon Gonadotropin–Releasing Hormone analogue (sGnRHa) in a novel excipient. Its intended uses are to advance and synchronize spawning of female finfish and increase milt production in male finfish. Unlike traditional methods of priming and resolving doses of spawning aids that are immediately biologically active and induce spawning after a very short period of latency, extended peptide release over a period of days aids to advance gonadal maturation of females that are not yet in the final stages of maturation, mitigates stress induced by repeated handling and injections, allows more customizable and exact dosage administration that implants, and does not induce tissue damage caused by implantation of multiple cellulose based implants necessary for large marine specimens. This presentation will detail preliminary evaluations of the pathology and safety of the delivery excipient in Red Drum and the effectiveness of OvaNext™ at synchronizing and inducing ovulation in female Cobia.

Effects of temperature and salinity on the survival of Southern Flounder (*Paralichthys lethostigma*) pre-metamorphic larvae spawned by broodstock from three different ecological regions along the Texas coast a transcriptomic perspective

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Keywords: Southern Flounder, pre-metamorphic larvae, environmental tolerance

We investigated the survival of Southern Flounder pre-metamorphic larvae spawned by parents from three ecological regions located along the temperature and salinity cline of Texas coastal bays for three consecutive years. The survival of different groups was evaluated after acute exposure to different temperature and salinity treatments. The data showed the best survival for the three groups of Southern Flounder at this phase of development occurs at 17°C and therefore the optimal temperature range for pre-metamorphic larvae is between 16-17°C as compared to the control (18°C), which is generally used in hatcheries. Sabine larvae exhibited higher tolerance to warmer temperatures. Differences in survival and tolerances of pre-metamorphic larvae to higher salinities (35, 40, 45 ppt) were also noted. Aransas Bay larvae displayed the highest survival for all treatments and even survived at 40 and 45 ppt salinity. The lowest survival for the Sabine Lake and Galveston Bay pre-metamorphic larvae was at 45 ppt. The intraspecific differences in temperature tolerance and survival of Southern Flounder larvae from Sabine Lake, Galveston Bay, and Aransas Bay are important to know for hatcheries in their efforts to increase survival rates during rearing of larval and pre-metamorphic stages. Transcriptomic analysis of the experimental groups revealed differences in expression of genes related to stress caused by temperature and salinity.

Age validation and population structure of Warsaw Grouper in the Gulf of Mexico

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Keywords: Warsaw Grouper, population demographics, stable isotopes

Fishery management policy for Warsaw Grouper (*Hyporthodus nigritus*) in the Gulf of Mexico (GoM) is based on a single-stock approach, with population demographics parameters adopted from a U.S. Atlantic assessment; an area composed of very different physicochemical properties than in the GoM. To address uncertainty in age-growth relationships and population structure of Warsaw Grouper in the Gulf of Mexico, we analyzed natural markers in otoliths from individuals throughout the northern GoM to conduct a bomb radiocarbon age validation and quantify chemical signature overlap as a proxy for mixing rate. Radiocarbon age validation supported annual growth increment formation for all size classes of Warsaw Grouper and validated a minimum 56-year longevity. To assess the population structure of Warsaw Grouper in the GoM, we compared trace element (Li, Mg, Mn, Co, Cu, Zn, Sr, Ba) and stable isotope (δ13C and δ18O) concentrations in otoliths from individuals collected from four regions (Texas, Louisiana, Alabama and NW Florida, and SW Florida) resulting in 5 influential markers (Mg:Ca, Mn:Ca, Sr:Ca, Ba:Ca, and δ18O). Distinct regional signatures were present for three life history stages (first year, most recent year, and lifetime), with the most notable differences between SW Florida and the Texas/Louisiana regions. Combined, these results help to clarify current uncertainties in Warsaw Grouper GoM assessments and suggest that an updated age-growth analysis developed under a multi-stock framework will help improve the current rebuilding plan.

Scale microchemistry as a non-lethal alternative for tracking individually variable migration patterns in mobile fish

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Keywords: scale microchemistry, stable isotopes, migration

Estuaries are important habitats to many coastal fishes. Some fishes can use the low salinity and freshwater habitats that estuaries provide, though the exact patterns of usage for these habitats for some species are not well understood. Stable isotope and microchemical analysis of fish otoliths and muscle tissue have been used to analyze fish migratory behavior. However, removal of otoliths and muscles tissue require the sacrifice of the subject organism. Scales are another structure of fish that experience deposition of stable isotopes and elements from the environment during their formation, and the removal of scales for most species is a non-lethal process. For this study, Red drum *Sciaenops ocellatus* were collected in bays and estuaries along coastal Texas and analyzed for a

suite of chemical assays including stable isotope (δ13C and δ15N) and elemental (strontium and barium) composition of scales. Scale chemistry was compared among fish collected in bays that differed in their distance from freshwater inflow sources to assess divergence in terrestrial influence as well as degree of fish residency in isotopically distinct food webs. Scale stable isotopes and elements are compared to determine if different chemical markers support comparable conclusions about movement or residency. Finally, scale chemistry compositions will be compared to prior analyses of otoliths and muscle isotope compositions to assess agreement in chemical history information between structures that can be sampled lethally and non-lethally. If scales contain comparable information to that of otoliths and muscle tissue, then this non-lethal method will be further validated as a suitable method for determining the migratory behavior of fishes. Usage of estuaries and low salinity habitats is an important part of the life history of many estuarine fishes, and further understanding of these behaviors is important in determining effective management practices for these fishes.

POSTER PRESENTATION ABSTRACTS

01

History, partners, and future of the Texas Chapter of the American Fisheries Society Student Scholarship Endowment Fund

Dave Terre (*Texas Parks and Wildlife, dave.terre@tpwd.texas.gov*)

02

Cryptic genetic and morphological divergence within the Texas Shiner *Notropis amabilis* group throughout central Texas drainages

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Keywords: Texas Shiner, lineage divergence, genetics

Lineage divergence is attributed to reproductive isolation and various ecological adaptations. These factors likely contribute to the large number of endemic fishes supported by the Edwards Plateau region of Central Texas. The Texas Shiner *Notropis amabilis*, found within the Edwards Plateau, was previously considered a single lineage; however, recent research has found that the Texas Shiner is two lineages, *N. amabil*s and *N. megalops*. The purposes of this study were to assess the genetic divergence and morphological variability within the *N. amabilis* group throughout its range. Fish were sampled from ten rivers for genetic analysis and four rivers for morphological analysis. Genetic results suggested there are four separate lineages with high genetic divergence: *N. megalops* (Independence Creek, Pecos, Devils, and San Felipe rivers), north *N. amabilis* (North Llano and Colorado rivers), east *N. amabilis* (San Marcos and Comal rivers), and south *N. amabilis* (Nueces and Devils rivers). Two lineages were sympatric in the Devils River, south *N. amabilis* and *N. megalops*, where a single F1 hybrid was found. This suggests there is some form of reproductive isolation, which could be due to a combination of ecological or morphological factors. Morphological results suggested there are differences within the *N. amabilis* lineages and *N. megalops*. Three lineages, north *N. amabilis*, south *N. amabilis*, and *N. megalops* differed significantly in morphology; however, individuals from the Devils River were not different from the *N. megalops* in Independence Creek. Observed morphological differences were the location of the dorsal and pelvic fins, eye size, and head depth. Furthermore, comparison of morphologies of the east *N. amabilis* lineage obtained from the San Marcos and Comal rivers will offer more insight on lineage divergence within *N. amabilis*. Overall, this study will further our understanding of lineage divergence within fishes within the Edwards Plateau through genetic and morphological analyses.

03

Diel fluctuations in Comanche Springs Pupfish abundances in San Solomon Springs, Balmorhea State Park

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Keywords: Comanche Springs Pupfish, diurnal behavior

The Comanche Springs Pupfish (*Cyprinodon elegans*) is a freshwater species only found in spring systems in the vicinity of Balmorhea, Texas in the Trans-Pecos region. The species was previously found in Comanche Springs in Fort Stockton, Texas until the springs ran dry because of groundwater depletion. The largest remaining population of Comanche Springs Pupfish occurs at Balmorhea State Park and is closely monitored and surveyed by the Texas Parks and Wildlife Department. The goal of this study was to assess diel behavior of the Comanche Springs Pupfish to test for diel variation consistent with the more widely studied Devils Hole Pupfish (*Cyprinodon diabolis*) that shows strong depth associations across gradients of light intensity. We hypothesized that Comanche Springs Pupfish abundance would be greater in shallow, concrete-bottom pool habitats during the day (when other fishes are absent) compared with night. To test this hypothesis, we conducted 9 repeated surveys (4 during the day; 5 at night) of pupfish abundance using a 1-m by 1-m quadrat to conduct visual counts along the shallow edge of

San Solomon Pool. We then fit a generalized linear mixed model to predict pupfish abundance using space (distance from deep water) and time (day or night). We found significantly higher abundances of pupfish in the shallow water during the day compared with the night, supporting our initial hypothesis. Distance from deep water was not a statistically significant predictor of pupfish abundance. Our findings for Comanche Springs Pupfish show a reversed pattern of shallow water habitat use across the diel cycle compared with Devils Hole Pupfish, and therefore highlight variation in behaviors among pupfish species. The results of this study can be used by managers to identify ideal times to conduct visual-based population abundance counts that yield the most accurate results.

04

Intermediate traits present in hybridized Prairie, *Macrhybopsis australis,* and Shoal, *M. hyostoma,* Chub within the Red River basin

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Keywords: Prairie Chub, Shoal Chub, hybridization, phenotypes

Hybrid zones form when distinct species convene at single location and interbreed, often resulting in intermediate genotypes and phenotypes. Previous research has found that the Prairie, *Macrhybopsis australis,* and Shoal, *M. hyostoma,* Chub hybridize in reaches of the Red River upstream from Lake Texoma, exhibiting a range of intermediate genotypes. The objectives of this study were to determine if individuals from the hybrid zone exhibit intermediate phenotypes as well. Barbel count, lengths of the 1st and 2nd barbel pairs, eye diameter, and the ratio between barbel length and eye diameter were measured from individuals collected from the upper Red River hybrid zone (reach immediately upstream from Lake Texoma), Red River downstream of Lake Texoma, and Pease and Wichita rivers. We used a Principle Components Analysis, followed by an ANOVA on PC axis 1 to determine if there are morphological differences and intermediates within the sampled reaches. Barbel lengths and barbel length to eye diameter ratio were the strongest loading on PC1, with eye diameter being the strongest loading on PC2. In multivariate space, reaches which consisted of putatively pure Prairie Chubs were separate from putatively pure Shoal Chubs with individuals from the hybrid zone forming a gradient between the two species. There was a significant difference between river and PC1 coordinates, suggesting morphological disparity between species. Specifically, there was no significant difference between downstream Lake Texoma Shoal Chubs and hybrid zone individuals, while there was a difference between Prairie Chubs and hybrid zone individuals. Overall, there seems to be morphological disparity between the two putatively pure species, with individuals from the hybrid zone more morphologically similar to putatively pure Shoal Chubs. This result corroborates the genomic data where a majority of the hybrid individuals had higher Shoal Chub genomic ancestry.

05

Conservation biogeography of Headwater Catfish in the United States

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Keywords: Headwater Catfish, species distribution models

We reviewed the conservation status of Headwater catfish (*Ictalurus lupus*) in Texas and New Mexico, USA with emphasis on Texas populations. Our status assessment included evaluating change in geographic distribution and measuring introgression and hybridization with Channel catfish (*Ictalurus punctatus*) to inform conservation prioritization. We used machine learning methods (random forest and boosted regression tree) to construct species distribution models based on historical and contemporary presence-absence data using 13 environmental predictors based on remotely sensed stream network data. We measured introgression and hybridization with the widely introduced Channel Catfish using external morphology and molecular markers. The sub-basin (8-digit hydrologic unit code) from which collections were made was the most important predictor variable across all models. Species distribution models illustrated temporal shifts in Headwater Catfish occurrence. Historically, Headwater Catfish occurrence was higher among streams with higher slopes, greater distances from spring outflows, broader ranges of annual precipitation, and with higher portions of the network catchment classified as water. These shifts are likely related to both range contraction of the species and temporal variation in sampling

locations. Morphological and molecular data revealed four genetically pure and isolated locations where conservation of Headwater Catfish phenotypes and genotypes are likely to be most successful. Species distribution models provide critical assessments of where a species might persist, but they require careful validation and cannot account for genetic introgression. Pairing targeted sampling efforts with locations highlighted by SDMs can be used to promote systematic conservation planning for rare and threatened species.

06

The value of citizen scientists: data collection for juvenile American Eel using non-traditional field gear

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Keyword: American Eel, citizen science, eel mop

American Eel *Anguilla rostrata* is a facultative catadromous species with a unique and complex life history. After hatching, larval eel begin their journey as leptocephalus in the Sargasso Sea and drift on ocean currents along the Atlantic coast, Gulf of Mexico, and Central and South America. They transform into glass eel as they approach shore and begin to develop pigment as they settle in estuaries or move upstream into rivers as elvers. American Eel then spend 3-40+ years in these habitats as yellow eel until they sexually mature into silver eel and return to the Sargasso Sea where they spawn and presumably die. State and federal agencies, multiple universities and numerous citizen science volunteers are working to better understand their movement patterns and recruitment window in Texas. Citizen scientists with coastal chapters of the Texas Master Naturalists (TMN) have taken a lead role in assisting with this effort. Since February of 2018, TMN have established a network of monitoring sites across the mid to upper Texas Coast to sample for juvenile American Eel using eel mops. Eel mops have been deployed for various lengths of time at 29 sites throughout the past two years and checked routinely for glass and elver eel. Volunteers have conducted approximately 250 eel mop checks and provided record of their catch by category (e.g., eel, shrimp, crab, other fish, etc.) based on occurrence or abundance. TMN have documented close to 7,000 individuals across all categories with various species of crab, shrimp, and fish being the most common groups collected. While no glass or elver eel have been collected in an eel mop, TMN have provide valuable data for this project by testing a common gear type that is often used to monitor for American Eel on the Atlantic Coast.

07

Molecular phylogenetics of the North American chubsuckers (Catostomidae: *Erimyzon*) based on mitochondrial and nuclear loci

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Keywords: Chubsuckers, phylogenetic studies

The North American sucker genus *Erimyzon* currently comprises four valid species: *E. oblongus* (Eastern Creek Chubsucker), *E. claviformis* (Western Creek Chubsucker), *E. sucetta* (Lake Chubsucker), and *E. tenuis* (Sharpfin Chubsucker). Though several previous phylogenetic studies of suckers (Catostomidae) have focused on resolving relationships of higher taxonomic groups (e.g., subfamilies, tribes, and genera), little effort has been directed towards inferring species level relationships within these higher groups. For example, the intrarelationships between the four species of *Erimyzon* have been poorly explored to date. While *Erimyzon* is consistently recovered as monophyletic, a recent study recovered individuals of *E. oblongus* as members of two separate clades and not as each other's closest relatives. This could be due to simple misidentification of samples, presence of cryptic species, incomplete lineage sorting, lateral gene transfer or hybridization/introgression. Regardless of the cause, the current classification of *Erimyzon* may not be aligned with the evolutionary history of the group, which may require future taxonomic changes to the classification. In this study, we use mitochondrial and nuclear markers amplified from multiple individuals of each of the four species of *Erimyzon*, across reported ranges (including individuals from TX), to reconstruct phylogenetic relationships and better understand evolutionary relationships within the genus.

08

Hands-off: visual approaches to monitor threatened and endangered pupfish

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Keywords: Comanche Springs Pupfish, Conchos Pupfish, sampling techniques

Species of the family Cyprinodontidae, collectively referred to as pupfish, are some of the most imperiled species on the planet. Nearly 90% of pupfish are listed in some form and many inhabit decreasing geographic ranges. Texas is home to six pupfish species and all but one is listed either federally or by Texas. One of the major hurdles to conservation of this family is the lack of consistent monitoring. Our research focused on population status of two endemic species, Comanche Springs Pupfish (CSP) *Cyprinodon elegans* and Conchos Pupfish (CP) *Cyprinodon eximius*. The last remaining stronghold of CSP is located in Balmorhea State Park (BSP). We collected or observed 3,537 CSP across spring and fall of 2019. Results from multiple gear types across BSP suggest CSP population is strongest in habitats designed to mimic natural ciénegas and abundance is dependent on cyclical fluctuations of temperature and *Chara* spp. Our other target species (CP) is believed to have a broader distribution and required a sampling protocol that could be replicated quickly across a broad spatial scale. Repeated line transect samples were conducted in fall of 2019 and the population estimate (95% confidence interval) was 1,677 (1,250-2,249) within the sampled areas using program Distance. Results indicate that CP abundance is associated with low water velocity and greater flocculent in shallow habitat. Monitoring both species to meet conservation and preservation goals required distinct sampling methodologies that account for behavioral and habitat differences. Within BSP there were differences in capture efficiency between minnow traps and visual counts that could be attributed to behavior. However, minnow traps and in-water visual counts are not possible in the majority of shallow habitat occupied by CP. Identifying effective and repeatable sampling techniques is critical to species conservation and we present potential monitoring solutions for two imperiled Texas pupfish.

09

Does urbanization affect life history parameters of the Western Mosquito fish (*Gambusia affinis*)?

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Keywords: Western Mosquitofish, life history strategies

The Western Mosquitofish (*Gambusia affinis*) is a widespread species that has been frequently introduced in freshwater habitats around the globe. This species exhibits pronounced sexual size dimorphism, with females being larger than males in adult stages and an opportunistic life history strategy (LHS: fast growing, early maturity, high reproductive effort, short life span, and without maternal investment). These LHSs allow *G. affinis* to succeed in a variety of aquatic habitats including urban streams. Here, we examined morphological traits and reproduction of two populations of *G. affinis* inhabiting a rural and an urban stream in Texas. Given the affinity of *G. affinis* for unstable environments, we expected to observe high reproductive effort (i.e., higher fecundity) in the urban stream population, but consistent morphology between the rural and urban streams. *Gambusia affinis* was common in both streams, with a higher relative abundance in the urban stream. The rural stream population had larger individuals with more slender bodies when compared to the population at the urban stream, but this relationship was not statistically significant. In both populations, females were more abundant and larger than males. The urban stream population had a higher fecundity than the rural stream population, but this relationship was not statistically significant. Water properties differed between streams, and concentrations of pollutants in urban streams might be affecting morphological, physiological and reproductive traits of this tough fish. Our future research will focus on examining organismal stoichiometry in this fish populations to better understand the nutritional balance of these populations.

10

Assessing fish assemblage structure in Lake Conroe using rarefaction and electrofishing

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Keywords: electrofishing, Lake Conroe

Electrofishing is one of the most effective and widely used sampling techniques in freshwater fisheries. Researchers utilize this method for its high capture rate and the limited long-term effects on captured specimens. The goal of this study was to determine the most efficient length of shocking interval to accurately represent the fish assemblages occupying differing habitats in Lake Conroe. The location of this experiment was Lake Conroe, a 20,118-acre reservoir on the West Fork of the San Jacinto River, Texas. It was built for municipal and industrial purposes but is a popular sportfishing location. The Texas Parks and Wildlife Department lists a total of twenty-five species found in the reservoir, meaning fish assemblage diversity is high. Our experiment was conducted in two habitats, one referred to as sunken timber and the other as riprap. The Experiment was conducted at dusk to maximize species found in the shallows along the littoral zone, the ideal electrofishing region in reservoirs. We found a larger number of sportfish species and greater variety of size classes in the riprap habitat, but a larger number of prey species of smaller size in the sunken timber habitat. Rarefaction curves suggest a shocking interval of 5 minutes is sufficient to document local fish assemblage structure in the habitats sampled. The results of this experiment allow professionals to use the most effective electrofishing methods to collect fish assemblage in larger waterbodies. This is critical to minimizing the time spent on the water while maximizing species captured, saving researchers both time and energy, yielding more accurate data, and reducing captured fish mortality rates.

11

Autonomous imaging and identification of invertebrates and fish to support biological monitoring

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Keywords: Artificial Intelligence, biological monitoring

Biological monitoring (BM) of aquatic organisms, such as invertebrates and larval fish, is important for understanding aquatic biodiversity, while also studying changes in biological communities associated with environmental change and degradation. However, BM programs are typically labor-intensive, expensive, and require manual field collection and manual identification of organisms by trained faunal experts. Artificial Intelligence (AI) provides promising capabilities in achieving autonomous and adaptive BM programs. New imaging capabilities and machine learning (ML) algorithms can decrease the burden of manual field and laboratory operations, while also providing the eventual prospect of remote monitoring and automated classification of organisms yielding real-time insights and forecasts of changing environmental conditions. Not only does AI serve to transform BM, but also provides a novel mechanism to capture global biodiversity by utilizing new sources of information in ecological informatics. Here we describe recent research and technologies we've been testing for autonomous monitoring of aquatic benthic invertebrates and larval fish.

12

Abundance and movement of Black Bass in headwater streams of the Edwards Plateau, Texas

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Keywords: Guadalupe Bass, Largemouth Bass

To inform statewide management of Guadalupe Bass, the state fish of Texas, a mark/recapture effort was initiated in fall 2015 on the Upper Guadalupe River. Tagging efforts were expanded to include Largemouth Bass in addition to Guadalupe Bass, thus encompassing both native species of black basses in the system. Objectives of

the study included estimating *Micropterus* abundance and density as well as assessing the effects of instream barriers on *Micropterus* movement. Through 2018, more than 3,000 Guadalupe Bass and 3,400 Largemouth Bass were tagged with over 850 combined recaptures. Densities of Guadalupe Bass (≥100 mm) ranged from 52 to 127 fish per river km among the four major stream segments. In contrast Largemouth Bass (≥100 mm) densities ranged from 99 to 202 fish per river km. Analyses of movement data from recaptured fish indicated limited movement of either species. The Texas Parks and Wildlife Department will use the results of this study to inform management of Guadalupe Bass in Texas which has focused on genetic restoration of populations in response to widespread hybridization/introgression with introduced Smallmouth Bass. Greater understanding of native bass densities in these stream habitats, combined with the apparent limited movement, will allow more efficient stocking strategies.

13

Distribution, abundance, diet and sex ratios of Common Snook (*Centropomus undecimalis*) in Texas

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Keywords: Common Snook

Common Snook (*Centropomus undecimalis*) distribution and patterns of abundance were examined from eight estuaries along the Texas coast during a 35-year period. Long-term monitoring data from bag seine and gillnet samples were used to describe juvenile and adult population trends respectively. Sex and diet data were also recorded from Snook caught in gillnets in the Lower Laguna Madre from 2006-2018. Adult Snook (n = 902) were found throughout the Texas coast with the majority coming from the Lower Laguna Madre. Juvenile Snook (n = 55) were encountered infrequently but were found as far north as Matagorda Bay. Both adult and juvenile populations exhibited recent increases with a coastwide surge in abundance in 2017. Juvenile Snook were mainly captured from Oct. – Dec. with an average total length of 84.2 mm and a likely hatch date between July - Sep. Length distribution, sex ratios and diet were also analyzed to further describe adult populations. Snook populations once supported both commercial and recreational fisheries in Texas, but numbers have failed to rebound since targeted fisheries have ended. These data suggest that the Texas Snook population may be rebounding after a long period of low abundance. Since Snook are intolerant of cold temperatures and are at the Northern extent of their range in Texas, increases in abundance could be due to stable or warming climatic conditions in recent years.

14

A student's perspective on fisheries management

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Keywords: electrofishing, fisheries management

Applied research experiences for students enrich educational programs and promote more competitive graduates ready to take-on career challenges. With these benefits in mind, the Texas A&M University Student Subunit of the Texas Chapter American Fisheries Society conducted a fishery assessment of two small impoundments to develop a management report. The George Ross Lakes are two impoundments on Spicer Creek in Bastrop County, Texas managed by the Circle D Civic Association Board. On April 5-6, 2019, we sampled the fisheries in Upper George Ross Lake (UGRL) and Lower George Ross Lake (LGRL) using boat electrofishing. All fishes collected were identified, measured, weighed, and returned to the water. From these measurements, we developed catch per unit effort (CPUE; fish per hour), length-frequency histograms, length-weight relationships, relative weight (Wr) estimates, and proportional size distribution (PSD) statistics. Dominant species based on CPUE were Bluegill (128.2 UGRL; 187.1 LGRL), Largemouth Bass (70.6 UGRL; 132.3 LGRL), and Redear Sunfish (45.9 UGRL; 64.5 LGRL). Length-frequency plots illustrated a greater number of large Bluegill in LGRL, a greater number of large Largemouth Bass in UGRL, and wide ranges of Redear Sunfish sizes in both lakes. Length-weight regressions indicated Largemouth Bass were more robust in UGRL relative to LGRL. Fishery classifications based on Largemouth Bass relative weights revealed both lakes were on the border of balanced (Wr = 95-105) and panfish (Wr = 85-95) fisheries. Bluegill PSD was higher in LGRL (21.6%) compared with UGRL (4.3%), while

Largemouth Bass PSD was higher in UGRL (88.4%) compared with LGRL (32.6%). We used these fishery metrics to provide potential management actions stakeholders at Circle D Civic Association Board might consider in the future.

15

Inquiry-based education which includes biotic immersion better enhances river conservation ethic

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Keywords: inquiry-based learning, biotic immersion

The San Gabriel River is a cool, high-gradient stream residing in the mountains above Los Angeles. The river supports endemic plants and animals, including the endangered Santa Ana Sucker and Arroyo Toad. Despite the biological importance of the area, the river is highly impacted from recreational use. The area represents 70% of open space available to Angelinos and receives over 7 million visitors per year. Abundant trash, low-head recreational dams, roads, and erosion from vehicles reduce habitat integrity in the area. Education and outreach provide an opportunity to engage the local community in river conservation, but opportunities like these are few. To resolve this, Biocitizen School for Field Environmental Philosophy has opened the Living Rivers School. This program establishes in-situ inquiry-based learning and motivates students to apply learning through acts of stewardship. Students make connections between prior knowledge and scientific understandings of the natural world. The mixed-age classroom utilizes role-play education and panel-based teaching to encourage students to teach others in the most effective way. Deep biotic immersion allows for discovery-based learning through learner-centered instruction. Interdisciplinary curriculums strengthen students' sense of problem-solving, empathy, negotiation, and material-retention. The goal is to provide higher-order cogitative skill development through wonder, connection, and stewardship. By doing so, students are encouraged to involve their families into this space. Students leave the class excited about their biospheres and inspired to engage the opposition in passion-based change. Living Rivers School is open to all school-age students but focuses on developing programming for schools in LAUSD with predominately TANF-eligible (free and reduced lunch) students. Working with public school educators can create curricula which will outlive the small NGO-school. By doing so, the school hopes to shift the paradigm of river conservation in Los Angeles towards a self-sustaining system inspired by pride.

16

A riverscape divided: longitudinal change in fish community structure in White Creek, College Station, Texas

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Keywords: habitat fragmentation, riverscape ecology

Principles of landscape ecology such as scaling, habitat connectivity, and pattern-process relationships can be immersed in water, specifically rivers and streams, to form 'riverscape' ecology. In streams, habitats are arranged as linear and dendritic networks in which individual dispersal, meta-population dynamics, and meta-community processes are constrained. This means habitat fragmentation and loss caused by alterations to streams can result in strong changes to ecological properties such as species distributions and community structures. We studied stream fish communities in White Creek, College Station, Texas to assess spatial change-over in fish communities in a small stream interrupted by serial fragmentation by road crossings. We seined >50 habitats and tracked the geographic location and fish species encountered. Local community structure was dominated by Western Mosquitofish (*Gambusia affinis*) and Green Sunfish (*Lepomis cyanellus*) upstream, but community complexity increased downstream. Our results suggest fish communities are regulated by fragmentation through road crossings. Overall, clustering algorithms revealed spatial scales associated with longitudinal community change, breaks in communities at barriers illustrated habitat fragmentation, and habitat-community gradients illustrated relationships between geomorphic processes and the ecology of fishes. Our application of landscape principles in White Creek emphasizes the utility of riverscape ecology in freshwater resource conservation and management.

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The complex nature of conservation in urbanized streams: A case study in La Nana Bayou, East Texas

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Keywords: urbanization, land use

Urbanization alters surrounding landscapes, flow regimes, and increases pollutants in streams, consequently affecting stream habitats and fish diversity residing in these ecosystems. La Nana Bayou is tributary of Angelina River in East Texas, highly impacted by anthropogenic land use and introductions of nonnative species. Nevertheless, a diverse native and endemic freshwater fish species assemblage remains in this watershed. Historical records and contemporary data (1950-2019) were used to determine the distribution and status of stream fishes in La Nana watershed. Fishes were classified into habitat guilds, physiological tolerances and feeding guilds to identify drivers of species persistence. Increased urbanization and deforestation within the La Nana Watershed have reduced relative species abundance and species richness of flow-habitat dependent cyprinid species (e.g., *Notropis sabinae, N. texanus, N. atherinoides*, *Erimyzon claviformes*). The cyprinid *N. sabinae* which is considered a SGCN was not reported in contemporary surveys. Native fish species (e.g., *N. atrocaudalis*, *Cyprinella lutrensis*, *Pimephales vigilax*, *Lepomis megalotis*) still persist, native invaders (e.g., *Lepomis auritus*) and non-native (e.g., *Gambusia affinis*, *Oreochromis aureus*) species have become abundant. Invertivore and omnivore trophic guilds have become more abundant as well. The nonnative species, blue tilapia (*O. aureus*) overlaps in functional trait space and trophic guild with native sunfishes and may be a potential novel competitor for these native species. Persistence of native species in this urbanized stream can result from different factors such as the existence of undeveloped landscapes in headwaters of this stream, the wide physiological tolerance of native species, and the existence of small reservoirs that may function as habitat for several native species. Our results suggest that despite of losing important endemic species, streams in complex urban setting can retain important conservation benefits to native stream fishes in the face of perturbations and the establishment of non-native species.

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Water quality assessment of the Upper Neches River watershed

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Keywords: water quality, TMDL, *E. coli.*

Several waterways have been flagged in East Texas as being bacterially impaired, including portions of the upper Neches River. Water quality is important to support healthy aquatic ecosystems as well as the well-being of inhabitants near or downstream of the body of water. Many factors can contribute to the water quality of rivers, such as agriculture, recreational use, as well as urban and industrial growth. This study looks at the water quality of specific branches in the Upper Neches River including the Neches River above Lake Palestine and Black Fork Creek. All sample sites were visited during the months of April, May, June and July 2019. Water quality assessments were performed including tests of bacterial impairment, dissolved oxygen, as well as various other water chemistry parameters. Fish and macroinvertebrate assays were also completed. Fish assays included anesthetizing and fixing with formalin. Any deformed or compromised fish were also fixed and brought back to the UT-Tyler campus. The data will be used to calculate water quality indices (IBI, B-IBI). Asian Clams, *Corbicula fluminea*, collected during the macroinvertebrate assays will be used to obtain *Escherichia coli*. The *E. coli* will be sequenced and analyzed to obtain strain variation. These data may be combined with hydrological and stream habitat information to perform a TMDL analysis of the Upper Neches River watershed.

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Development of environmentally friendly methods to control harmful blooms of golden alga

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Keywords: golden algae, giant reed

Golden alga (*Prymnesium parvum*) is a euryhaline haptophyte that produces compounds highly toxic to fishes and other gill-breathing aquatic organisms. In North America, harmful blooms of this species were first reported in 1985 in the Pecos River. Tens of millions of fishes have been lost due to these blooms in Texas alone. Effective methods to control golden alga in the field are presently unavailable. Recent studies by our laboratory, however, have shown that preparations made from giant reed (*Arundo donax*), itself a harmful invasive plant in the USA, strongly inhibit golden alga growth. The objective of this study is to screen known constituents of giant reed for their ability to influence golden alga growth in batch cultures. Five natural compounds and one synthetic derivative were tested. All but one of the compounds inhibited growth of golden alga. The most potent of the natural compounds was ellipticine, which exhibited growth-inhibitory and algicidal activities at concentrations much lower than dichlorogramine, a synthetic derivative of gramine specifically designed to enhance potency. Oleamide was the only test chemical that did not have allelopathic activity; on the contrary, this compound stimulated growth. These observations confirm the existence of anti-golden alga allelochemicals in giant reed and suggest there is potential for using this invasive plant as a source of natural, environmentally friendly products for bloom control.

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Morphological variation and distribution of *Cyprinodon variegatus* and *C. rubrofluviatilis* in Brazos River, Texas

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Keywords: Sheepshead minnow, pupfish

Historically, the Brazos River had one native pupfish, *Cyprinodon rubrofluviatilis* (Red River Pupfish). However, *Cyprinodon variegatus* (Sheepshead Minnow) has recently been introduced into the Brazos River. *Cyprinodon variegatus* occupies niche space that is very similar to other *Cyprinodon* species. Because of their potential niche overlap, the introduction of *C. variegatus* may pose a conservation threat to *C. rubrofluviatilis*. In this study, we described the current distribution of *C. rubrofluviatilis* and range of expansion of *C. variegatus* in the Brazos River. We have reviewed published literature and fish collections made in the middle-upper Brazos River between 2007 and 2017, and quantified species abundance and morphological traits of both *Cyprinodon* species. Out of 17 sites surveyed, three sites contained both species of *Cyprinodon*, with *C. variegatus* being more abundant than *C. rubrofuvialtilis*. Both species also overlapped in functional morphological space, although *C. rubrofluviatilis* was slightly longer than its native congener. Such morphological overlap can result in greater niche similarity consequently leading to utilization of similar resources. Introduction of *C. variegatus* in other freshwater systems in Texas has resulted in ecological and genetic changes to native *Cyprinodon* species. Yet, ecological interactions between *C. rubrofluviatilis* and *C. variegatus* have not been studied in the Brazos River. Our future studies based on feeding ecology will help elucidate potential ecological effects of *C. variegatus* in Texas inland water ecosystems.

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Growth of the harmful alga, *Prymnesium parvum*, under past, present and projected future atmospheric concentrations of carbon dioxide

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Keyword: golden algae, climate change, carbon dioxide

Prymnesium parvum, also known as golden alga, is an ichthyotoxic microalgal species presumed native to coastal environments that has become established in inland brackish waters of the USA and elsewhere, where it can form fish-killing blooms. Carbon dioxide is the primary source of carbon for photosynthetic fixation by plants and algae. Carbon dioxide is highly soluble in water and changes in its atmospheric concentration can lead to

corresponding changes in dissolved CO_2 of natural waters. This has led to concerns over the potential effects on growth of harmful algae by the increasing concentration of atmospheric CO_2 associated with climate change. Current knowledge suggests that these effects are species-specific, but no information is available for golden alga. This study compared the effects on golden alga growth by different concentrations of ambient CO_2 from 280 (pre-industrial era), 400 (current) to 670 ppm (projected scenario by 2100). Batch cultures were conducted in two different media, Artificial Seawater Medium (ASM) at salinity of 5 and Instant Ocean® (IO) at salinity of 30. Treatments were done in triplicate and experiments were conducted twice. Early (pre-exponential) growth was not affected by ambient CO_2 levels. Exponential growth rates were positively stimulated by ambient CO_2 concentration in the higher but not the lower salinity medium. In both media, maximum cell density increased with increasing CO_2 concentration. In conclusion, increasing concentrations of ambient CO2 generally stimulated golden alga growth, especially at high salinity. Our results contribute to a better understanding of how climate change may have influenced the growth and spread of golden alga blooms over time and how it may continue to do so in the future.

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Mercury concentrations in Dusky Grouper along the Southern Brazilian coast

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Keywords: mercury, toxicology

Mercury is a non-essential element that enters the environment from a variety of sources including coal combustion and artisanal gold mining. In aquatic systems, mercury is transformed by bacteria into toxic methylmercury which biomagnifies in food webs. Through biomagnification, methylmercury can reach concentrations that are toxic to both fish and humans. Dusky Grouper (*Epinephelus marginatus*) are important in both commercial and recreational fisheries along the coast of Brazil and are an important cultural icon. The species is currently listed as vulnerable by the IUCN. Dusky Grouper inhabit shallow tide pools as juveniles, and deeper areas of the ocean as an adult. They feed mainly on crabs, lobsters, octopi, and other bottom-dwelling species. The objective of this study was to analyze mercury concentrations in three different tissues, muscle (n=147), liver (n=36), and eggs (n=102), of Dusky Grouper harvested from the coast of Brazil. Mercury concentrations in the tissue samples were determined using a Milestone DMA-80 Direct Hg Analyzer. Tissue concentrations of total mercury were (mean ± 1 SD) 1.74±1.17 mg/kg dw, 12.02±12.81 mg/kg dw, and 0.67±0.78 mg/kg dw for the muscle, liver, and eggs, respectively. There was a correlation between grouper length and mercury concentration. Muscle samples from three individuals had mercury levels higher than the FDA action level of 5 mg/kg dw suggesting a risk to human health. 97 individuals had muscle concentrations higher than those known to cause effects on fish health (1 mg/kg). These data have implications for both ecological and human health in Brazil.

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Elucidating variation in migration strategies of catadromous fish (*Anguilla rostrata*) utilizing natural tracers

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Keywords: American Eel, stable isotopes

The American Eel (*Anguilla rostrata*) is an economically important species that has one of the largest ranges in North America. Unfortunately, the breadth of knowledge regarding the species does not match its range. Little is known about the population in the Gulf of Mexico, compared to the Atlantic population. The species was once believed to display an obligate growth and migration strategy in which it was thought to have spent the entirety of its juvenile phase in freshwater rivers and lakes. However, eels in the Atlantic populations have shown significant variability in the timing, duration, and frequency of trans-haline movements. Flexibility in freshwater habitat requirements could impact sustainable management strategies, particularly in the face of drought and water extraction. In this project I will use otolith microchemistry, with a focus on Ba:Ca ratios, to elucidate habitat variability of American Eel found in Texas. I will also incorporate stable isotope analysis for δ15N and δ13C in

concert with otolith laser ablation to not only give insight of habitat preference but also trophic interactions. These data should provide valuable insight into growth, movement, and food web dynamics of these migratory fish.

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Fish assemblage structure in leaflitter patches of the Jacunda River, Lower Amazon
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Keywords: leaf litter, spatially constrained rarefaction
Littoral zones containing abundant leaf litter patches provide complexity to freshwater ecosystems by creating different microhabitats for fish and other aquatic organisms. This study aimed to examine fish assemblages in littoral leaf litter patches of a black water river in the Lower Amazon, the Jacunda River (Pará State). We sampled 20 sites along this river over a seven-day period in August 2019. At each site, 13 environmental variables were collected in a standardized manner in combination with a standardized fish collection protocol designed to target ecologically cryptic species. Environmental variables measured included: temperature, pH, DO, conductivity, total suspended solids, canopy cover, depth, and substrate type (which included leaf litter, detritus, open water, submerged vegetation, emergent vegetation). We applied recently developed models for spatially constrained rarefaction (SCR) to fish diversity data from the Rio Jacunda to test for the effect of space on estimates of total diversity. Results suggest diversity estimates are influenced by spatial autocorrelation in that total diversity estimates are lower when we account for spatial arrangement of sampling sites. The SCR methodology can be applied by fisheries ecologist and managers to avoid potential overestimation of diversity regardless of ecosystem type or spatial arrangement of sampling sites.

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Ecological analyses of macroinvertebrates and fish species in six streams on a Louisiana military base from 2001 to 2019

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Keywords: fish diversity, Fort Polk

An in-depth ecological analysis of how and why the aquatic community changes over time was conducted for 6 streams on the Fort Polk military base in Louisiana using data collected from 2001 to 2019. Fort Polk is a unique location as nineteen first-order streams are located on the premises belonging to three separate drainages. The primary goal was to determine whether temporal or between-drainage variation has a larger effect on community assemblages. To accomplish this the effects of disturbance on fish and macroinvertebrate assemblages was determined between drainages and temporally. A few hypotheses were drawn from this: 1) temporally, assemblages will exhibit fluctuations in diversity around the disturbance events, but will eventually recover to a base-state; 2) fish assemblages will vary between drainages more so than macroinvertebrate assemblages; 3) the localized clear-cut along the Red River tributaries will cause a reduction in both fish and macroinvertebrate assemblages in comparison to the other drainages. A secondary goal was to determine the overall assemblage diversity of the drainages. To accomplish this the species richness, presence of habitat indicator species, and any species associations along with why those linkages may be present were determined. Disturbances and equilibrium were examined using multivariate analyses. Habitat indicators were determined using the indicator species analysis, incorporating fish, macroinvertebrate, and habitat (watershed, hydrology, etc.) data. Lastly, associations between species were found using the analysis of similarity (ANOSIM) and similarity percentages (SIMPER). These ecological analyses served to acquire a more comprehensive picture of the drainage ecosystems in the region.

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Fishes of Texas Project: Sampling Completeness and Data Visualization

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Keywords: Fishes of Texas Project

The Fishes of Texas Project (http://fishesoftexas.org) database currently has 124,452 specimen-vouchered occurrence records spanning > 150 years, and over 400,000 new records (including from non-vouchered sources such as literature, anecdotal, and photo-based), are in the process of being imported. Continual data growth prompted creation of new tools to dynamically assess (as the data evolve) the state of data coverage across various dimensions to help increase user understanding and accessibility to the data and improve overall utility of the project for researchers and managers. We thus produced heat maps of collecting event density over time and space, species sampling curves, and temporal species accumulation graphs for each major river sub-basin (HUC8s in National Hydrography Dataset +v2) within Texas. Each type of visualization has basic documentation, easily accessible statistical summaries, and flexible queries and exploration tools to help reveal variations in sampling density over both temporal and spatial dimensions We highlight here examples of notably under-sampled sub-basins (as indicated by diverse forms of evidence), such as the Little and San Bernard Rivers, and White Oak Bayou. With addition of future records, these dynamic tools will continue to illustrate taxonomic and spatial sampling deficiencies and thus help guide conservation planning.

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Temporal dynamics of aquatic habitat structure, water chemistry and biodiversity in ephemeral and intermittent habitats on a sustainable land management ranch in North Texas

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Keywords: ephemeral, intermittent

Temporary waterbodies play important roles in ecosystem functioning and supporting biodiversity in arid regions. Phenology of episodic rainfall and seasonal drying are primary drivers structuring aquatic communities in ephemeral and intermittent habitats via rapid changes in aquatic habitat availability, connectivity and quality. This ongoing project quantifies temporal dynamics of distribution, structure, water chemistry and biodiversity of ephemeral and intermittent aquatic habitats at sites on and adjacent to a North Texas ranch managed using sustainable land management practices. The Dixon Water Foundation's Leo Unit ranch is managed with high-rotation grazing, which enhances terrestrial diversity, ecosystem functioning and resilience. Our research provides a baseline to assess whether similar benefits are experienced by aquatic systems and biodiversity. Preliminary results are based on 12 sampling events across 22 total sites. Temporal dynamics in extent of ephemeral habitats was assessed using aerial images from a drone and HOBO data loggers measured water depth of intermittent habitats over time. Water chemistry (e.g. DO, conductivity, pH, total dissolved nitrogen and phosphorus) and macroinvertebrate family richness and abundances were measured at all sites during each sampling event, and habitat characteristics and fish species richness and abundances were quantified at intermittent sites only. Ephemeral sites reduced extent and variously dried from mid-June through July whereas intermittent sites retained at least some available aquatic habitat as isolated pools throughout the study period. Total dissolved N and P ranged from below detection to 12.6 and 3.5 µg/L, respectively, and varied within and among sites over time. DO decreased dramatically through time (8.5 mg/L to <0.5 mg/L), especially following formation of isolated pools in intermittent sites. Approximately 40 macroinvertebrate families were recorded, with late summer assemblages dominated by Chironomids. Fish species richness increased during onset of drought as species were restricted to refugia, but richness declined over time as few species persisted.

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Flow-recruitment relationships of Smallmouth Buffalo in the Colorado, Brazos and Guadalupe rivers

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Keywords: periodic life history, flow regime

Stream flow alteration through water withdrawal and the construction of impoundments and levees is a global issue implicated in declining populations of native species with flow-dependent life histories. Flow alteration often reduces variability present in the natural flow regime primarily by reducing the magnitude of high flow pulses and overbank floods. Fish species with periodic life-history strategies are often adapted to capitalize on the flood pulse, using the floodplain as foraging and spawning habitat during overbank floods. Recruitment is expected to be high in years with suitable conditions, forming strong age classes, whereas recruitment is weak or absent in years lacking flow conditions needed for spawning and larval development. Consequently, life history theory predicts that reductions in the frequency and magnitude of flood pulses negatively affects population size and age structure of periodic species. We test this theory by quantifying relationships between population age structure and flows for Smallmouth Buffalo (Ictiobus bubalus), a periodic life-history strategist native to the Mississippi and other Gulf slope basins. We sampled Smallmouth Buffalo populations at multiple locations along the Colorado, Brazos and Guadalupe rivers in Central Texas via boat electrofishing. Otoliths were removed in the field and aged in the lab using standard methods. Multiple components of the flow regime were quantified using USGS streamflow data for each basin and indices from the Indicators of Hydrologic Alteration. Retrospective flow analyses were based on recruitment index values calculated as observed versus expected age structure controlling for mortality over time. Models were fit using flow indices related to timing, magnitude and duration of high flow pulses and recruitment index values separately for each basin. Herein we present preliminary results based on 114 individuals ranging to over 50 years old which support the predicted relationship between high flow pulses and recruitment for this species.

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Gut morphology and digestive enzyme activities in North Texas stream fishes

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Keywords: ecomorphology, amylase, trypsin

Fish species native to drought-prone regions are adapted for population persistence during drought or rapid recolonization after cessation of drought and return of flowing conditions. However, anthropogenic stressors such as increased demand for freshwater and global climate change will likely lead to species experiencing environmental conditions at the extremes of their tolerances. Mechanistic understanding of species responses to drought conditions and predictive modeling of species responses to future drought scenarios can be aided by approaches that quantify trait-environment relationships. Historically, traits-based approaches related to trophic ecology in fishes have been dominated by analyses of external and internal morphology (ecomorphology) and guild classifications. Those approaches, to various degrees, preclude analyses of variability in performance among individuals and in relation to changing environmental conditions. Such variability is likely important for population persistence in changing environments at or near their tolerance extremes. In this study, we quantified gut length and performed activity assays for amylase and trypsin (enzymes responsible for breakdown of carbohydrates and proteins, respectively) for eight fish species that are common in intermittent streams in North Texas. Enzyme activity assays were performed with lab-acclimated individuals to test for inherent differences among species (i.e. controlling for environmental conditions and diet) as well as wild-caught individuals to quantify within and among species differences that reflect diet type and breadth in a variable environment. Preliminary results suggest that species with longer relative gut lengths corresponded with higher amylase and lower trypsin activities, reflecting adaptation for a relatively more herbivorous/detritivorous diet. Concomitantly, shorter relative gut lengths correspond with higher trypsin activities reflecting adaptation for a more carnivorous diet. Closely related species had more similar enzyme activities than distantly related species, reflecting phylogenetic conservatism of digestive enzyme activities. Intraspecific variation in enzyme activity levels was greater for wild-caught fishes, reflecting individual variation in recent diet.

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Gill surface area and metabolic enzyme activity of North Texas stream fishes

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Keywords: gill surface area, citrate synthase, heart mass

Fish species native to drought-prone regions are adapted for population persistence during drought or rapid recolonization after cessation of drought and return of flowing conditions. However, anthropogenic stressors such as increased demand for freshwater and global climate change will likely lead to species experiencing environmental conditions at the extremes of their tolerances. Mechanistic understanding of species responses to drought conditions and predictive modeling of species responses to future drought scenarios can be aided by approaches that quantify trait-environment relationships. Traits associated with hypoxia tolerance are not often quantified, and thus not frequently used in trait-based approaches, even though hypoxia is a common abiotic stressor influencing species distributions and activity levels during drought conditions. In this study, we quantified morphological and physiological traits associated with dissolved oxygen acquisition, transport and metabolic scope for 10 fish species common in intermittent streams in North Texas. These traits are directly related to species' abilities to cope with hypoxia during drought conditions. For replicate individuals of each species, primary lamellae were counted for the first left gill arch, and the length of every tenth as well as the first and last primary lamellae were measured. The number and area of secondary lamellae were also recorded for every primary lamella measured. Heart mass was measured, and heart tissue was used to assess activity of citrate synthase, a metabolic enzyme. Preliminary results for the species studied indicate that relative gill surface area, heart mass and citrate synthase activity are all positively correlated. In general, pelagic fishes generally characterized by more active habits had higher gill surface areas, heart masses and citrate synthase activities compared to fishes with more benthic, sedentary habits. These data will be combined with results from respirometry experiments to further elucidate species' abilities to withstand hypoxia and for modeling species responses to drought.

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Development of the trophic apparatus in three species of South American Armored Suckermouth Catfishes (Family Loricariidae)

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Keywords: armored catfish, trophic apparatus

Suckermouth armored catfishes (Family Loricariidae) are native to South America and Panama and are popular in the aquarium trade. Members of this family have been introduced outside of their native range via the aquarium trade and have become established as invasive species in many areas of the United States (including Texas) and other countries. These catfishes are surrounded by well-developed plates of armor, which make them difficult prey for predators to consume. They also mature quickly and have a reproductive life cycle involving male parental care of eggs and early larval stages. This combination of characters may enable these species to quickly establish populations in waterbodies outside of the native range. In order to manage the invasion of suckermouth catfishes (also commonly called plecos) we need to learn as much as we can about the biology of these species, including basic aspects of anatomy, development, life history, and ecology. Trophic anatomy can provide clues to the diet of species and changes in trophic anatomy through development often correspond with shifts in diet. The diet of adult plecos has been well-studied in both wild and introduced populations but little is known about the diet of early stages (including larvae and early juvenile stages). This project will investigate the development of the trophic apparatus (including the adhesive disc) in larval and early juvenile stage suckermouth catfishes representing three genera, including two that include invasive species in TX (*Hypostomus* and *Pterygoplichthys*) and one that has the potential to be invasive in TX (*Ancistrus*). We aim to document: (1) the timing of first appearance of major trophic structures (e.g., teeth, lips, adhesive disc) in development; (2) major changes in trophic structures through development (e.g., tooth shape); and (3) when the trophic apparatus becomes functional.

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The lateral-line canal bearing scales of the Ghost Shiner *Notropis buchanani* and three other species of *Notropis* (Teleostei: Cyprinidae)
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Keywords: Ghost Shiner, neuromasts, lateral line scales

The Ghost Shiner *Notropis buchanani* is a small, semi-transparent North American minnow that is native to the Mississippi River basin and the Gulf slope drainages of the US, from the Rio Grande to the Calcasieu River. The scales bearing the lateral-line canal in *N. buchanani* vary in height along the length of the body. The first 9-11 scales are approximately twice as tall as scales located towards the posterior of the body and are often referred to as "elevated". In addition to differences in size, the elevated lateral-line scales also exhibit a greater number of primary and secondary radii than the most posteriorly located scales. One or two vertical rows of superficial neuromasts are located on the surface of each lateral-line canal bearing scale. The number of superficial neuromasts that contribute to these vertical rows varies along the length of the body, ranging from 18-22 on the surface of anterior elevated scales to 2-5 on the surface of scales located towards the posterior of the body. The aforementioned differences in scale size, shape, and microanatomy along the length of the lateral line canal scale row are documented using a combination of light and scanning microscopy techniques. We predict that the elevated anterior lateral-line canal bearing scales of *N. buchanani* that are well provisioned with superficial neuromasts may serve a different function from those located more posteriorly on the body. Finally, we compared the lateral-line canal bearing scales of *N. buchanani* with those of three other species of *Notropis* (*N. sabinae, N. volucellus*, and *N. shumardi*).

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Notes on the life history of the Caribbean Clingfish *Tomicodon reitzae* (Teleostei: Gobiesocidae)
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Keywords: Caribbean Clingfish, stomach contents

Members of the Clingfish genus *Tomicodon* are found in coastal marine areas of the eastern central pacific and western central Atlantic oceans. We do not know much about the members of this genus and few studies have provided details on diet or habitat preference. In this study, we provide a general report on the natural history of *Tomicodon reitzae*, based on specimens recently collected from Salybia Reef, northeastern Trinidad; a location from which this genus has not been recorded previously. 29 individuals were collected over a period of 7 days at extreme or near extreme low tide from isolated shallow pools, often located on flat bedrock shelves. This species is sexually dichromatic (males exhibit thicker, darker vertical bars on the body side) but does not appear to be sexually dimorphic in body size. Stomach content of five individuals comprised remains of intertidal marine invertebrates (mostly isopods, but potentially also malacostracans). One individual also contained larval stages of an unidentified dipteran insect (potentially Coelopidae). Using a combination of light microscopy and scanning electron microscopy, we also provide details on trophic and gut anatomy for *T. reitzae*. Our study is the result of undergraduate research conducted during the Texas A&M Trinidad and Tobago Field and Tropical Biology Education Abroad program.

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Evolution of electroreceptor distribution in weakly electric fishes
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Keywords: electroreceptor pores, electric fish, gymnotiform fish

The design of animal sensory systems involves trade-offs between different selective forces such as optimal foraging, communication with conspecifics, and predator avoidance. This on-going study investigates the distribution of electroreceptor pores along the body of electric fishes. The objective is to determine whether the distribution and density of electroreceptors differs non-randomly among gymnotiform genera and whether these differences are consistent with specific ecological factors such as habitat type and diet. Gymnotiform fishes

display strong evidence of phylogenetic niche conservatism (Crampton 2011; unpublished data) and likely diversified quite rapidly, so it is possible that the distribution of electroreceptor pores remains uniform throughout the phylogeny. However, they occur in a wide variety of aquatic habitat types and have different trophic strategies. For example, though most feed on macroinvertebrates, some feed in fast-flowing rivers while others feed in lentic environments. Therefore, we might expect to see patterns in the distribution of electroreceptor pores that reflect specializations in foraging strategies and diet for each habitat type. Comparative studies in elasmobranchs support this hypothesis (Raschi 1986; Yopak 2007; Kajiura et al. 2010; Kempster et al. 2012). To test this, scanning electron microscopy is used to image the epidermal surface of sister taxa collected from different habitat types. Pores are counted using ImageJ cell counter and an ANOVA is used to compare mean pore counts for different body sections. Diet and habitat data are supplemented with data collected from scientific literature. Fish specimens are acquired from various museum collections.

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Evaluation of palatability enhancers in plant-based diets with juvenile Red Drum (*Sciaenops ocellatus*)
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Keywords: inosine monophosphate, feeding trials, aquaculture

In efforts to find solutions to low palatability of plant-based diets, a comparative feeding trial was conducted under controlled conditions at the Aquaculture Research and Teaching Facility with juvenile red drum. Potential feed attractants including glycine, krill meal, menhaden fish solubles and citric acid were supplemented to the basal diet at 2% by weight while inosine monophosphate (IMP) was added at 0.5% by weight to a basal diet containing 40% crude protein and 10% lipid with 75% of the fishmeal protein replaced by plant feedstuffs. Juvenile red drum were raised in a recirculating aquaculture system in 38-L aquaria, all with brackish water (4 ppt). Red drum were obtained from Texas Parks and Wildlife and conditioned in the experimental system for 1 week. At the beginning of the trial, aquariums were stocked with 10 fish averaging 23.3 g/fish. Diets were fed to the fish in triplicate groups for 6 weeks. The fish were weighed weekly and initially fed 4% of body weight with two feedings per day. Every 2 weeks the feed percentage for all diets was decreased by 1% to minimize overfeeding. Glycine, krill meal, and fish solubles were ineffective compared to IMP and citric acid. Fish fed the diet supplemented with IMP showed much better performance than any of the other treatments as fish in this treatment had significantly ($P<0.05$) higher weight gain and feed efficiency compared to the other treatments. Fish fed the diet supplemented with IMP also had a markedly improved survival (83.3%) compared to those fed a diet with citric acid (63.3%) or basal diet (53.3%). Fish fed the IMP diet showed over three times higher feed efficiency compared to fish fed the other diets. Based on the results which have been collected from this trial, IMP could be an effective feed attractant for Red Drum.

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In vitro and in vivo effects of butyrate, propionate and their combination in high-plant-protein-diets for Red Drum (*Sciaenops ocellatus*)
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The objective of this study was to investigate in vitro and in vivo the supplementation of two organic acids individually as well as in combination in a high-plant-protein diet for Red Drum. A basal diet was formulated with soybean products to provide 75% of the total crude protein and supplemented with either 0 or 0.5 g kg-1 of butyrate, propionate, or their combination. In the in vitro experiment, digesta was aseptically collected from 16 juvenile fish and incubated under anaerobic conditions with an incomplete anaerobic media supplemented with the experimental diets. After 24 h incubation at 27°C, the samples were frozen and further processed for DNA extraction and the microbial communities were compared among treatments by denaturing gradient gel electrophoresis (DGGE). Results from this trial suggested that the supplementation of the organic acids mildly affected the bacterial community, having a 90% similarity with that of the basal diet. A 60-day feeding trial also was conducted to evaluate if the experimental diets would affect production parameters and intestinal microbial community. Digesta contents were collected at day 30 and 60 of feeding to compare the microbial communities

within treatments by DGGE. The supplementation of propionate to the diet slightly but significantly (P=0.02) impaired the growth performance of Red Drum, and feed efficiency was also slightly but significantly (P=0.01) impaired by the addition of butyrate. The DGGE results showed that the gut microbiome was significantly affected by the supplementation of the organic acids individually and by their combination, when compared to fish fed the basal diet at the two different collection points. Supplementing organic acids in high-plant-protein ingredients did not benefit the growth performance of Red Drum.

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