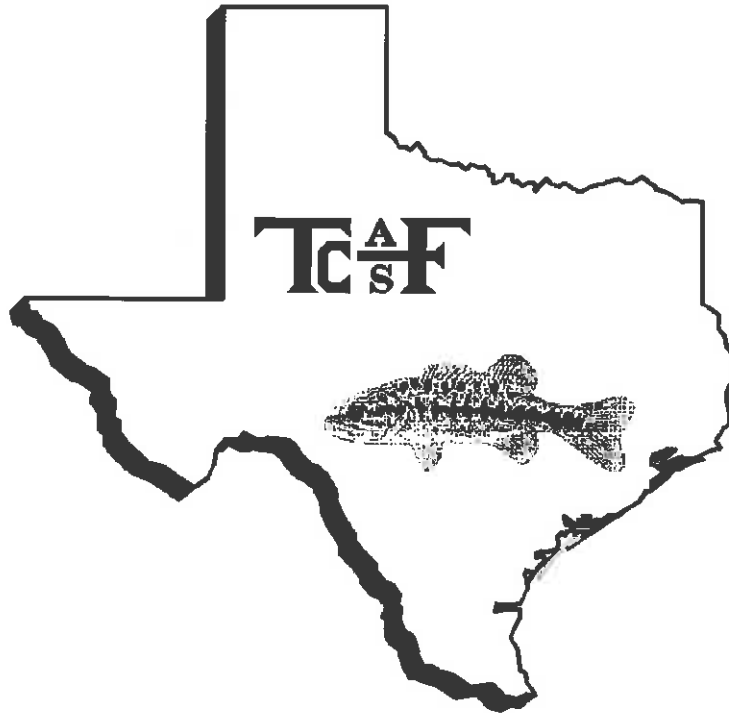


**ANNUAL PROCEEDINGS
of the
TEXAS CHAPTER**

AMERICAN FISHERIES SOCIETY



**Galveston, Texas
9-11 February 2012**

Volume 34

TEXAS CHAPTER

AMERICAN FISHERIES SOCIETY

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

MEMBERSHIP

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

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

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

**ANNUAL PROCEEDINGS OF THE TEXAS CHAPTER
AMERICAN FISHERIES SOCIETY**

Annual Meeting
9-11 February 2012
Galveston, Texas

2012-2013 Officers

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Texas Parks and Wildlife Department

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2012

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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	Lorraine 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

TEXAS CHAPTER AWARDS RECIPIENTS

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

- 1989 Fish Culture - Robert Vega (TPWD)
 Fisheries Management - Joe Kraai (TPWD)
 Fisheries Administration - Gary Matlock (TPWD)
 Fisheries Research - Roy Kleinsasser and Gordon Linam (TPWD)
 Honorable Mention (research) - Bob Edwards (UTPA)
 Best Presentation - Robert Smith (TAMU)
- 1990 Fish Culture - Glen Alexander and David Campbell (TPWD)
 Fisheries Management - Dave Terre (TPWD)
 Fisheries Administration - Gene McCarty (TPWD)
 Best Presentation - Joe Kraai (TPWD)
 Scholarships - Tommy Bates (TAMU:1989), Michael Brice (TTU)
- 1991 Fish Culture - Jake Isaac (TPWD)
 Fisheries Management - Mark Webb (TPWD)
 Fisheries Administration - Pat Hutson (TPWD)
 Fisheries Research - Ronnie Pitman (TPWD)
 Special Recognition - The Wetland Habitat Alliance of Texas
 Best Presentation - Mark Stacell (TPWD)
 Scholarships - Jim Tolan (TAMUCC), Michelle Badough (TXSTATE)
- 1992 Fish Culture - Camilo Chavez (TPWD)
 Fisheries Education - Brian Murphy (TAMU)
 Fisheries Management - Ken Sellers (TPWD)
 Fisheries Research - Bob Colura (TPWD)
 Special Recognition - Bobby Farquhar, Andy Sansom, and Rudy Rosen (TPWD)
 Best Presentation - Maurice Muoneke (TPWD)
- 1993 Fisheries Management - Bruce Hysmith (TPWD)
 Special Recognition - Joe Martin and Steve Gutreuter (TPWD)
 Best Presentation - Jay Rooker (UTMSI)
 Scholarships - Erica Schlickeisen (TXSTATE), Brian Blackwell and Nancy McFarlen (TAMU)
- 1994 Fish Culture - Ted Engelhardt (TPWD)
 Fisheries Management - Steve Magnelia (TPWD)
 Fisheries Administration - Dick Luebke (TPWD)
 Special Recognition - Bob Howells (TPWD)
 Best Presentation - Travis Kelsey (TXSTATE)
 Scholarships - Kathryn Cauble (TXSTATE), Howard Elder and Kim Jefferson (TAMU)
- 1995 Fish Culture - Robert Adami (TPWD)
 Fisheries Education - Bill Neill (TAMU)
 Fisheries Management - Spencer Dumont (TPWD)
 Fisheries Administration - Roger McCabe (TPWD)
 Fisheries Research - Maurice Muoneke (TPWD)
 Special Recognition - Tom Heffernan and Robin Reichers (TPWD) S. Ken Johnson (TAMU)
 Best Presentation (s) - Robert Weller (TTU), Robert D. Doyle (ACE)
 Scholarships - Jay Rooker (UTMSI), Robert Weller (TTU), Gil Rosenthal (UT), John Findiesen and Karen Quinonez (TXSTATE)
- 1996 Fisheries Education - Billy Higginbotham (TAMU)
 Fisheries Management - Gary Garrett (TPWD)
 Fisheries Administration - Gene McCarty (TPWD)
 Fisheries Research - Ivonne Blandon (TPWD)
 Special Recognition - Reeves County Water Improvement Board
 Best Presentation (s) - Craig Paukert (OSU), Gene Guilliland (ODWC)

- Scholarships - Chad Thomas (TXSTATE), Anna-Claire Fernandez (UTMSI), Kenneth Ostrand (TTU), Dawn Lee Johnson
 Technical Support - Jimmy Gonzales (TPWD)
 Honorable Mention (technical support) - Eric Young (TPWD)
- 1997/8 Fish Culture - Tom Dorzak (TPWD)
 Fisheries Education - Robert Ditton (TAMU)
 Special Recognition - Fred Janssen, Chris Cummings, Dan Lewis, Dan Strickland, and Gary Graham (TPWD), Jim Davis (TAMU)
 Best Presentation (s) - Timothy Bonner (TTU) and Gene Wilde (TTU)
 Scholarships - Tony Baker and Allison Anderson (TAMU), Patrick Rice (TAMU-Galveston), Laurie Dries (UT)
- 1999 Fisheries Administration - Lorraine Fries (TPWD)
 Special Recognition - Pat Hutson (TPWD, retired)
 Best Presentation (s) - Gene R. Wilde and Kenneth G. Ostrand (TTU)
 Scholarships - Scott Hollingsworth and William Granberry (TTU), Brian Bohnsack and Michael Morgan (TAMU)
- 2000 Fisheries Research - Gene R. Wilde (TTU)
 Best Presentation - J. Warren Schlechte, coauthors - Richard Luebke, and T.O. Smith (TPWD)
 Best Student Presentation - Scott Hollingsworth, coauthors - Kevin L. Pope and Gene R. Wilde (TTU)
 Special Recognition - Emily Harber, Joe L.Hernandez, Robert W. Wienecke, and John Moczygemba (TPWD), Joe N. Fries (USFWS)
 Scholarships - Mandy Cunningham and Calub Shavlik (TTU), Laurieanne Lancaster (SHSU)
- 2001 Fisheries Administration - Ken Kurzawski (TPWD)
 Fisheries Education - Kevin Pope (TTU)
 Fisheries Management - Brian Van Zee (TPWD)
 Fisheries Research - Reynaldo Patino (TTU)
 Fisheries Student - Timothy Bonner (TTU)
 Technical Support - David DeLeon (TPWD)
 Special Recognition - Rhandy Helton, Rosie Roegner, and Walter D. Dalquest (TPWD)
 Best Presentation - Jason Turner, coauthors - Jay Rooker and Graham Worthy (TAMUG), and Scott Holt (UTMSI)
 Scholarships, Undergraduate - Mandy Cunningham, and Cody Winfrey (TTU)
 Scholarship, Graduate - Abrey Arrington (TAMU), and Laurianne Dent (SHSU)
- 2002 Fisheries Administration - Leroy Kleinsasser (TPWD)
 Fisheries Management - Gordon Linam (TPWD)
 Special Recognition - Raymond Mathews, Jr. (TWDB), Austin Bass Club of the Deaf
 Best Presentation - Jay Rooker, coauthors - Bert Geary, Richard Kraus, and David Secor (TAMUG)
 Best Student Presentation - J. P. Turner, coauthor - Jay Rooker (TAMUG)
 Best Poster Presentation - Michael Lowe, Gregory Stunz, and Thomas Minello (NMFS)
 Scholarships, Undergraduate - Felix Martinez, Jr. (TTU), Stuart Willis (TAMU)
 Scholarships, Graduate - Mathew Chumchal (TCU), Michael Morgan (TAMU)
- 2003 Fisheries Culture - Dennis Smith (TPWD)
 Fisheries Education - Gene Wilde (TTU)
 Fisheries Student - Christine Burgess (TAMU)
 Special Recognition - Larry McEachron (TPWD)
 Best Presentation - Gregory Stunz (TAMUCC), coauthors Thomas Minello and Phillip Levin (NMFS)
 Best Student Presentation - Monte Brown, coauthors Felix Martinez Jr., Kevin Pope, and Gene Wilde (TTU)
 Best Poster Presentation - Suraida Nanez-James (TAMUG) and Thomas Minello (NMFS)

- 2004 Fisheries Culture - Lisa Griggs (TPWD)
 Fisheries Education - Timothy Bonner (TXSTATE)
 Fisheries Research - Dave Buckmeier (TPWD)
 Fisheries Student - Casey Williams (TXSTATE)
 Special Recognition - Deborah Wade (TPWD)
 Best Presentation - Richard Kraus and David Secor (TAMUG)
 Best Student Presentation - Tracy Leavy, coauthor Timothy Bonner (TXSTATE)
 Best Poster Presentation - Brian Scott and Gary Aron (TXSTATE)
- 2005 Fisheries Administration – Roger McCabe (TPWD)
 Fisheries Management – Todd Driscoll (TPWD)
 Fisheries Student – Bart Durham (TTU)
 Special Recognition – Jimmie Green (TPWD) and Kirk Green
 Special Recognition – The Patsy B. Hollandsworth Family Foundation
 Best Presentation – Gregory Stunz (TAMUCC), and coauthors Jay Rooker (TAMUG), Joan Holt and Scott Holt (UT)
 Best Student Presentation – Julie Hulbert, and coauthors Timothy Bonner and David Pendagrass (TXSTATE), and Joe Fries (National Fish Hatchery – San Marcos)
 Best Poster Presentation – Michael Baird (TPWD)
 Scholarships, Undergraduate – Brian Bartram (TAMUCC), John Putegnat (TAMU)
 Scholarships, Graduate – Megan Fencil (UTMSI), Casey Williams (TXSTATE)
- 2006 Fisheries Education – Kevin Pope (TTU)
 Fisheries Management – Dave Terre (TPWD)
 Fisheries Research – Loraine Fries (TPWD)
 Technical Support – Todd Robinson (TPWD)
 Special Recognition – Bruce Hysmith (TPWD)
 Special Recognition – Joan Glass (TPWD)
 Best Presentation - Richard Kraus and David Secor (TAMUG)
 Best Student Presentation - Tracy Leavy, coauthor Timothy Bonner (TXSTATE)
 Best Poster Presentation - Brian Scott and Gary Aron (TXSTATE)
 Scholarships, Undergraduate – Chris Arredondo (TAMUCC), Josh Perkin (TXSTATE)
 Scholarships, Graduate – Bart Dunham (TTU), Casey Williams (TXSTATE)
- 2007 Fisheries Administration – Larry McKinney (TPWD)
 Fisheries Culture – Gary Garrett (TPWD)
 Fisheries Management – Charlie Munger (TPWD)
 Fisheries Research – Gary Garrett (TPWD) and Bob Edwards (UTPA)
 Fisheries Student – Chris Chizinski (TTU)
 Honorable Mention (Fisheries Student) – Brad Littrell (TXSTATE)
 Technical Support – Reynaldo Cardona (TPWD)
 Special Recognition – Robert Howells (TPWD)
 Special Recognition – Fred Janssen (TPWD)
 Special Recognition – Craig Scofield (TPWD)
 Special Recognition – Sandy Henry (Science Spectrum, Lubbock)
 Best Presentation – Craig Bonds, coauthors John Taylor and Jeremy Leitz (TPWD)
 Best Student Presentation – Matthew Chumchal (OU), coauthors Michael Slattery, Ray Drenner, Matthew Drenner and Leo Newland (TCU)
 Best Poster Presentation – Richard Ott and Timothy Bister (TPWD)
 Scholarships, Graduate (M.S.) – Brian Bartram (Baylor)
 Scholarships, Graduate (Ph.D.) – John Froeschke (TAMUCC)

- 2008 Fisheries Administration – Lance Robinson (TPWD)
 Fisheries Education – Andre M. Landry, Ph. D. (TAMUG)
 Fisheries Research – Bart Durham (TTU)
 Fisheries Student – Preston Bean (TXSTATE)
 Honorable Mention – Zachary Shattuck (TXSTATE)
 Technical Support – Corey Clouse (TPWD)
 Special Recognition – Chad Thomas (TXSTATE)
 Best Presentation – Matthew Chumchal (TCU)
 Best Student Presentation – Rodney Gamez (TAMUCC)
 Best Poster Presentation – James Tolan (TPWD)
 Scholarships, Undergraduate – JoHanna Weston (UD)
 Scholarships, Graduate (M.S.) – Megan Bean (TXSTATE)
 Scholarships, Graduate (Ph.D.) – Preston Bean (TXSTATE)
- 2009 Fisheries Administration – Phil Durocher (TPWD)
 Fisheries Education – Michael Masser (TAMU)
 Fisheries Research – Ray Drenner (TCU)
 Fisheries Student – Joshua Perkin (TXSTATE)
 Honorable Mention –
 Fisheries Management – John Moczygemba (TPWD)
 Technical Support – Mike Gore (TPWD)
 Special Recognition –
 Best Professional Presentation – Ray Drenner (TCU)
 Best Student Presentation – Ted Valenti (BAYLOR)
 Best Professional Poster Presentation – Pat Bohannon (TPWD)
 Best Student Poster Presentation – Brianne Kiester (TCU)
 Scholarships, Undergraduate – Michelle Parmley (TXSTATE); Nicholas Bertrand (TXSTATE)
 Scholarships, Graduate (M.S.) – Joshua Perkin (TXSTATE)
 Scholarships, Graduate (Ph.D.) – Bridgette Froeschke (TAMUCC)
 Clark Hubbs Research Award – Ben Labay (TXSTATE)
- 2010 Fisheries Administration – Mike Ray (TPWD)
 Fisheries Research – Aaron Barkoh (TPWD)
 Fisheries Culture – Hugh Glenewinkel (TPWD)
 Fisheries Student – Ben Labay (TXSTATE)
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- 2011 Fisheries Administration – Art Morris (TPWD)
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 Special Recognition – Brian Van Zee (TPWD)

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Clark Hubbs Research Award – Carmen G. Montana (TAMU)

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Fisheries Research – Kirk Winemiller (TAMU)
Fisheries Student – Carmen G. Montana (TAMU)
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Special Recognition – Seven Coves Bass Club
Special Recognition – TTU-Department of Biology: Gene Wilde, Aaron Urbanczyk, Doug Knabe
Special Recognition – TPWD-River Studies: Kevin Mayes, Clint Robertson, Kevin Kolodziejczyk
Special Recognition – TPWD-Hatcheries: Dale Lyon, Carl Kittel, Daniel Field, Greg Polk
Special Recognition – Kevin Mayes (TPWD)
Best Professional Presentation – Brad Littrell (BIO-WEST)
Best Student Presentation – William Smith (TAMU)
Best Professional Poster Presentation – Raelynn Deaton (SEU)
Best Student Poster Presentation – Dan Fitzgerald (TAMU)
Scholarships, Undergraduate – Ruben Palacios (TAMUCC)
Scholarships, Graduate (M.S.) – Karen Drumhiller (TAMUCC)
Scholarships, Graduate (Ph.D.) – Larissa Kitchens (TAMUG)
Harry Tennyson Scholarship – William Smith (TAMU)
Harry Tennyson Scholarship – Matt VanLandeghem (TTU)
Clark Hubbs Research Award – Steven Curtis (TXSTATE)

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
USFWS – U.S. Fish and Wildlife Service
UT – University of Texas – Austin
UTMSI – University of Texas Marine Science Institute
UTPA – University of Texas – Pan American

TECHNICAL SESSION ABSTRACTS

Distribution, status, and habitat associations of the Devil's River minnow in Pinto Creek, Kinney County, Texas

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J. Warren Schlechte (Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, Mountain Home, Texas)

We collected Devils River minnow (*Dionda diaboli*) from an isolated population in the headwaters (~4 km) of Pinto Creek (Kinney County) during 2009-2011. We seined, and collected water quality and habitat data, from 19 sites to learn where *D. diaboli* occurred, its relative abundance, and its habitat associations. We captured 8,640 fish of eleven species. The dominant species were *Gambusia speciosa* (54%), *Astyanax mexicanus* (28%), *Cichlasoma cyanoguttatum* (5%), *Micropterus salmoides* (4%), *D. diaboli* (2%), and *Notropis amabilis* (2%). *Lepomis* sp. made up 5% of the fish captured. We captured adult and juvenile *D. diaboli* in equal numbers. The headwaters were a series of disjunct habitats for much of the period of study due to drought conditions. We collected *D. diaboli* at seven locations: six pools and one run just upstream of one of the pools. All fish were found in locations with thick *Chara* sp. and low flow (<0.1 m/s). It is unclear if our data reflect habitat preference or contraction of this population into the available habitat. Rains in spring of 2010 temporarily restored surface flows to the entire study area. By July 2011, because of continued severe drought conditions, the headwaters where our study sites were located were reduced to two pools. One pool had a surface area of about 30 m²; the other had a surface area of about 860 m². These remaining pools were shallow (~0.5m), turbid, and had no vegetation. We did not find *D. diaboli* within either pool. Physical barriers between existing downstream populations of *D. diaboli* and the upper reaches of Pinto Creek may hinder re-colonization after the drought.

Population genetic structure of the Guadalupe bass, *Micropterus treculii*

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The population genetic structure of aquatic species are largely influenced by geographic factors, but can also be influenced by contemporary factors including anthropogenic activities such as stocking of hatchery reared fish and translocations. The Guadalupe bass, *Micropterus treculii*, is native to the western gulf slope drainages from the Brazos to the Guadalupe drainages and occurs primarily in upland streams of the Edwards Plateau where stream captures and sea level changes have been proposed as mechanisms of dispersal among drainages. Also, stocking of Guadalupe bass has occurred as a part of restoration efforts because of introgression with introduced smallmouth bass, *M. dolomieu*. We investigated the influences of these historical and contemporary factors on the population genetic structure of Guadalupe bass using fifteen microsatellite loci. Analysis of molecular variance revealed that genetic structuring of Guadalupe bass populations was primarily at the river basin level with the exception that the Pedernales sub-basin was genetically distinct from other Colorado River basin populations. Additionally, introduced populations of Guadalupe bass in the Nueces basin showed reduced genetic diversity relative to their original source populations. Patterns of genetic structuring revealed in this study indicate that source populations for broodstock used for restoration of Guadalupe bass populations should ideally be from the same drainage as the restored population when non-introgressed populations are available.

Influence of watershed and instream alterations on the upper San Marcos River fish assemblage

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Long-term fish assemblage persistence and resiliency is often related to the environmental and temporal stability of a river system with stable systems exhibiting more persistent and resilient assemblages. A historical narrative on watershed and instream changes in the upper San Marcos River was compiled and related to upper San Marcos River fish assemblage changes from 1880 – 2011 to test predictions on the persistence and resiliency of an environmentally stable river system. A total of 58 fishes have occurred within the upper San Marcos River, including 16 exotic fishes, 4 basin endemics, and 8 spring-associated species. Only one species (i.e. *Gambusia geogeri*) is considered extinct and exotic fishes currently constitute only a small proportion (9%) of the assemblage. Assemblage composition varied among decades and can be attributed to stream morphology changes, exotic species additions, and differences among sampling technique and location. Despite numerous watershed modifications, the upper San Marcos River fish assemblage has remained fairly persistent and exhibited resiliency from both natural and anthropogenic disturbances, thus supporting current predictions of assemblage persistence in stable systems.

Population structure of eastern oyster in the western Gulf of Mexico

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The eastern oyster, *Crassostrea virginica*, is a commercially and ecologically important species. We examined amounts and distribution of genetic variation in eastern oyster using a 1149 bp region of the ND4 gene in the mitochondrial genome across seven Texas bays: Galveston, East Matagorda, Carancahua, Matagorda, San Antonio, Copano, Aransas, Corpus Christi, and the Lower Laguna Madre. Some populations were sampled in multiple years. We estimated haplotype diversity, nucleotide diversity, and population differentiation (ϕ_{st}) for 150 individuals. Overall haplotype (haploid genotype) diversity was 0.95 and overall nucleotide diversity was 0.005. Our results also indicate no differentiation among populations ($\phi_{st}=0.008$, $p = 0.11$). However, we found one haplotype unique to southern part of our study area. We explore the distribution of this haplotype in Texas bays and consider the implications for population connectivity. Understanding population structure and connectivity of this species will inform management decisions, including harvest policies and oyster reef restoration. Furthermore, this work provides a foundation for other studies examining ecological significance of genetic diversity.

Using recreation-grade side-imaging sonar to produce georeferenced mosaics and classified maps of submerged macrophyte distribution in a geographic information system

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Understanding the habitat characteristics of aquatic systems is a fundamental tool in fisheries management. Recently, the availability of recreation-grade side-imaging systems has made capturing high resolution (<10 cm) underwater imagery practical. Using side-imaging sonar, we evaluated the ability to produce classified maps of submerged macrophyte distribution in reservoirs in a Geographic Information System (GIS). Using a Hummingbird[®] 1198 SI unit, we recorded sonar images of littoral habitat. Mosaics of sonar images were created for use in a GIS (ESRI[®] ArcGIS). Ground-truthing was accomplished during the survey by visual inspection to determine species composition for each classified habitat. Our ability to produce accurately classified map products for each reservoir was assessed using a traditional error matrix of observed versus classified cells corresponding to each class of submerged habitat.

Using MAXENT to predict distributions of rare fish and mussel species in east Texas

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The population decline of rare and endangered fish and mussel species has become a topic of concern. In the last three decades there has been a consistent decline in aquatic diversity in East Texas due to alteration of the landscape. The Sabine shiner, *Notropis sabiniae*, blue sucker, *Cyaleptus elongatus*, sandbank pocketbook, *Lampsilis satura*, Louisiana pigtoe, *Pleurobema riddellii*, triangle pigtoe, *Fusconaia lananensis*, Texas heelsplitter, *Potamilus amphichaenus*, and Texas pigtoe, *Fusconaia askewi*, are rare species that have been collected in the Sabine and Neches River in East Texas. Little information is known about the ecology of these species. Ecological niche modeling was used, with geological, landcover, TOPMODEL hydrographic data layers, and the software package MAXENT, to predict the probability of occurrence of rare fish and mussel species in East Texas. Results suggest that geology, soil, and vegetation are important variables for predicting the distribution of rare species; however, TOPMODEL is not the best predictor variable. Through the use of this software, we are able to determine locations and quantities of similar habitat and predict probability of occurrence.

Quantifying delayed post-release mortality in the Gulf of Mexico recreational red snapper fishery using acoustic telemetry

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Red snapper (*Lutjanus campechanus*) is considered an ecologically and economically important reef fish species in the Gulf of Mexico. Populations are highly regulated but have failed to recover as expected and stocks remain low. One possible reason for the slow recovery is that red snapper are susceptible to pressure-related injuries (i.e. barotrauma) and estimating delayed mortality rates in deep water environments is difficult. Delayed mortality may occur from reduced fitness, reduced predator avoidance ability, or inability to forage. To determine the extent of delayed post-release mortality, we tagged 100 red snapper with Vemco[®] V9AP accelerometer tags

and released them at an oil platform at 50m depth. Unlike previous acoustic tagging experiments, fish were rapidly (1-3 min) tagged externally without anesthesia. Procedures were performed to best replicate normal fishing practices and minimize artifacts associated with tagging related surgeries (i.e. venting and use of only "survivors"). Acoustic receivers attached to the platform at depths of 30m and 50m recorded acceleration ((m/s)²) and depth (m) data for approximately 45 days. There was a significant seasonal effect in overall delayed mortality. There was also a significant difference among four release treatments tested. These results suggest that temperature is highly influential in the fate of regulatory discards. The method of release may also dictate the fate of discarded fish. Results from these experiments enhance our understanding of post-release mortality and behavior of red snapper and provide useful information that documents the fate of regulatory discards. Estimates of delayed post-release mortality from this study can be integrated into stock assessment models to achieve better calculations of overall mortality and ultimately more accurate estimates of population size.

Fish assemblage dynamics at the river-reservoir interface: the ecological and physical connection of two aquatic environments

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Ecosystem scale management of aquatic systems requires an understanding of the structural and functional relationships between communities of reservoirs and their upstream tributaries. However, this information is largely lacking. To address this, we examined the fish assemblage at the river-reservoir interface where the two environments are physically and ecologically connected. Fish were sampled in four river-reservoir interfaces at Lake Buchanan, O.H. Ivie, and Lyndon B. Johnson Reservoirs for two years using gillnets, seines, and electrofishing. We estimated the proportion of the regional species pool present at each interface to identify which were using this area of the ecosystem. We also examined overall patterns of fish assemblage structure to identify temporal and spatial relationships within and among interfaces. We found that these fish assemblages were diverse; 55-78% of the regionally available species were represented at each interface. Overall structure of the fish assemblages changed significantly ($p < 0.05$) through time. However, except for weak patterns in gillnet data, the assemblage structure within each river-reservoir interface were not related to season or month-sampled. Comparisons among the four river-reservoir interfaces showed that assemblage structure of Lyndon B. Johnson Reservoir was significantly ($p < 0.05$) different than the others. Although it contained the same suite of species, species richness and evenness were higher. We speculate that differences within and among these assemblages may be influenced by such things as habitat quality, spatial position in the watershed, reservoir water level fluctuations, and characteristics of the incoming tributary. Further investigations into how fish within river-reservoir interfaces contribute to fish communities in reservoir and upstream tributaries is needed to manage these systems at an ecosystem scale.

Effectiveness of host snail removal in the Comal River, Texas and its ability to reduce cercariae of the invasive gill parasite *Centrocestus formosanus* (Trematoda: Heterophyidae)

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Centrocestus formosanus (Trematoda: Heterophyidae) is an invasive fish parasite found in the Comal River, Texas, and has been observed infecting gill tissues of the federally-listed endangered fountain darter, *Etheostoma fonticola*. Although the complete removal of the invasive parasite is unlikely, the manual removal of one of the parasites' intermediate hosts, the red-rimmed melania snail *Melanooides tuberculatus*, has been discussed as a possible method for decreasing cercariae densities within the river system. This study evaluated this potential management technique's effectiveness to significantly reduce the density of *C. formosanus* cercariae in the water column by monitoring cercariae densities prior to and following the manual removal of invasive snails. We sampled cercariae densities at 5 sites, including 1 upstream control site, 3 snail "hotspot" sites, and a downstream site, to measure overall effectiveness of the technique to decrease cercariae densities within the Spring Island complex of the Comal River. Removing snails did cause statistically significant declines in cercariae densities in the water column immediately surrounding all 3 hotspots where snails were removed. However, no significant declines were observed at the downstream monitoring site. The data suggests that this method is effective for decreasing cercariae densities, although the effect was localized in this study. Additional research is needed to determine if this removal method is appropriate for a large-scale attempt to decrease cercariae within the Comal River system, or a viable management strategy during periods of low-flow when cercariae densities within the system are at their highest.

Evaluating the effects of barotraumas on red snapper (*Lutjanus campechanus*) using hyperbaric experimentation

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Red snapper, *Lutjanus campechanus*, is the most economically important reef fish in the Gulf of Mexico and since 1984 has been classified as overfished. They are often found at depths that can result in pressure-related injuries (barotrauma) when captured. As the fish is brought to the surface their gas bladder expands and displaces internal organs, which can cause injuries such as an everted stomach, or exophthalmia (bulging eyes). Due to minimum size and harvest regulations, many fish caught must be released after capture. Once released, these fish often have trouble swimming and re-submerging. One technique to aid in re-submersion is "venting" the gas bladder by inserting a hollow needle into the abdomen to allow excess gasses to escape. This study examined the physiological effects of barotrauma on red snapper through the use of hyperbaric chambers to simulate a fish being caught at depth and brought to the surface multiple times. Our treatments included vented and non-vented fish at depths of 30 meters (m) and 60m. After barotrauma events, fish underwent predator simulations to determine fitness to evade a predator upon release. Injuries and mortality have been greater at 60m than at the 30m, and also increase with multiple barotrauma events. Venting has decreased mortality rates and increased ability to evade predation. Our findings show the importance of understanding the effects depth and venting on barotrauma injuries. This vital information will allow fisheries managers to make more informed decisions in how best to aid in the recovery of this important fishery.

Demographic diversity and sustainable fisheries

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Fish species are diverse. For example, some exhibit early maturation while others delay maturation, some adopt semelparous reproductive strategies while others are iteroparous, and some are long-lived and others short-lived. The diversity is likely to have profound effects on fish population dynamics, which in turn has implications for fisheries management. In this study, a simple density-dependent stage-structured population model was used to investigate the effect of life history traits on sustainable yield, population resilience, and the coefficient of variation (CV) of the adult abundance. The study showed that there are marked differences in the sustainable yield among species with different life history strategies. In particular, semelparous fish can produce very high sustainable yields, near or above 50% of the carrying capacity, whereas long-lived iteroparous fish can produce very low sustainable yields, which are often much less than 10% of the carrying capacity. The difference is not because of different levels of sustainable fishing mortality rate, but because of difference in the sensitivity of the equilibrium abundance to fishing mortality. In addition, the resilience of fish stocks tends to be reduced with increased fishing mortality. This means that changes in population abundance in response to natural or anthropogenic perturbations will last longer at higher fishing mortality rates. The CV of the adult abundance increases with increased fishing mortality, not because more individuals are recruited into the adult stage (as previous speculated), but because the mean abundance is more sensitive to fishing mortality than its standard deviation. The magnitudes of these effects vary depending on the life history strategies of the fish species involved. It is evident that any past high yield of long-lived iteroparous fish is a transient yield level, and future commercial fisheries should focus more on fish that are short-lived (including semelparous species) with high compensatory capacity.

Freshwater mussels of the proposed wild and scenic Neches River

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The 360 km stretch of the Neches River from Lake Palestine to Lake B. A. Steinhagen has been proposed to be designated as a U. S. Wild and Scenic River. This area also includes the U. S. Fish and Wildlife Neches River Refuge and has several species of mussels that are listed as threatened by Texas Parks and Wildlife. From 2009 to 2011 surveys of 9 sites from just below Lake Palestine to just above B. A. Steinhagen for Unionid mussels were conducted. Sites were chosen within kayaking distance of a bridge access and by examining the underlying geology on GIS maps. After reconnaissance for shells, 3 continuous 50 meter reaches were sampled at each site by 2 to 4 persons searching the substrate tactilely for 30 to 45 minutes. All live and recently dead mussels were identified, counted and then returned to the substrate. A total of 3123 mussels of 22 species were recorded. The upper reaches had the least diversity and abundance with the center area having the greatest. The lower reaches had the only gulf mapleleafs but the threatened Louisiana pigtoe, the Texas pigtoe, the Texas Heelsplitter and the Sandbank pocketbook were found throughout the river. In each reach the extent of appropriate habitat for riverine mussels was quite limited and our sites had been chosen from the best of those, therefore the numbers do not suggest that Unionids are doing well in the river as a whole. However, the protection that designation of it as a Wild and Scenic River should improve the amount of appropriate habitat and increase the chances for survival of these declining organisms.

Effect of environmental conditions on the distribution and abundance of dolphinfish larvae in the northern Gulf of Mexico

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Dolphinfish (*Coryphaena hippurus*) and pompano dolphinfish (*C. equiselis*) are economically and ecologically valuable pelagic species found in tropical and subtropical waters worldwide. Although they support both commercial and recreational fisheries, knowledge of their ecology during early life is limited. The aim of this study is to examine the distribution and abundance of dolphinfish larvae in the northern Gulf of Mexico and assess the role of this region as spawning and/or nursery habitat of both species. Dolphinfish larvae were collected during eight ichthyoplankton surveys in northern Gulf waters off Texas and Louisiana (26 – 28° N 86 - 93° W) during June and July over 4 years (2007-2010). Dolphinfish larvae were relatively common in our sampling area (frequency of occurrence 59%) and of the 1,145 larvae collected during this study, 87% were *C. hippurus*. Overall mean densities of *C. hippurus* and *C. equiselis* were 0.58 and 0.10 larvae per 1000 m² with catches peaking at 16.79 and 4.01 larvae per 1000 m², respectively. Generalized Additive Models (GAMs) were used to examine the effect of environmental conditions on 1) presence/absence and 2) density of *C. hippurus* larvae. Final models were selected using a stepwise selection procedure based on Akaike Information Criterion (AIC). The presence/absence model revealed that the presence of larvae was significantly influenced by several oceanographic (sea surface temperature, sea surface height anomaly, current strength, and distance to the nearest eddy), temporal (time of day and year), and biological (*C. equiselis* presence and *Sargassum* biomass) parameters. The density model showed an additional positive relationship between larval abundance and latitude. Results of this study indicate that that mesoscale features and physicochemical conditions drive the distribution and abundance patterns of *C. hippurus* in the Gulf.

Long-term changes in water quality and fish assemblage composition in the Trinity River of Texas

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Degradation of water quality including anthropogenic nutrient enrichment threatens ecosystem goods and services provided by streams. However, despite detrimental effects such as harmful algae blooms, anoxic environments, and fish and invertebrate kills, streams have the potential to recover from water quality disturbances once sources of pollution are mitigated. The Trinity River of Texas has a history of nutrient contamination stemming from the Dallas-Fort Worth Metroplex (DFWM) and the stream was termed a “Mythological River of Death” by the Texas Department of Health in 1925. We quantified temporal fish assemblage changes in three mainstem reaches of the Trinity River in relation to improvements in water quality following passage of the Federal Clean Water Act of 1972, including reductions in the concentrations of ammonia, biochemical oxygen demand, and phosphorus. We hypothesized that shifts in water chemistry parameters would cause an increase in overall fish species richness as well as occurrence of species intolerant to pollution. During 1968-2008 nutrient concentrations declined through time and with longitudinal distance from the DFWM, despite only subtle changes in flow regime. After controlling for the total number of individuals collected, rarified fish species richness increased through time immediately downstream of the DFWM (Reach 1; 1970-1971: $S = 14$; 1987-1989: $S = 20$; 1994-2008: $S = 28$), further downstream (Reach 2; 1970-1971: $S = 18$; 1987-1989: $S = 20$; 1994-2008: $S = 22$), and abundance of species intolerant to pollution increased through time. Furthest downstream (Reach 3), species richness increased (1970-1971: $S = 45$; 1994-2008: $S = 54$) likely in response to construction of a mainstem impoundment in 1969 and invasion by lacustrine species. Results suggest improvements to water quality in the form of reductions in nutrient concentration allowed for recovery of the lotic fish assemblage, but recovery was limited to species that maintained populations capable of recolonization.

The influence of urbanization on coastal streams: the role of upstream land on stream fish communities within southeast Texas

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Streams throughout the U.S. have been historically subjected to degradation due to urbanization, agriculture and industry. The influence of urbanization on stream ecosystems is difficult to evaluate, due to many interacting variables. Previous studies have found that the degree of urbanization influences flow regime, pollutant loading, and resulting fish community structure. Our study investigated the influence urbanization on hydrology, physical habitat, water quality, and resulting fish community structure at 8 coastal streams located in Southeastern Texas. Streamflow, physical habitat, water quality and fish community data were collected at these sites during 2011. The stream sites were selected to represent a variety of land uses ranging from highly urbanized, to minimally urbanized or reference conditions. In order to determine the degree of urbanization within each watershed we used ArcGIS software to assess land use. We utilized total impervious area (TIA) and percent impervious area (PIA) for each watershed studied as a simple index of urbanization. TIA and PIA were estimated using 2006 impervious surface data obtained from the United States Geological Survey. Various fish community metrics including the Index of Biological Integrity (IBI), species richness, and Shannon-Weiner diversity were used to evaluate the impact of urbanization on fish community structure. Estimated land use data was compared to IBI scores, fish community metrics, water quality, and physical habitat. Several statistical analysis methods including Pearson correlation analysis, Analysis of Variance (ANOVA) and cluster analysis were used to evaluate the response of fish communities to land use and associated hydrology, physical habitat, and water quality. We found that IBI scores and stream fish diversity were negatively correlated with PIA. We also observed positive correlations between TIA and phosphate and nitrate and nitrite concentrations among the sites. We did not observe any strong correlations between the amount of impervious area within the upstream watershed and physical habitat metrics, with the exception of a negative correlation between TIA with mean instream cover and the amount tree canopy.

Habitat use and movement of red drum across habitat patches within a shallow estuarine seascape

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Acoustic telemetry was used to examine habitat use of red drum *Sciaenops ocellatus* in Galveston Bay, Texas to improve understanding of essential fish habitat (EFH) in Texas estuaries. Age-1 red drum ($n=8$) were collected in December 2010 were surgically fitted with Vemco V9 acoustic transmitters (69kHz). A VR2W Positioning System (VPS) array consisting of a grid of eight passive receivers was positioned on a shallow flat in Christmas Bay, a small secondary bay in the Galveston Bay estuary containing multiple habitat types (e.g. seagrass, oyster reef, marsh edge, and sand). The VPS estimates fish position by triangulation utilizing simultaneous detections of a specific tag by multiple receivers. Red drum were released into the VPS array on December 22, 2010 and data was recorded for 30 days. A total of 2,008 fish positions was estimated from 16,648 tag detections recorded by receivers within the array during the study period. Fish positions were plotted in a Geographic Information System (GIS) containing detailed benthic habitat maps. Euclidean Distance-based Analysis (EDA) was used to determine non-random use of specific habitat types (shoal grass, turtle grass, oyster reef, marsh edge, and sand) by red drum to infer potential habitat preference. A greater proportion of red drum were located near seagrass and sand habitats than would be expected, based on available habitat. Habitat preference was similar across diel and tidal cycles during the winter study period; however, tidal direction appeared to affect the use of certain habitats (e.g., marsh edge and oyster reef). Within the Christmas Bay estuary, the interface between two or more habitat types were preferred by red drum to homogenous habitats. Overall, results from this study support the importance of seagrass habitats to red drum in Texas estuaries.

Taxonomic distribution and evolution of heterodonty in the ray-finned fishes (Actinopterygii)

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The taxonomic distribution of heterodonty (having multiple types of teeth) is well documented in chondrichthyan and sarcopterygian lineages, yet remains poorly understood in the Actinopterygii. Though a few striking examples of actinopterygian heterodonty have been described previously (e.g. in the oral jaws of the wolf fish) our rudimentary knowledge of the distribution of this trait across Actinopterygii hinders our ability to investigate its evolution within a phylogenetic context and assess macroevolutionary hypotheses. This review summarizes the taxonomic distribution of heterodonty across the Actinopterygii and utilizes current phylogenetic hypotheses to examine macroevolutionary patterns of dentition. Utilizing a novel standardized terminology, at least 10 different patterns of heterodonty (e.g., combination of incisiform and molariform or caniniform and cardiform teeth) have been identified within the Actinopterygii to date. Ancestral character state reconstruction methods based on current phylogenetic hypotheses suggest that heterodonty has evolved at least seven times independently throughout the evolutionary history of the Actinopterygii. This data will provide a concise summary and phylogenetic road map to the dentition of actinopterygian fishes and will provide an invaluable resource for future Ichthyologists and other researchers interested in the evolution of vertebrate dentition.

Community structure and fishes and mussels in two east Texas rivers

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We compared fish and mussel community structure in the Neches and Sabine Rivers of East Texas, two rivers with similar geology and biogeographic history. Biota were collected on the Sabine River, between Lake Tawakoni and Toledo Bend Reservoir, and on the Neches River, between Lake Palestine and B.A. Steinhagen Reservoir. Fish data were collected using a Smith Root electroshocker throughout a 200m reach. Mussel data were collected in 50m transects using one-hour tactile searches. Fish species richness was higher in the Sabine River and evenness and diversity were both higher in the Neches River. Mussel richness, evenness, and diversity were all higher in the Neches River. Nonmetric multidimensional scaling showed sites for the fish data were separated by river and longitudinal position. In contrast, mussels from the lower Sabine River and the Neches River are more closely related than sites from the upper Sabine River. These results may be explained by differences in habitat, stream size and impacts of reservoirs.

Quantifying the effects of temperature, salinity, and marsh access on the growth of brown shrimp (*Farfantepenaeus aztecus*) in salt marsh ponds of Galveston Bay, Texas

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Growth of juvenile brown shrimp (*Farfantepenaeus aztecus*) is mainly a function of temperature, salinity, and food availability. Food availability is affected by flooding of the *Spartina* marsh surface that provides the opportunity for brown shrimp to forage on abundant benthic infauna. These ecological factors can vary widely in coastal estuaries of the northern Gulf of Mexico, and we are in the process of building a simulation model describing these relationships based on published information from field distributions, ecological experiments, and

other models. To validate model results, we used a mark-recapture method to estimate growth of juvenile brown shrimp in four marsh ponds in Galveston Bay, Texas. Three ponds were located within the Galveston Island State Park. A fourth pond was selected at the Nature Conservancy's Prairie Preserve on Moses Lake, north of the Texas City Dike, and historically an area of lower average salinity in the bay. More than 3200 shrimp were captured, measured, tagged, and released from April through July 2011. At two to three week intervals, we sampled the ponds and recaptured 122 shrimp over the duration of the study. Growth rates averaged 0.99 mm day^{-1} (SD = 0.24) across all ponds but varied significantly among ponds ($0.95 - 1.23 \text{ mm day}^{-1}$, $P < 0.001$). These results will be compared with modeled growth of brown shrimp, since ponds and experimental periods differed in temperature, salinity, and duration of access to the flooded marsh surface.

Landscape-level associations between water quality and golden alga presence, abundance, and toxicity in reservoirs of west Texas

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Toxic blooms of golden alga (*GA*, *Prymnesium parvum*) have caused massive fish-kills in Texas surface waters. Impacts to fish populations have been relatively severe in reservoirs of the Upper Colorado River (UCR) basin of west Texas. Although *GA* blooms elsewhere occur primarily in winter, blooms in the UCR often last for several months and can extend into summer. Water quality conditions in UCR reservoirs therefore seem to be relatively suitable for *GA* growth. To test this hypothesis, we quantified *GA* cell density, ichthyotoxicity, and water quality conditions in three impacted reservoirs from the UCR or its tributaries; two non-impacted (reference) reservoirs from the Concho River (CoR); and three sites at the confluence of the UCR and CoR (O.H. Ivie Reservoir). Sampling occurred monthly from January 2010 to July 2011. Principal components analysis showed that impacted sites clearly separated from reference sites by salinity and hardness. When analyzed with multiple regression, however, salinity and hardness did not explain variability in *GA* cell density within impacted reservoirs. Nutrients were also quantified from December 2010 to July 2011. *GA* cell density in impacted reservoirs seemed to associate with dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus (DIP) concentrations. *GA* cell densities were highest at DIN:DIP values less than ~14, and a rise in DIN:DIP during early summer corresponded to a decline in *GA* cell density. Interestingly, DIN:DIP was generally above 14 in reference reservoirs. Overall, these findings suggest that management of reservoir hardness and/or salinity could reduce favorable conditions for *GA* growth and also highlight differences in nutrient dynamics between *GA*-impacted and non-impacted reservoirs.

Reproductive ecology of plains minnow *Hybognathus placitus* in the Brazos River, Texas

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Plains minnow *Hybognathus placitus* occurs widely throughout the Great Plains, ranging from Saskatchewan, Canada, and Montana south into Texas, where it inhabits large streams and rivers with moderate currents and sand and silt substrates. Previous studies have suggested the plains minnow has a spawning period from late April to August, and that the species spawns in synchronization with high flow events. The purpose of this study is to characterize the spawning habits of plains minnow at two localities in the upper Brazos River over a two-year period, 2008 to 2009. Using a combination of gonadosomatic indices, measurements of ova diameter, and histological analyses we found the plains minnow to have a protracted spawning period from April through September, and to spawn synchronously and asynchronously. During periods of base flow, individual fish spawn

asynchronously on a daily basis, whereas during periods of increased flow the population spawns synchronously. The plains minnow is one of a growing number of Great Plains minnows that have recently been shown to utilize this spawning method to cope with variable flow regimes found in Great Plains Rivers.

Possible use of oligohaline habitat by juvenile southern flounder (*Paralichthys lethostigma*) on the gulf coast of Texas

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Previous research conducted in North Carolina and the northern Gulf of Mexico has established that there is extensive use of freshwater habitat by juvenile southern flounder (*Paralichthys lethostigma*). Juvenile southern flounder have been collected at salinities below 10 ppt in Aransas Bay, suggesting that southern flounder in Texas might also utilize freshwater habitat. However, considering the dynamic climate of south Texas and the fact that southern flounder in Texas have been shown to have significant genetic and physiological differences from their congeners in other regions, the importance of freshwater and oligohaline habitat to juvenile southern flounder in Texas must be established. Habitat use patterns will be determined using otolith microchemistry by analyzing trace element (Sr/Ca, Ba/Ca) ratios to determine movements across salinity boundaries. In order for trace elemental analyses to be performed on otoliths, the trace elemental concentration of tributaries to the area must first be established. Water samples collected in the summer of 2010 and 2011 from the major tributaries to the Aransas, Copano, San Antonio, and Mission Bay systems indicate that trace element (Sr/Ca and Ba/Ca) values show significant variation among locations. Preliminary results indicate that southern flounder juveniles appear to be using habitats across a broad salinity gradient and habitat use is variable between years and within year classes. This work will provide fisheries managers with a more informed understanding of habitat requirements of juvenile southern flounder, leading to the implementation of more comprehensive and effective conservation and management strategies.

Hydrogen sulfide, bacteria, and fish: a unique food chain supported by chemical-based energy

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Throughout planet Earth, the great majority of food chains are supported by plants that use light to fix atmospheric CO₂, synthesizing organic carbon. We recently used gut content and stable isotope analysis to show that, in a sulfide-rich cave stream in Tabasco state, Mexico, sulfur-oxidizing bacteria are directly consumed and assimilated by the fish *Poecilia mexicana*. These bacteria are chemoautotrophic, synthesizing organic molecules derived from the oxidation of hydrogen sulfide. This is the first evidence that we know of of a vertebrate obtaining its energy from chemoautotrophic production. I will discuss our findings as well as other examples of food chains supported by chemical energy, including Movile Cave in Romania and deep-sea hydrothermal vents and seeps.

Age and growth of young-of-the-year red shiner in the Brazos River, Texas

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Red shiner *Cyprinella lutrensis* is a small-bodied cyprinid found in streams and rivers of the central United States. Previous studies of red shiner reproduction, based on ovarian development, have indicated the species spawns continuously throughout the summer, with peaks in reproductive output correlated with moderate stream discharge. In this study, we sampled young-of-year red shiner twice monthly from April to September for three consecutive years, 2008-2010. We used otoliths to age individual fish and calculate the date each fish was

spawned. Calculated spawning dates show that red shiner in the Brazos River reproduce throughout the summer, regardless of stream discharge levels. We found successful spawning to be negatively correlated with high stream discharge, with fewer juvenile red shiner spawned during periods of high discharge than during times of low to moderate streamflow. We also found no correlation between growth rates and spawning date and discharge.

Morphological assembly patterns in tropical-temperate percomorph fishes

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Neotropical cichlid fishes exhibit morphological and ecological traits that appear parallel those Neartic centrarchids (sunfishes and basses). Given the divergent evolutionary histories of cichlids and sunfishes, we examined and compared morphological traits and floodplain river habitat-associated of 27 species of Neotropical cichlids and 13 species of Neartic sunfishes to extend our predictions of community organization, morphological structure, and patterns of convergent adaptive radiation. We hypothesized that despite Neotropical cichlids being more diverse than temperate centrarchids, similarity between habitats (e.g., flow regime and substrate types) might create selective pressures resulting in patterns of convergence between these two taxa. Fishes were collected from different habitat types in floodplain rivers in South America (Venezuela, Peru) and North America (Texas). Habitat use was assessed in terms of species richness and relative abundance, and habitat structure was evaluated based on substrate categories among other habitat variables. Principal components analysis was used to characterize the species morphological space using a set of traditional measurements of body and fin shapes. Morphological similarities based on Euclidean distances were assessed via mean of nearest neighbor distance (NND), standard deviation of NND, and distance from the centroid. Despite species-by-species matching not being consistent; we found that some species in the family Cichlidae and Centrarchidae were indeed convergent in morphological and functional traits. Greater species packing and more even spacing assemblages were observed in tropical rivers at local-habitat patch. Local-habitat patterns within tropical assemblages differed from the random expectation indicating niche partitioning drives species co-occurrence. Overall results suggest that assembly organization of tropical cichlids and temperate centrarchids is primarily driven by local factors such as habitat characteristics. Assembly in tropical rivers appears to be a function of high morphological diversification which allows species coexistence, whereas in temperate rivers coexistence is driven by high degree of interspecific morphological diversity within species.

Texas anglers: trends in selected socio-demographic variables from 1989-2009

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The previous twenty years have seen dramatic changes in the population of Texas anglers. Larger social forces of urbanization and migration, population growth, and shifting economic structures, have shaped the Texas population as a whole as well as the population of Texas anglers. Changes in angler motivations, species preferences, income, and desire to keep fish all have bearing on the way in which anglers participate in the sport, and fisheries are managed in the state. This study examined trends in selected variables taken from the Texas Statewide Angler Surveys conducted over the period of 1989-2009. A trend analysis of; freshwater and saltwater species preferences, participation in saltwater and freshwater angling, motivations, consumptive orientation,

preferred angling locations, and place of residence were all examined over this period. Results indicate changing target species preferences of fresh and saltwater fishes, location of residence, preferred angling location and consumptive orientation among anglers. As these variables change, so do the relative angling pressures faced by Texas inland and coastal waterways. The results from this analysis have implications for shaping future management decisions related to fisheries in Texas. As the population of Texas anglers evolves so to must the management of fisheries resources.

Effects of groundwater and spring influenced communities on downstream riverine assemblages in the Llano River

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Stream fish assemblages consist of a dynamic mosaic shaped both spatially and temporally by the physical habitat parameters that influence species' distribution. Karstic spring-fed streams of the Edwards Plateau, Texas, consist of a groundwater influenced gradient based on proximity to spring seeps and outflows. Spring-associated communities have received much attention in the literature; however, the effects of spring-influenced communities on riverine assemblages within lower river reaches have not. The objective of this study was to assess the influence of spring flows and spring-influenced assemblages on the downstream riverine communities in the Llano River, Texas. Habitat associations were quantified seasonally across nine sites in the Llano River for one year. Shifts in association and community structure were analyzed to assess variation due to environmental variability in relation to groundwater influence.

An assessment of habitat suitability in Galveston Bay for juvenile southern flounder (*Paralichthys lethostigma*)

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Factors influencing suitable habitats of juvenile southern flounder (*Paralichthys lethostigma*) within the Galveston Bay Complex (GBC), Texas, were assessed using generalized additive models (GAM). Fishery independent data collected with bag seines throughout the GBC from 1999-2009 were used to predict the probability of southern flounder occurrence. Binomial GAMs were used to assess presence/absence of southern flounder and models included temporal variables, benthic variables such as distance to habitats generated within a geographic information system, and physicochemical conditions of the water column. Separate models were generated for newly settled southern flounder, young-of-the-year (YOY) southern flounder observed in summer, and YOY southern flounder observed in fall based on size and collection month. Factors affecting southern flounder occurrence changed seasonally, as did the corresponding shifts in the spatial distribution of suitable habitat. Temporal effects (year and month) were retained in all models. Physicochemical conditions (temperature, turbidity, and measures of environmental variability), and the presence of seagrass beds were influential for newly settled southern flounder. Distance to marine and/or freshwater sources were found to be important for YOY southern flounder in the summer and fall seasons. The abundance of brown shrimp was found to only influence the distribution of YOY southern flounder in the fall, when intermediate abundances of the potential prey item increased the occurrence of southern flounder. After model completion, the availability and spatial distribution of suitable habitat within the GBC was predicted using available environmental and spatial data for 2005. Spatial distributions of predicted suitable habitat stress the relative importance of West Bay during the newly settled stage and in the fall season, and Upper Bay during the summer and fall of the first year of life. These models demonstrate the potential dynamics of suitable habitats for juvenile southern flounder and provide insight into ontogenetic shifts in habitat preference during the first year of life.

Effects of recreational activities on the spatial and temporal trends in habitat associations for the fish assemblage of the San Marcos River

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The effects of anthropogenic influence on aquatic ecosystems are often difficult to quantify, as a number of factors contribute to the dynamic structure of aquatic communities. Recreational use of spring-fed aquatic ecosystems is well documented; however the effects of recreational activities on fish community structure are not well known. The upper San Marcos River is a spring-fed system in central Texas characterized by intermittent corridors of high to low recreational use areas and supports a unique fish community. The purpose of this study was to quantify the effects of recreational activities on the fish assemblage and the habitat associations of the upper San Marcos River. From January through December 2011, eighteen sites along the upper San Marcos River were sampled quarterly to assess spatial and temporal trends of fish community composition. Observed trends in fish occurrences were associated with habitat, site, season and recreational effects. Recreational use will likely continue to increase in the San Marcos River, but options are available for continued recreational use while maintaining adequate protection for the San Marcos River fish community.

Perceptions of spotted seatrout decline and associated displacement behavior among Texas inshore fishing guides

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In 2010, a growing concern among anglers regarding perceived spotted seatrout (*Cynoscion nebulosus*) population declines prompted the Texas Parks & Wildlife Department Coastal Fisheries Division to conduct a series of public scoping meetings to gauge support for spotted seatrout conservation measures. Citing the lack of biological urgency and divided support for management options, the TPWD Coastal Fisheries Division declined to recommend regulatory changes. Regardless of actual spotted seatrout population declines, perceived declines may still have implications for fisheries managers. A perceived decline in the desired size or overall quantity of spotted seatrout among participants who target this species could lead to displacement. Displacement is a change in angler behavior in response to fisheries changes, such as declining fish stocks, and may lead to substitution of fish species, fishing method or location. To that end, this study investigated perceptions of spotted seatrout decline and associated displacement behavior among Texas inshore fishing guides based on geographic location (i.e. preferred bay system) and their preferred fishing style (i.e. four self-classification categories based on bait type, tackle type, fishing technique, casting tactic, water depth, and fish species). In the spring of 2011, a 12 page self-administered survey instrument was provided to all TPWD licensed recreational saltwater fishing guides (n=909) using a modified Dillman et al. (2008) approach. A total of 391 usable surveys were completed and exclusion of non-deliverables resulted in an overall response rate was 46%. Analysis of variance revealed significant differences exist among bay systems as well as preferred fishing styles with respect to: perceptions of spotted seatrout decline (e.g. decline in overall population, legal sized and over-sized spotted seatrout) and associated displacement behavior (e.g. fishing other bay systems, targeting alternative fish species, using other methods and baits, and travelling greater distances to fish). A full discussion of these differences will be presented.

Terrestrial subsidies in the diets of stream fishes of the USA: comparisons among taxa and morphology

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Terrestrial-aquatic linkages of energy and materials are crucial in many ecosystems and terrestrial food items are important energy sources to a wide array of fish species throughout the world. Using published values of the terrestrial food proportion of fish diets, we investigated the patterns of fish taxonomy and mouth morphology in the consumption of terrestrial food items by non-salmonid stream fishes in the USA. Trends emerged where certain cyprinids and fundulids consumed the most terrestrial food items (20 – 44%) but catostomids, cottids, moronids, and percids consumed little (< 2%) terrestrial food items. We also found that fishes with terminal jaw positions tend to consume more terrestrial inputs than those with sub-terminal and inferior jaw positions. Fishes of the same species demonstrate highly variable propensities for consuming terrestrial inputs and the results of this paper underscore the potential importance of terrestrial food items in the maintenance of stream fish communities across a wide range of taxa and habitats. Because terrestrial food consumption by fishes is highly variable, it will be necessary to assess the relative importance of terrestrial food items in fish communities on a case by case basis while simultaneously considering overall food availability and resource quality.

POSTER SESSION ABSTRACTS

Exploring the potential of species distribution models for bioassessment without reference sites

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Recent literature reviews on bioassessment research indicate an increase in questioning the implications of using reference sites to construct benchmarks in biological assessments, stating that the frequent use of least-disturbed sites in stream bioassessment supports management of steadily declining system health, especially in developed landscapes. We test an alternative approach of bioassessment using species distribution models (SDMs) as environmental filters to produce a predictive assessment of the deviation of fish composition from estimated potential richness. In order to validate and answer if and how this approach can replace multi-metric bioassessment protocols commonly used in the study area, we compare the performance of an observed/predicted metric for two survey datasets: The first consists of 90 comprehensively sampled sites that provide a robust approximation of presence, and importantly absence, for native fish species at each site, and thus serve as an independent validation of models. The second is a set of 91 sites sampled as part of a rapid bioassessment protocol and have associated multi-metric-based index of biological integrity scores. The linear relationship between the number of observed and predicted species per site was highly significant ($P < 0.001$) for both datasets, although the comprehensively sampled survey showed a stronger correlation (R^2 of 0.49 compared to 0.36). Observed/predicted ratios for the rapid bioassessment dataset showed a weak correlation with calculated IBI scores ($R^2 = 0.12, P = 0.001$). This study suggests that this method has much potential to provide a benchmark for ecological integrity analyses

without using reference sites. However, it remains unclear whether this approach can utilize rapid assessment sampling protocol, and much improvement in models is desired through increased species data and hydrologically relevant covariate data.

Oxidizing golden alga: controlling *Prymnesium parvum* (Haptophyta) cell density and toxicity using hydrogen peroxide

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Golden alga *Prymnesium parvum* has caused frequent massive fish kills in Texas inland waters since 1985, resulting in an estimated loss of over 33.4M fishes valued at US\$13M. Ammonium sulfate and copper algaecides are effective in controlling this alga; however, they present adverse environmental effects and copper compounds are under increasing regulatory scrutiny. We evaluated three oxidative compounds (hydrogen peroxide, StorOx[®], and GreenClean[®] PRO) for efficacy in controlling *P. parvum* cell densities and ichthyotoxicity. The tests were conducted under laboratory conditions on water samples from laboratory-grown cultures. GreenClean[®] PRO was also tested on water samples collected from two west Texas reservoirs (Colorado City and E.V. Spence reservoirs) during active golden alga blooms and fish kills. Hydrogen peroxide (≥ 58 mg/L), StorOx[®] (≥ 105 mg/L), and GreenClean[®] PRO (GCP ≥ 30 mg/L) were effective in significantly reducing *P. parvum* densities in laboratory-grown culture samples 48 h post-treatment. GreenClean[®] PRO (20 mg/L) also was effective in reducing densities of *P. parvum* and toxicity levels in reservoir water samples within 24 h of application. Field trials have further demonstrated the efficacy of GreenClean[®] PRO to control *P. parvum* blooms in small impoundments.

Current distribution of the largespring gambusia, *Gambusia geiseri*, in Texas

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The largespring gambusia (*Gambusia geiseri*) is a livebearing fish likely endemic to the headwaters of the San Marcos River. This stenoeicous species thrives in cool headwater spring habitats, and as a result of introductions for mosquito control, is now likely invasive in many springs throughout Texas. *Gambusia geiseri* is believed to be outcompeting its endangered congener, *G. nobilis*, in the San Solomon Spring in west Texas and may be a threat to other endemic spring-dwelling *Gambusia*. Thus, it is important to understand its current distribution. Approximately 13 years ago, in a series of studies, Clark Hubbs documented the distribution of *G. geiseri* through much of its range; however, many sites where *G. geiseri* occur presently were not explored or were unknown to Hubbs. Therefore, to update the current distribution of this species, we revisited all sites documented

by Hubbs, in addition to several other sites where *G. geiseri* now persists. We present updated results for the distribution of *G. geiseri* in Texas, providing an extensive documentation of its current range. We also provide rough estimates of population numbers at each locale (comparable to Hubbs).

Use of historical water quality data from Texas reservoirs to investigate associations between trends in water quality and the establishment of golden alga (*Prymnesium parvum*)

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Toxic blooms of golden alga (GA, *Prymnesium parvum*) have caused fish kills in several reservoirs of the Colorado River (CR) and Brazos River (BR) basins in Texas since 2001, typically in winter or spring. The environmental conditions responsible for GA becoming established in these reservoirs are unknown. One hypothesis is that their water quality changed over time and became favorable to GA around 2001. Seasonal Kendall Tau analyses were conducted on water quality/quantity data from GA-impacted and non-impacted reservoirs from the two basins to examine trends over long (ca. 1965-2010) and short (1991-2010) time spans. Classification tree analyses were used to model GA bloom occurrence from winter water quality data between 2001 and 2010 and identify water quality conditions associated with the blooms. The only consistent long-term trend across the landscape was for phosphorus, which increased over time in most reservoirs regardless of GA establishment. A decline in reservoir storage was the only consistent short-term trend and was also observed in both GA-impacted and non-impacted reservoirs. Classification tree analyses indicated that relatively high levels of specific conductance, chloride and sulfate (i.e., salinity) are associated with high probabilities of toxic bloom occurrence. In conclusion, trend analyses of available water quality data did not reveal any changes in ambient conditions that are temporally associated with the onset of GA blooms. This observation suggests either that the database used in this study does not contain the relevant variables that might have changed to create conditions favorable to GA, or that the onset of blooms in 2001 was caused by the de-novo introduction of GA into CR and BR reservoirs with pre-existing conditions favorable to its growth. Our results also suggest that relatively high salinity is an important condition for the establishment of GA in inland waters.

Land use practices in the upper Colorado River and Concho River basins, 1985-2011: associations with golden alga blooms

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The Upper Colorado River (UCR) and Concho River basins (CoR) in rural west Texas are part of the Colorado River watershed. Whereas several UCR reservoirs have experienced toxic blooms of golden alga (GA) since 2001, CoR reservoirs remain unaffected. Landuse practices can impact the quality of surface waters and consequently influence the distribution of aquatic biota. To determine if spatiotemporal differences in landuse practices are associated with the onset and distribution of GA blooms, this study examined changes (ca. 1985-2011) in landcover types, population densities, ground and surface water usage, and oil/gas well density in proximity (1 km) to perennial streams in each basin. The proportion of agricultural (crop) area was consistently higher in UCR than CoR; it declined somewhat in UCR but remained stable in CoR during the analysis period

(1985-2011). The proportion of developed area was similar between basins in 1985 and it remained stable in UCR, but increased in CoR from 1985 to 2011. Rate of combined (ground and surface) water usage was generally higher in CoR during the period examined (1985-2009). Although average density of unplugged oil/gas wells near perennial streams did not change during the analysis period in either basin, it was far higher (≥ 10 -fold) in UCR than CoR. Overall, this study did not reveal temporal changes in UCR landuse practices that can be associated with the onset of GA blooms in 2001. However, the spatial difference in oil/gas well average density between basins is notable. Along with differences in surface water sources, the large difference in oil/gas well density near perennial streams between basins could partially explain their known differences in surface water quality (e.g., salinity) which, in turn, could influence GA distribution.

County of origin of coastal fishing pressure by major bay system

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TPWD Coastal Fisheries determines the man*hours of fishing pressure and the county of origin of recreational anglers during routine exit surveys at boat ramps. The geospatial distribution of angling pressure was examined using GIS software. The spatial -distribution of a bay system's angling pressure is influenced by a county's proximity to the bay, the proximity of major metropolitan areas, and access to transportation corridors.

Are successful fish invasions only from species-rich into species-poor communities?

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Certain regions of the world (e.g. the Pacific coast of North America, western Europe, and southern Australia) contain a relatively high percentage of non-native freshwater fish species, while other regions report relatively few. Previous studies have attributed much of this geographic variation to different levels of economic development and human activity, which determine the number of both intentional and accidental introductions. Another potential factor is species tolerances to abiotic conditions within the receiving habitat. In spite of the fact that temperate-zone fishes should generally be more tolerant of warm temperatures in the tropics when compared to tropical fishes' limited tolerance of cold winter conditions in temperate regions, the dominant global pattern is that more tropical fish populations have become established within temperate regions than have temperate fishes within the tropics. Moreover, instances of successful establishment of non-indigenous tropical fishes within tropical habitats are comparatively rare. Reach-scale data indicating successful establishment of non-native fish populations within lotic ecosystems worldwide was compiled from ichthyological databases and published literature. Data were examined to determine patterns of native and non-native species richness as well as if non-native fishes were more likely to become established in reservoirs or other constructed lentic habitats. The overwhelming global trend appears to be that invasions into lotic waters are successful when the receiving fish fauna contains fewer native species than the donor fauna, with the donor fauna often containing substantially more species than the receiving fauna. This pattern suggests that coevolved ecological interactions within species-rich tropical rivers and streams prohibit establishment of non-native species that are relative ecological generalists from less-rich faunas. Data from several Texas drainages were used to determine if similar trends exist on a regional scale.

Status and distribution of freshwater mussels (Family: Unionidae) in the Leon River, Texas

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Freshwater mussels have suffered precipitous declines worldwide. Similar trends have been observed for mussel populations in Texas. The Leon River, a tributary of the Brazos River in central Texas, historically supported 16 species of unionids. Three of these species are state threatened and candidates for protection under the Endangered Species Act, including *Quadrula houstonensis* (smooth pimpleback), *Quadrula mitchelli* (false spike), and *Truncilla macrodon* (Texas fawnsfoot). Surveys conducted over a decade ago, utilizing an opportunistic sampling strategy at a small number of sample sites, suggest these populations are declining. However, it is unknown whether these declines were real or an artifact of insufficient sampling effort. Therefore, our objective was to examine whether *Q. houstonensis*, *Q. mitchelli*, and *T. macrodon* are still extant in the Leon River and to assess the distribution and abundance of rare and common mussel species in this river drainage. We observed 2081 individuals from 12 species across 52 sites. Our surveys failed to detect *Q. mitchelli* and *T. macrodon*, but *Q. houstonensis* was observed with the highest relative abundance (31%). Species richness per site ranged from 0-9 species ($\bar{X} \pm SE$; 3.75 ± 0.35). Catch-per-unit-of-effort (CPUE) per site ranged from 0.00 to 89.67 individuals/person-h (14.82 ± 3.15). Species richness and CPUE were highest in the middle reaches and lowest in the upper and lower reaches of the Leon River. This is likely attributed to Proctor Lake and Belton Lake dividing the upper and lower most portions of the Leon River, indicating these reservoirs may be influencing mussel community composition.

Status of the endangered Pecos gambusia (*Gambusia nobilis*) and Comanche Springs pupfish (*Cyprinodon elegans*) in Phantom Lake Spring, Texas

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Desert springs of the American Southwest are home to many endemic fishes, including the Pecos gambusia (*Gambusia nobilis*) and the Comanche Springs pupfish (*Cyprinodon elegans*). Both fishes inhabit the Balmorhea Springs Complex in west Texas and are federally listed as endangered. Historically, several of the springs within this complex were dried due to agricultural use of the water. However, efforts were made to restore some of the springs and preserve the organisms living in them. Both *G. nobilis* and *C. elegans* inhabit Phantom Lake Spring, the headwaters of this complex. Until recently, this spring and its two endangered fishes have not been monitored regularly. Therefore, it was our goal to census both species over two seasons in 2010 (spring and

summer) to update their current status within Phantom Lake Spring. We also sought to determine whether the introduced largespring gambusia (*G. geiseri*) - or any *G. nobilis*-*G. geiseri* hybrids - were present in the spring. Finally, we present habitat parameters for the spring and its adjacent canal. Here, we present data from our first full census of the spring, which will complement a long-term monitoring program.

Shoaling preferences between two sympatric livebearing fishes in Texas and their putative hybrids: the endangered Pecos gambusia (*Gambusia nobilis*) and the largespring gambusia (*Gambusia geiseri*)

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There are several documented cases of hybridization in livebearing fishes (family Poeciliidae). In particular, the introduced largespring gambusia (*G. geiseri*) and endangered Pecos gambusia (*G. nobilis*) coexist in the San Solomon Cienega in west Texas and are thought to be hybridizing. Research also suggests that the invasive may be gradually replacing the endangered species in the cienega, a cause for concern because this is one of the few remaining habitats for the Pecos gambusia. Investigating association and shoaling behaviors to determine preference for conspecifics vs. heterospecifics is a first step in understanding potential for interbreeding between the two species. Here we conducted a series of preference experiments using both visual and olfactory cues for both association time and shoaling behaviors. Each experiment was fully crossed, testing males and females for both species and putative hybrids. Only *G. nobilis* females showed any association preferences, and this preference was for the conspecific male. Moreover, activity level of the males significantly predicted female association time, and activity peaks were different between the two species. Both *G. nobilis* and *G. geiseri* females prefer their own species when tested with heterospecifics vs. conspecific shoals. But, both also preferred mixed shoals when given that option. In general, *G. geiseri* females showed stronger shoaling preferences than *G. nobilis* and putative hybrids, and this preference was largely for conspecifics and/or mixed shoals. Preferences for mixed shoals may be a means to reduce intraspecific competition, as female *Gambusia* are quite aggressive. *G. nobilis* males showed preferences for conspecific shoals, but *G. geiseri* males showed no preference. This study is an important step in understanding behavioral mechanisms that might mitigate or prevent hybridization between these two species.

Reproductive investment of two *Gambusia* congeners and their putative hybrids in west Texas

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Hybridization events between native and invasive species can be detrimental to natural populations, and as a result, native species may experience a decrease in fitness or increased viability of hybrid offspring. In both of cases, native species are lead towards extirpation, thereby decreasing biodiversity. In west Texas, *Gambusia nobilis* (endangered) and *Gambusia geiseri* (introduced) are sympatric in several springs and are thought to have recently established hybrid zones in some of these locations. In the current study, 13 possible *G. nobilis*- *G. geiseri* adult hybrids were identified and isolated. We observed parturition of newly hatched offspring from the tank that held only putative hybrid females. This observation suggests that hybrid individuals are capable of reproduction and are backcrossing with their parental species. Further, we attempted to verify hybrids using geometric-morphometric analysis and compared fecundity of hybrids with both *G. nobilis* and *G. geiseri* females. Results show that putative hybrids resemble *G. nobilis* morphometrically, but overlap substantially with both species. Finally, we report on the life history (reproductive investment) of males and females for both species, and female putative hybrids. These data could provide information on the dynamics between *G. nobilis* and *G. geiseri* and allow for a more comprehensive conservation plan for *G. nobilis*.

Drought conditions threaten the lower Neches River and Big Thicket National Park

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Concerns have escalated regarding environmental flow regulations of the lower Neches River in times of drought. These concerns primarily surround rising salinity and pollutant levels. The portion of the Neches below the salt-water barrier (located near Beaumont) receives up to 65 million gallons of paper mill effluent per day; a permitted discharge that is not reduced unrestricted during periods of low flow. In order to formulate environmental flow recommendations, fish were sampled using experimental gill nets along the lower Neches. Two of three gill net surveys conducted during fall 2011 yielded few fish. Salinity levels during these surveys were relatively high (approximately 15 ppt near the bottom), and rainfall during the previous weeks was 0 - 1 inch. The third gill net survey produced the most fish; salinity at this time was 6-7 ppt, and rainfall during the previous week ranged from 2.7 inches to 6.4 inches in surrounding areas. Water above the barrier had lower salinity, lower conductivity but similar dissolved oxygen (DO) levels compared with water sampled below the barrier; however, DO was lowest in water near the paper mill effluent discharge. Results indicate water quality in the lower Neches below the salt-water barrier deteriorates during times of low flow. This results from lack of dilution of dissolved organic material introduced from the paper mill effluent. It also appears that freshwater flows during drought conditions are insufficient to maintain the current vegetation community in the Lower Cypress Tract. Salinities of

10 ppt are reported to be lethal for bald cypress. Future studies will include comparisons of ecological conditions in the lower Neches River above and below the salt-water barrier to conditions in the neighboring Sabine River, which also empties into Sabine Lake but lacks a salt-water barrier.

Influence of bioenergetics on habitat associations of two Texas darters

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Orangethroat and greenthroat darters are sympatrically occurring species in several river systems across the Edwards Plateau of Central Texas, including the Llano River. Previous studies assessed spatial and temporal trends of physical habitat associations and found differing selection preferences between orangethroat and greenthroat darters. The objective of this study was to supplement previous findings by assessing the contribution of physiological differences to habitat associations by measuring standard metabolic rate and lactic acid production. Underlying physiological differences among taxa might provide a mechanism for observed patterns in habitat segregation among congeners. Fish were collected from June to November 2011 and held four to six weeks before testing. Standard metabolic rate (SMR) was measured using closed-cell circuit respirometry at four temperature treatments. Lactic acid production was measured by blood lactate assay. Preliminary findings suggest a disparity in metabolic rates and stress tolerance.

Temperature modulation of growth and physiology of Guadalupe bass (*Micropterus treculii*)

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The Guadalupe bass (*Micropterus treculii*) is a stream dwelling micropterid native to the Edwards plateau region of South-Central Texas and a species of state special concern due to limited natural range and genetic introgression with introduced micropterids. In support of hatchery and management efforts to re-establish healthy populations of Guadalupe bass, we determined the effect of temperature on growth, body condition (K), hematocrit, and liver index using five temperature treatments (18, 21, 24, 27, and 30 °C) that reflect their native temperature regime during spring and summer in the Llano River. We used six Living Stream systems each with 30 individuals. Fish were fed once per day to satiation and water quality was monitored daily. Fish were anesthetized prior to blood sampling using tricaine methanesulfonate. For statistical analyses, we treated the means of the 30 individuals across the six Living Streams as independent observations ($n = 6$) and used linear regression in order to test of significant effects of temperature. We found significant treatment effects of temperature on % growth by length ($P = 0.042$, $r^2 = 0.88$), body condition ($P = 0.049$, $r^2 = 0.66$), and liver index ($P = 0.041$, $r^2 = 0.88$). The best fit model for temperature versus % growth in length and liver index was polynomial. The optimal temperatures were 28.1 °C for % growth in length and 23.6 °C for liver index. The relationship between temperature and hematocrit was linear so an optimum was not generated. These results will help guide hatchery protocols for future Guadalupe bass stocking efforts and provide some predictive models for production. Additionally, these results will provide managers of wild Guadalupe bass populations with some predictive basis

for the growth of this species and some physiological parameters that might be useful in the future development of bioenergetics models.

Temperature thresholds of the invasive Harris mud crab, *Rhithropanopeus harrisi*

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The Harris mud crab, *Rhithropanopeus harrisi*, is a small crab generally found in brackish water along the coast of Texas, Louisiana and Florida. In recent years the crab has expanded its range to freshwater lakes and reservoirs in Texas, California and Oregon. In 1998 the Harris mud crab was first spotted in Possum Kingdom Lake. Since then it has been found in Granbury reservoir, E.V. Spence, Colorado City, Tradinghouse Creek, Balmorhea and Whitney reservoirs. They are reproducing and are well established in these reservoirs. Based on their native distribution they would appear to have a fairly wide temperature tolerance. However, freshwater habitats are generally more variable in temperature than marine habitats, and knowing the temperature tolerance of this crab may help in predicting habitats that may or may not be at threat for invasion. This project investigated the critical thermal maximum for the Harris mud crab. We examined survival at various temperatures over a period of 14 days. All crabs survived temperatures of 20°C, 25°C, and 30°C; however at 35°C, all crabs perished by 12 days. Future research will investigate the critical thermal maximum with more precision, as well as the affects of different acclimation temperatures on the critical thermal maximum.

Conceptual framework to assess the effects of the wildland fire and fire suppression tactics on aquatic communities

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A total of 1.3 million acres burned within watersheds of Texas Gulf Slope streams in 2011, including 828,000 acres of mixed use land that border ecologically significant stream segments. Studies assessing the effects of fire on aquatic communities are limited primarily to montane wildlands and might not be applicable to the arid and semi-arid regions of the western gulf slope drainages of Texas. To better understand and manage the land-water interactions within the western gulf slope drainages, we propose a conceptual framework to serve as a basis for testing hypotheses on initial, mid and long-term effects of wildland fires on aquatic communities and for assessing factors that mitigate the effects (i.e., burn intensity, distance from stream reach, resiliency of the aquatic community). Opportunistic sampling of the associated initial community response from two recent fires (Canon Ranch Fire, Independence Creek Drainage, Terrell County; Oasis Ranch Fire, South Llano River drainage, Kimble County) provided an example of how empirical studies populate the framework with replication over time.

Variation within the mitochondrial genome of the bull shark, *Carcharhinus leucas*

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As apex predators, bull sharks (*Carcharhinus leucas*) serve a vital role in structuring ecosystems, necessitating their conservation for ecosystem based fisheries management. Protecting nursery grounds for these predators requires their delineation and is essential to shark conservation. The Texas coast has numerous areas of potential nursery habitat. Understanding stock structure among these sites will aid managers in applying proper management. We are examining the mitochondrial genome (mtDNA) of the bull shark for variation in loci commonly used in genetic studies. The purpose of this study is to survey amounts of variation in potential markers for studying genetic population structure. We amplified and sequenced three loci (NADH dehydrogenase subunit 4 or ND4, cytochrome oxidase subunit I or COI, and the Control Region) from seven western Gulf of Mexico sharks to determine the amount of variation present within each locus. We are comparing haplotype and nucleotide diversity estimates for each locus. Haplotype networks will be constructed for each locus to determine the number and relationship of haplotypes. So far, ND4 is not variable in our study region. The information we gather will inform proper marker selection in future population structure studies. Ultimately, these future studies will help delineate bull shark nursery grounds along the Texas coast, providing managers with a valuable tool in shark conservation.

Life history and population status of burrhead chub *Macrhybopsis marconis* in three western gulf slope drainages of Texas

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Burrhead chub (*Macrhybopsis marconis*) is endemic to Western Gulf Slope drainages of Texas and reproductive ecology and conservation status of the species are poorly understood. In 2007-2008 we collected burrhead chub monthly from a stable population in the lower Guadalupe River of Texas to describe aspects of reproductive life history including population structure, longevity, age at maturity, clutch production (i.e., single or multiple), and reproductive season timing and length. We also reviewed historical collections of burrhead chub in three Western Gulf Slope drainages (San Antonio, Guadalupe, Colorado) to describe population status of the species throughout its distribution. Results suggest burrhead chub in the lower Guadalupe River live 2.5 years, reach reproductive maturity at ~40 mm total length (age 1), and spawn multiple clutches during a seven month period ranging March-October. Review of historical collections and literature revealed populations in lower portions of the San Antonio, Guadalupe, and Colorado basins have remained stable through time. However, populations in fragmented upper sections of each river basin have either declined or become extirpated. Stream fragmentation was coincident with decline of the species and we found accounts of fragmentation associated with burrhead chub declines dating back to 1955. These findings support previous works relating the decline of species belonging to the *Macrhybopsis* genus to stream fragmentation and suggest maintenance of connectivity is likely required for long-term persistence of the Texas-endemic burrhead chub.

Mating behaviors of two sympatric livebearing congeners and their putative hybrids

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The endangered Pecos gambusia (*Gambusia nobilis*) and the introduced largespring gambusia (*Gambusia geiseri*) occur sympatrically in some headwaters of west Texas. In the San Solomon Cienega (located at Balmorhea State Park) the two species likely compete, and are thought to hybridize. In order to assess potential for hybridization, we must understand general mating behaviors and patterns for parental species. Here, we tested male and female mating behaviors of *G. nobilis* and *G. geiseri* in dichotomous and open water choice experiments. In forced choice experiments (one male and one female), both species preferred to copulation with conspecifics. *G. geiseri* males did not mate with *G. nobilis* females, but *G. nobilis* males did attempt matings with *G. geiseri* females. In open choice experiments (one male and two females) males also preferred conspecific females; however, males of both species also mated with heterospecifics. In general mating behaviors increased in the presence of competing females, which may drive increased matings with heterospecifics. Peak mating times occurred between dawn and dusk for both species. These results indicate that heterospecific *Gambusia* are in fact mating in at least one habitat in which they overlap. Subsequent studies should focus on understanding dynamics of shoals and frequency of matings with heterospecifics in the wild.

Bottom-up and top-down impacts on contaminant flux from aquatic ecosystems

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Aquatic ecosystems export organic matter and nutrients to the terrestrial environment in the form of emergent aquatic insects. This flux of resources can provide a critical subsidy to consumers in terrestrial ecosystems. However emergent insects may also transport contaminants from aquatic ecosystems to terrestrial consumers (the dark side of subsidies). Although there has been some recognition that emerging insects are a potentially significant source of contaminants to terrestrial consumers, very few studies have examined the factors that influence the flux of contaminants out of aquatic ecosystems via emergent insects. In this study, we used experimental mesocosms to explore how nutrient input and the presence of predatory fish influence the flux of mercury via emerging insects out of aquatic ecosystems. Mercury is one of the most hazardous and widespread environmental contaminants. We demonstrated that the flux of mercury from aquatic to terrestrial ecosystems is strongly enhanced by bottom-up nutrient effects and diminished by top-down consumer effects. Our results indicate that eutrophication and the alteration of fish communities, two common anthropogenic impacts on aquatic ecosystems, have the potential to impact the flux of mercury and its transport into terrestrial food webs.

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