ANNUAL PROCEEDINGS
of the
TEXAS CHAPTER

AMERICAN FISHERIES SOCIETY

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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.

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ANNUAL PROCEEDINGS OF THE TEXAS CHAPTER AMERICAN FISHERIES SOCIETY

Annual Meeting
27-31 January 2009
Fort Worth, Texas

Held in conjunction with the 2nd International Golden Alga Symposium

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Abstracts and manuscripts for papers presented during the 2nd International Golden Alga Symposium are not included in these Annual Proceedings of the Texas Chapter American Fisheries Society, but will be published in 2010 as a special publication of the Journal of the American Water Resources Association (Volume 46).

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

PAST TEXAS CHAPTER PRESIDENTS AND MEETING LOCATIONS

Date	President	Location
1976		College Station
1976	Ed Bonn	Lake Brownwood
1977	Jim Davis	San Antonio
1978	Bill Rutledge	San Marcos
1979	Bobby Whiteside	College Station
1980	Richard Noble	Arlington
1981	Charles Inman	Austin
1982	Gary Valentine	Kerrville
1983	Don Steinbach	Lake Texohoma, OK
1984	Gary Matlock	Port Aransas
1985	Maury Ferguson	Junction
1986	Brian Murphy	San Marcos
1987	Joe Tomasso	Kerrville
1988	Dick Luebke	Abilene
1989	Mac McCune	San Antonio
1990	Bobby Farquhar	Lake Texohoma, OK
1991	Gene McCarty	Galveston
1992	Bill Provine	Kerrville
1993	Barbara Gregg	Port Aransas
1994	Loraine Fries	Lake Travis
1995	Pat Huston	College Station
1996	Mark Webb	Pottsboro
1998	Katherine Ramos	Athens
1999	John Prentice	Corpus Christi
2000	Paul Hammerschmidt	Bossier City, LA
2001	Charles Munger	San Marcos
2002	Gordon Linam	Junction
2003	Gene Wilde	Galveston
2004	Gary Garrett	College Station
2005	Fran Gelwick	Grapevine
2006	Dave Terre	San Antonio
2007	Debbie Wade	Lake Jackson
2008	Art Morris	Junction
2009	Tim Bonner	Fort Worth

TEXAS CHAPTER AWARDS RECIPIENTS

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

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

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

1980 None

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

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

1983 Special Recognition - Robert Kemp (TPWD)

1984 None

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

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

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

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

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

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

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

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

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

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

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

1996 Fisheries Education - Billy Higginbothan (TAMU)
Fisheries Management - Gary Garrett (TPWD)
Fisheries Administration - Gene McCarty (TPWD)
Fisheries Research - Ivonne Blandon (TPWD)
Special Recognition - Reeves County Water Improvement Board
Best Presentation (s) - Craig Paukert (OSU), Gene Guilliland (ODWC)

Scholarships - Chad Thomas (TXSTATE), Anna-Claire Fernandez (UTMSI), Kenneth Ostrand (TTU), Dawn Lee Johnson
Technical Support - Jimmy Gonzales (TPWD)
Honorable Mention (technical support) - Eric Young (TPWD)

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

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

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

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

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

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

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

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

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

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

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

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

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
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 Commisson 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
USFW – 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

Paddlefish Ranching Effects on Plankton in Missouri Lakes

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C. Hicks *(Department of Agriculture & Environmental Sciences, Lincoln University of Missouri, Jefferson City, Missouri 65101)*
J. Parcell *(University of Missouri – Columbia, Coumbia, Missouri 65211)*
C. Boessen *(University of Missouri – Columbia, Columbia, Missouri 65211)*

Paddlefish, *Polyodon spathula*, is an endemic filter-feeding fish. Interest has been generated by the good quality caviar produced and by its declining populations in most rivers. Another area of interest is the effect of the filter-feeding mode of nutrition on the plankton of lakes and ponds. In experimental mesocosms, juveniles (10-20 g) have shown the potential to reduce HAB algae. However, reduction in zooplankton by paddlefish filter-feeding could negatively affect fish recruitment. Ranching involves stocking low densities (10-20/ha) in private water bodies at no cost and returning after 8-10 years to harvest mature marketable paddlefish (20-30 kg). The owner receives a payment based on the weight and sex (females are more valuable due to the roe). For these reasons, a study was undertaken in ponds and lakes in central Missouri where paddlefish juveniles had been stocked for ranching purposes. Sampling was performed monthly during the summer-fall in 5 stocked and 5 unstocked lakes greater than 1.2 ha for two years. Water samples for phytoplankton and zooplankton were taken from the upwind and downwind ends of the ponds and combined. Although effects were noted on plankton from paddlefish, climatic differences between the two years were judged the more important factor. HAB algae (*Microcystis cyanea*, *Aphanizomenon* sp. *Anabaena* spp.) were present, and somewhat reduced in incidence the first year in paddlefish lakes, but not in the second year. Experimental control of HAB algae by fingerling paddlefish may be due to the higher stocking levels (1360 kg/ha vs. ranching harvest biomass of 300-600 kg/ha) or the earlier life stage. Paddlefish, as seen in another filter-feeding fish *Oreochromis aureus*, seemed to accelerate normal species succession and reduced boom and bust cycling. Zooplankton were at times and by group reduced (and stimulated) by paddlefish, but levels were judged to remain adequate for planktivores, including fish fry, populations.

Blooms of Toxigenic *Prymnesium parvum* in Lake Texoma: What Can We Learn from Environmental Monitoring?

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James Easton *(University of Oklahoma Biological Station, University of Oklahoma, Norman, Oklahoma, 73019)*
Richard M. Zamor *(Department of Zoology and Biological Station, University of Oklahoma, Norman, Oklahoma 73019)*
Anne Easton *(University of Oklahoma Biological Station, University of Oklahoma, Norman, Oklahoma, 73019)*
Karen G. Looper *(University of Oklahoma Biological Station, University of Oklahoma, Norman, Oklahoma 73019)*

Toxigenic golden algae, *Prymnesium parvum*, first appeared and bloomed in Lake Texoma, Oklahoma-Texas, during winter 2003-04 causing massive fish kills around the lake. They have been permanent winter residents since, blooming again in 2005-06, 2006-07 and 2007-08. Lake Texoma, an impoundment of the Red and Washita Rivers, is a complex dendritic system with many diverse habitats, including extensive wetlands and shallow coves, flooded tributary mouths, semi-enclosed and isolated bays, and marinas, as well as riverine and pelagic habitats. While Lake Texoma is among the largest impoundments yet to be affected by *P. parvum*, blooms have thus far been restricted to western shallow habitats associated with the Red River. Intense monitoring since 2006 has revealed significant differences in temperature, pH, salinity, nutrients, and microbial and crustacean zooplankton populations between areas of the lake with and without *P. parvum* blooms. Analysis of these patterns

in light of recent experimental results has yielded testable hypotheses regarding potential management scenarios aimed at curbing blooms and fish kills.

Chemical Signatures Associated with *Prymnesium parvum* Blooms in Texas Waters

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Greg Southard *(Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, San Marcos, Texas, 78666)*
Gary Steinmetz *(Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, San Marcos, Texas, 78666)*
Steven Hamby *(Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, San Marcos, Texas, 78666)*
Loraine Fries *(Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, San Marcos, Texas, 78666)*

A statewide study was conducted to test whether specific water chemistry is associated with *Prymnesium parvum* occurrence in Texas waters. We examined thirty-four different analytes to see if their presence was correlated with measurable densities of *P. parvum*. Twenty-seven of the analytes were metals, many of which were highly correlated. We reduced the dimensionality of the problem by creating five principal component axes, which explained 73.5% of the variance. We used these five axes and the time of the sampling to develop a classification tree for predicting *P. parvum* presence. After the initial fit, potential trees were pruned and refit using cross-validation to reduce overfitting. We found that the first two axes of the PCA, along with month, classified the blooms with 8% misclassification. We also examined seven anions, and estimated a classification tree for predicting *P. parvum* presence. The algorithm suggested that chlorine and fluorine concentrations could be used to classify the densities, with 7% misclassification. We then added the signals for the metals to the anions, but found no benefit of adding the metals data. While our analyses were unable to isolate conditions that were always associated with *P. parvum* presence, our analyses do suggest there are conditions during which *P. parvum* is more likely to occur.

Prymnesium parvum Cell Counts, Intensity of Fish Kills and In-situ Water Quality Monitoring of Two Winters on the Three Brazos River Lakes - 2006 to 2008

Joan Glass *(Texas Parks and Wildlife Department, 1601 E. Crest Drive, Waco, Texas 76705)*

Relationships of water quality and weather during a winter of fish kills and a winter of very little activity by *Prymnesium parvum* in the Brazos Basin, Tx. Use of plankton dominance, *P. parvum* cell counts, toxicity to fish and intensity of blooms compared to Brazos River Authority lake levels and the Texas Commission on Environmental Quality Real Time Monitoring Station data from the headwaters of each of the three lakes on the Brazos River.

Use of Nitrogen and Phosphorus to Control *Prymnesium parvum* and Aluminum Sulfate to Mitigate pH in Striped Bass Fingerling Rearing Ponds

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Gerald L. Kurten *(Texas Parks and Wildlife Department, Possum Kingdom State Fish Hatchery, 401 Red Bluff Road, Graford, Texas 76449)*
Aaron Barkoh *(Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, Mountain Home, Texas, 78058)*
Loraine Fries *(Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, San Marcos, Texas, 78666)*

Previous studies have shown that the addition of nitrogen (N) and phosphorous (P) at a rate of 30 µg P/L plus 300 µg N/L is effective at lowering *P. parvum* cell density and ichthyotoxicity. However, a significant obstacle to utilizing this technique effectively in striped bass culture ponds has been a parallel increase in pH to levels (up to 10.8) that are toxic to striped bass fry and fingerlings. In this experiment, we evaluated aluminium

sulfate (alum) for its efficacy in lowering pH in ponds that received 30 μg P/L plus 300 μg N/L fertilizations for *P. parvum* control. Ten ponds (0.1-ha each) were utilized in the study, all receiving 30 μg P/L plus 300 μg N/L fertilization thee times weekly. Half of these ponds were treated with alum based on phenolphthalein alkalinity when afternoon pH levels exceeded 9.0 on a one-to-one ratio (e.g. for 1 mg/L phenolphthalein alkalinity, 1 mg/L alum was applied). The remaining ponds received no alum and served as controls. Striped bass fingerlings were produced in these ponds in 40-d. *P. parvum* ichthyotoxicity was not detected at pond filling or during the experiment; cell densities also were low or not detectable throughout the experiment. The 30 μg P/L plus 300 μg N/L without alum treatment had a mean afternoon pH of 9.79 and striped bass fingerling survival of 0%. The 30 μg P/L plus 300 μg N/L with alum treatment had a mean afternoon pH level of 8.99 and fingerling survival of 2.74%. Alum improved pH and striped bass production and appears to be a promising addition to managing *P. parvum* where pH is a problem. Future studies should investigate if higher rates or more frequent applications of alum are required to maintain pH levels conducive to striped bass fingerling production.

Preliminary Results of *Prymnesium parvum* Bloom Monitoring in Lake Whitney

David Buzan *(PBS&J, 6504 Bridge Point Parkway, Suite 200, Austin, Texas 78730)*
Meridith Byrd *(Texas Parks and Wildlife Department, Coastal Fisheries Division, Port O'Connor, Texas 77982)*
Janet Nelson *(Texas Parks and Wildlife Department, Coastal Fisheries Division, Austin, Texas 78744)*

Texas Parks and Wildlife Department, with assistance from the Texas Commission on Environmental Quality, monitored water chemistry, phytoplankton and zooplankton communities, toxicity, and fish die-offs in Lake Whitney from 2004 through 2008. Lake Whitney is a man-made reservoir on the Brazos River in north-central Texas, USA. The reservoir began experiencing fish die-offs resulting from *Prymnesium parvum* blooms in April 2001. The monitoring was conducted to target locations of blooms in the reservoir, seasonality of blooms, and water chemistry associated with pre-bloom, bloom, and post-bloom conditions.
Fish die-offs occurred during monitoring in the springs of 2004, 2005, and 2006. There was no fish die-off during the spring of 2008 during monitoring. Cell concentrations of *P. parvum* at times reached 100,000 cells/ml and 48-hr acute toxicity tests with fathead minnow larvae indicated LC50's at time with dilutions of less than 2% reservoir water. Zooplankton abundance tended to be lower during bloom conditions. Rainfall during 2007 in the reservoir's watershed lowered conductivity levels in the reservoir consistently below 1,800 μS by the fall of 2007 compared to levels in excess of 3,000 μS during the spring 2006 bloom. Toxicity and *P. parvum* cell concentrations typically declined from winter through spring. Comparisons will be made between water chemistry in successive years and between samples which were toxic and samples which were not toxic.

Impacts of Golden Alga on Fisheries Management in Texas Reservoirs, 2001-2008

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C. Craig Bonds*(Texas Parks and Wildlife Department, 11810 FM 848, Tyler, Texas 75707)*
Mandy Scott *(Texas Parks and Wildlife Department, 3407-A S. Chadbourne, San Angelo, Texas 76904)*
Greg Southard *(Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, San Marcos, Texas 78666)*
Brian Van Zee *(Texas Parks and Wildlife Department, 1601 E. Crest St., Waco, Texas 76705)*

The performance of many fisheries in Texas has historically been very cyclical due to large-scale fluctuations in water levels, often producing a "boom or bust" status for the fishery. During drought years fisheries management efforts in these reservoirs can be hindered by the low water levels whereas during wet years stocking efforts often combined with protective harvest regulations can be highly effective. Recently, the phenomenon of toxic golden alga blooms has added a new dimension to the management of these fisheries. Golden alga blooms have been recorded in eleven important waterbodies managed by the San Angelo district office of the Texas Parks and Wildlife Department's Inland Fisheries Division. Five fisheries have been severely impacted by recurring toxic blooms. Systematic monitoring of water quality and records of fish kills dating back to 2001, combined with fish population data over a broader period of time at three of these reservoirs provide some insight on the effect these toxic blooms can have on fisheries. In E.V. Spence Reservoir, fish kills in 2001, 2002, and 2003 effectively eliminated a once popular fishery. Subsequent restocking efforts have been hampered by toxic alga blooms and fish kills every winter since 2003. Colorado City and Moss Creek reservoirs were also severely impacted by toxic golden alga blooms over the same period of time. These fish kills, combined with other factors that provide conditions conducive to chronic toxic alga blooms point to a somewhat tenuous co-existence of fisheries and golden alga in certain reservoirs of Texas.

Impacts of Golden Alga on the Fisheries in Two Central Texas Reservoirs, 2001-2008

Michael S. Baird *(Texas Parks and Wildlife Department, 8684 LaVillage Ave.Waco, TX 76712)*
John Tibbs *(Texas Parks and Wildlife Department, 8684 LaVillage Ave.Waco, TX 76712)*

Golden alga has killed millions of fish in Central and West Texas since 2001. Many sportfish populations have been devastated or severely impacted, while others have faired more positively. An aggressive sampling protocol, coupled with continued stocking of affected sportfish, has allowed TPWD to monitor the effects of golden alga on Lakes Whitney and Granbury, while maintaining functional fisheries in both. Although it's clear that golden alga has had some negative effects in Central Texas, fisheries data for many sportfish species collected post-alga is similar to data collected prior to 2001. This illustrates the incredible resiliency of fish populations to environmental catastrophes and validates the effectiveness of many current management efforts.

Golden Algae in Arizona

Bill Stewart *(Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, AZ 85086)*

In 2005 Arizona experienced major golden alga related fish kills at three of the four reservoirs located along the Salt River just Northeast of Phoenix. As a response, in May 2007 the Arizona Game and Fish Department initiated a research plan that involved testing two different methods of stocking. The goal of the study is to assess the current status of the largemouth and smallmouth bass populations, identify current angling catch, harvest and effort, develop a fish kill response protocol, and to evaluate the effectiveness of stocking many (~200,000) small (1-2 inch) bass in the spring versus fewer (~20,000) larger bass (6-8 inch) in the fall Preliminary findings from gill netting, electrofishing and creel surveys suggest that fishing effort at all three reservoirs is down compared to historical records and catch is down at two of the three reservoirs. Initial results also indicate that largemouth bass stocking efforts have had limited impact on two of the three reservoirs; while smallmouth bass populations, which were completely eliminated from the reservoirs following the 2005 kills, have had a positive impact. Upon the completion of the study in 2010, management recommendations will be developed with the goal of enhancing the current status of the fisheries at each of the three reservoirs to a historical level prior to the introduction of golden alga.

Low Salinity vs. Phosphate Deficiency in *Prymnesium parvum:* Possible Independent Regulation of Toxin Production

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The haptophyte *Prymnesium parvum* produces at least two toxic components whose functions are not entirely understood. These compounds cause hepatotoxic, neurotoxic, hemolytic, cytotoxic and ichthyotoxic responses in marine fauna, including in isolated tissues, and express possibly overlapping deleterious effects towards protists. Low salinity has been previously shown to increase the cellular toxicity of *Prymnesium* in culture. Recently, nutrient deficiency (of N & P) was also shown to enhance toxicity of *Prymnesium*l. Whether or not this enhancement involves an increase in the rate of production of these toxic compounds is still unknown. In this study, growth in low saline aqueous medium under P-deficiency in batch culture was investigated to determine if the combination of these factors can further enhance *Prymnesium* toxicity. Strain K252 was cultured at both 26 and 5 psu, with or without addition of an inorganic phosphate source to the culture medium. Intracellular lytic compounds of *P. parvum* cultures were tested using the fish Erythrocyte Lysis Assay (ELA), with saponin-equivalence units as proxy. Extracellular bioactive compounds were investigated via mortality rates of the cryptophyte *Rhodomonas baltica* exposed to differentially cultured *Prymnesium*. DNA microarray analyses to search for gene regulation patterns are currently underway. The combination of low salinity and P-deficiency enhances toxicity of this *Prymnesium* strain more than any individual factors. These results support the idea the production and/or secretion of lytic compounds in *P. parvum* may be independently regulated based on the availability of P-nutrients, as well as the salinity of the growth environment.

A Potential Explanation for pH-dependent Potency of *Prymnesium parvum* Toxins

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Prior research demonstrates that environmental conditions, such as light, temperature, and nutrient availability, affect growth and ambient toxicity of Prymnesium parvum; however, less is understood about factors that govern the behavior of the toxins once they are released into the water column. Prymnesin-1 and -2 have been identified as toxins and they are large, complex, and share components consistent with ionophoric compounds. The influence of pH on ambient toxicity was examined using toxicity identification evaluation procedures for samples collected from Lake Whitney, TX during a fish kill attributed to P. parvum, and in laboratory P. parvum cultures reared under conditions similar to those in Lake Whitney during the bloom. As with experiments conducted under marine and estuary conditions, ambient toxicity was reduced when pH was lowered in samples from a TX inland reservoir experiencing P. parvum blooms and for laboratory cultures in terms of cladoceran reproduction and fathead minnow survivorship. We hypothesized that pH-dependent responses were due to changes in ionization state of prymnesins and used ACD Labs modeling software to predict physiochemical properties. The modeled physiochemical properties of the prymnesins suggest that these toxins have pKa values around 9 (primary amine) and are weak bases. Coupling the results of laboratory and field studies with physiochemical modeling supports our hypothesis and provides a potential novel explanation for the observed pH-dependent toxicological relationship. Our findings further highlight how differences in site-specific pH may influence ionization state of P. parvum toxins, and ultimately influence ambient toxicity to aquatic life in TX inland waters.

Use of a Probiotic in Prevention of *Prymnesium parvum* Bloom Formation

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From 2006 to 2009 we tested a product called Clearwater Aqua Gold as a possible treatment for *Prymnesium parvum* caused fish kills. Small scale test showed reduction of *P. parvum* density with applications of Clearwater Aqua Gold and a pond level treatment regime is being evaluated. A single Aqua Gold treatment in the early fall of 2007 seemed to prevent *P. parvum* bloom formation the rest of 2007- 2008 season. Another treatment was not done prior to the 2008-2009 season and *P. parvum* was again found in water samples in Nov 2008. Two other lakes with *P. parvum* histories were treated in October of 2008 and are being evaluated. Preliminary results will be provided.

Impacts of Aquatic Vegetation Management on the Ecology of Small Impoundments

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Aquatic vegetation management and fisheries management are inseparable, however, conflicts are often perceived between the two. We investigated the effects of biological, chemical, and no vegetation control on the ecology of private impoundments stocked with largemouth bass and bluegill sunfish. Nine one-tenth acre ponds were obtained at the Aquaculture Research & Teaching Facility of Texas A&M University near Snook, TX in the fall of 2005. Southern naiad (*Najas guadalupenis*) was transplanted into each pond at a stocking rate of one ton per surface acre. The vegetation was allowed to grow and colonize the ponds over the winter so that southern naiad could become established. One of three treatments was then randomly assigned to each pond. The treatments were replicated three times and consisted of: an herbicide treatment using Reward and Cutrine, a triploid grass carp treatment, and an unmanaged control treatment. Fathead minnows (*Pimephales* promelas), bluegill sunfish (*Lepomis macrochirus*), and largemouth bass (*Micropterus salmoides*) fingerlings were stocked in each pond. The treatments were initiated on May 31, 2006. Prior to the initiation of the treatments, sampling of each pond occurred for hardness, total phosphorus, nitrite, nitrate, ammonia-nitrogen, dissolved oxygen, turbidity, pH, and temperature. Phytoplankton, zooplankton, and macroinvertebrate samples were collected from each pond. Post-treatment sampling was conducted on the Reward treatment and the control at day 2, day 7, day 14, day 28, and monthly there after. Post-treatment sampling on the triploid grass carp treatment was conducted at day 14, day 28, and monthly there after. Several ponds had major fish die-offs probably as a result of low dissolved oxygen. However, analysis of the water quality data, though highly variable, shows no significant differences between treatments. Analysis of phytoplankton and zooplankton samples has shown significant differences between ponds and treatments. Differences in species richness as well as biomass were observed between all ponds in the study. Marcoinvertebrate species richness and biomass appeared to be correlated with macrophyte abundance in each pond with no significant difference between treatments. Other aspects of the study will be discussed.

Gambusia speciosa as a Viable Species: a Resolution on its Distinction from *Gambusia affinis*

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Gambusia speciosa, Tex-Mex gambusia, was original described in 1859 (Girard) from the Rio San Juan in northern Mexico. Because of its morphological similarity to *Gambusia affinis*, western mosquitofish, its validity as a distinct species has been questioned. The latest revision of the genus by Rauchenberger (1989) provisionally treated it as a distinct species pending further investigation. In the nearly twenty years since that report no work on the subject has been published. The present study seeks to resolve the issue by examining gonopodial characteristics of fish from multiple river basins in and adjacent to its believed range in west Texas and Mexico. Using computer software, pictures were taken of gonopodia and a series of morphometric measurements were made on the bony structures that form the individual fin rays of the gonopodium. These data were then analyzed by river basin and site. Although this study is not complete, provisional data indicates that *G. speciosa* is morphologically distinct confirming Rauchenberger's assessment and thus warrants treatment as a full species.

Effect of Trawling and Habitat on Mercury Concentration in Juvenile Red Snapper, *Lutjanus campechanus*, for the Northern Gulf of Mexico

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We evaluated mercury (Hg) contamination in juvenile red snapper (< 250 mm total length) as indicators of Hg pollution on the northern Gulf of Mexico (GOM) continental shelf. Specifically, we examined the effects of fish size, commercial shrimp trawling, and habitat type on total Hg concentrations and $\delta^{15}N$ values (a proxy for trophic position) in red snapper. Red snapper Hg concentrations and $\delta^{15}N$ values were positively and significantly correlated with fish size. In addition, red snapper collected over trawled habitats had significantly higher Hg concentrations and $\delta^{15}N$ values than red snapper collected from similar non-trawled habitats. Red snapper also exhibited habitat-specific differences in Hg concentrations and $\delta^{15}N$ values, but differences were size-dependent and generally small. Our study suggests that Hg concentration of juvenile red snapper in the northern GOM are elevated in areas where commercial shrimp trawling occurs, possibly due to an increase in both red snapper trophic position and in bioavailable Hg that occurs in trawled areas. Additional studies are needed to determine if Hg concentrations in fish are elevated in trawled areas in other marine ecosystems.

Movement and Habitat Associations of Guadalupe Bass in two Texas Rivers

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Habitat degradation and introgression with introduced smallmouth bass have reduced the range and abundance of Guadalupe bass *Micropterus treculii*. Supplemental stocking of Guadalupe bass into its native range is used to mitigate or reverse introgression; however, aspects of autecology related to extirpations following habitat degradation are poorly understood. This study was developed to describe and quantify microhabitat scale associations of Guadalupe bass. During December 2007, Guadalupe bass were collected from the Pedernales River (n = 12) and South Llano River (n = 12) and surgically fitted with telemetry tags. Tracking was conducted January - August 2008 with diel tracking conducted seasonally. We measured and mapped available habitat in terms of depth, velocity, substrate, cover, etc for a 1 km reach of each river using GPS units at sub-meter accuracy. Guadalupe bass moved little during winter and exhibited increased movement during spring and summer. Nocturnal movement was not significantly different from diurnal movement; however habitat associations shifted from cover (diurnal) to open water (nocturnal). Cover type was associated with Guadalupe bass distribution during diel hours. Preliminary results suggest Guadalupe bass selected for undercut banks and roots during winter and large woody debris (LWD) and boulders and ledges during spring and summer. Nest site selection occurred within cover and included LWD and beneath boulders. Responses to a flood pulse on the Pedernales River indicated that Guadalupe bass seek current velocity refuges behind boulders and ledges. Habitat associations and movement suggest stream alterations such as dewatering and flood control may negatively affect density and dispersion of Guadalupe bass.

Effect of Floating Feed Rings in the Production of Advanced Channel Catfish *Ictalurus punctatus* Fingerlings

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Production of advanced (228- or 305-mm) Imperial strain channel catfish *Ictalurus punctatus* fingerlings at Texas Parks and Wildlife Department fish hatcheries occasionally exhibit poor growth and size variability requiring multiple grading of the fish. We investigated if feeding ring could improve size uniformity, weight gain, feed conversion ratio, harvest length, and total biomass of advanced channel catfish produced in plastic-lined ponds. The effect of feeding ring on water quality also was tested. Three ponds were each supplied with a floating 5.8- x 5.8-m enclosure (feeding ring) made from a 4-inch, schedule 40 polyvinyl chloride pipe to serve as the treatment group, and three ponds received no feeding rings (control). All ponds were subjected to advanced channel catfish production for 103 d. Fish from feeding ring ponds were significantly shorter, less heavy, but more uniform in length than those from control ponds. Fish biomass was lower and feed conversion ratio was higher for the feeding-ring ponds than for the control ponds. Measured water quality variables (water temperature, dissolved oxygen or pH) were unaffected by the feeding ring. Our results indicate that use of feeding ring to concentrate or prevent loss of floating catfish feed to the fish did not improve measured production variables except length uniformity.

Lake Conroe Re-vegetation: A Cooperative Management Project

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Lake Conroe is located approximately 93 km north of Houston, Texas on the West Fork of the San Jacinto River in Montgomery and Walker Counties. Constructed in 1973 as a joint project of the City of Houston, the Texas Water Development Board, and the San Jacinto River Authority (SJRA) to serve as an alternate water source for the City of Houston, the reservoir covers about 8,498 ha. An expanding problem with the invasive plant Hydrilla (Hydrilla verticillata) in 2006 prompted the creation of the Lake Conroe Vegetation Management Plan. The Texas Parks and Wildlife Department and SJRA developed the plan in cooperation with local homeowners, business owners, anglers, and other recreational users. The plan called for the reduction of hydrilla coverage to 16 ha or less by March of 2008 by means of integrated pest management while protecting and enhancing the native aquatic plant community in Lake Conroe. In order to support the plan's overall goal the Seven Coves Bass Club (a B.A.S.S. Federation affiliate) applied for and received a More Fish Partnership Fund Grant sponsored by the National Fish and Wildlife Foundation and B.A.S.S. Federation Nation to assist with native aquatic vegetation enhancement and exotic vegetation control. This presentation documents the process of the development of a native aquatic vegetation production facility by the Seven Coves Bass Club and the introduction of plants from that facility into Lake Conroe.

Fish Assemblage Structure and Associations with Environmental Conditions in a Texas Spring-fed River

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Numerous spring systems in the Edwards Plateau and Trans-Pecos regions of Texas support two distinct fish assemblages, spring-associated fishes and riverine fishes. Spring-endemic fishes are often concentrated near the spring source and rarely in the mainstem, whereas riverine fishes are common in the mainstream and absent or in low abundance near spring sources. Among environmental factors, constant water temperature is commonly recognized as the segregating factor, but these conclusions are based on data collected from assemblages that lacked adequate controls and independent treatment of temperature to distinguish whether temperature was the cause for segregation. Here we address the influence of water temperature, among other environmental conditions, on spatiotemporal patterns in fish occurrence and abundance along the Devils River, Texas. Multiple spring sources along a 64 km course of the Devils River allow an opportunity to test the influence of temperature on spatiotemporal patterns in spring fish occurrence and abundance. Seasonal transect sampling was used to gather fish assemblage and environmental data at four longitudinally arranged sites. Analysis of similarities (ANOSIM) was used to detect assemblage similarities among sites and canonical correspondence analysis (CCA) used to assess fish and habitat associations across sites and time. Occurrence and abundance of some spring-associated taxa (e.g., *A. mexicanus*, *D. argentosa*) were correlated with water temperature; however, others that were previously described as spring-associated taxa (e.g., *D. diaboli*, *E. grahami*) were not. Consequently, unregulated anthropogenic groundwater usage may result in diminishing abundances of some spring-associated taxa.

Covariation Among Plains Stream Fish Assemblages, Flow Regimes, and Patterns of Water Use

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Riverine fish assemblages on the North American plains continue to change as native species' distributions shrink and become increasingly fragmented due to impoundment, adjustment to changes in the quantity and quality of water, and the effects of introduced species. To identify important changes to fish assemblages and their environment, long-term data are needed. I used fish assemblage and discharge data from 22 Oklahoma plains river localities across nearly 20 years to identify potential covariation in fish assemblages and their riverine environment. I also obtained data on water-use at the watershed scale to determine its potential effects on flow regimes and fish assemblages. A modified time series analysis indicated that directional change was occurring for many of the fish assemblages, though the strength of this change was highly variable among localities. Directional change was strongly and positively associated with change in flow regime across the sample period, and change in flow regime was positively associated with watershed-level population-related variables, including number of wastewater facilities and returns. These results illustrate how demands on our water resources can ultimately influence riverine fish assemblages, largely by disrupting natural flow regimes. If global warming trends continue as predicted, the integrity of plains fish assemblages and their riverine environment will likely continue to decline, further exacerbating the fragmentation and reduction of species' geographic ranges.

Ammonia Tolerance by Striped Bass Fry and Fingerlings in Hard Water

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Ammonia toxicity to fish can be problematic in culture ponds that receive ammonium sulfate to control the toxigenic golden alga *Prymnesium parvum*. We quantified the LC_{50} and the no-effect level (NOEL) of un-ionized ammonia nitrogen (UIA-N) for 4-, 10-, 20-, and 28-d-old striped bass to provide guidance in managing ammonia levels in fingerling production ponds. Fish were exposed to UIA-N concentrations of 0 (control), 0.2, 0.4, 0.6, 0.8, 1.0, and 1.2 mg/L for 96 h at 20°C and pH 7.9-8.1 and mortalities determined at 24-h intervals. The relationship between UIA-N and fish mortality was modeled using logistic regression. We defined a UIA-N threshold (96-threshold) as the maximum concentration 89% of the fish survived in 96 h. The NOEL was estimated as nine percent of the 96-h LC_{50} for each age group. The 96-h LC_{50} for 4-, 10-, and 20-d-old striped bass were 0.36, 0.35, and 0.17 mg UIA-N/L, respectively. In the 28-d-old striped bass experiment, mortality never exceeded 50%; through data extrapolation, the LC_{50} for 96-h exposure was estimated to be 0.91 mg/L. The 96-threshold values were 0.13 mg UIA-N/L for the 4-d-old, 0.1 mg UIA-N /L for the 10-d-old, and 0.07 mg UIA-N/L for the 20-d-old fish. The NOEL for the 4-, 10-, and 20-d-old fish were 0.03, 0.03, and 0.01 mg UIA-N/L, respectively. These results suggest striped bass tolerance of UIA-N varies as a fish grows with the 20-d-old being the least tolerant of UIA among the age groups tested.

Coal-Fired Power Plants and Spatial Variation in Mercury Contamination of Largemouth Bass in Texas

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Mercury emissions from coal-fired power plants in Texas are among some of the highest in the USA. Fourteen power plants are located within a corridor that extends for 600 km from south-central to northeast Texas. To determine if mercury emitted from these power plants could be contributing to the contamination of fish in Texas, we surveyed mercury concentrations in largemouth bass (*Micropterus salmoides*) in aquatic ecosystems upwind (west) and downwind (east) of the power plants. We used largemouth bass as an indicator species because, as piscivores, they accumulate high concentrations of mercury. They are also a popular recreational fish species in Texas and routinely collected during fisheries surveys. In this study, we used combustion atomic absorption spectrometry to analyze the mercury concentrations in dorsal muscle tissue of largemouth bass collected during electrofishing surveys of Texas reservoirs. We combined our results with data from state and federal sources to create a database with mean mercury concentrations in largemouth bass from a total of 110 freshwater sites. Mean mercury concentrations in largemouth bass greater than 30 cm total length ranged from <100 to >1000 ng/g wet weight. Mercury concentrations in largemouth bass increased from west to east and were significantly higher downwind of the power plant corridor.

Evaluation of the Influence of Various Stream Substrates on Urban Fish Communities

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Increasing residential and commercial development in urban areas within the coastal watershed of the Gulf of Mexico has resulted in the need for more stream modification projects to reduce potential flooding risks. Local, state and federal agencies sponsor and utilize various engineering strategies to manage flood waters including the use of various substrates (earth, rip rap, concrete, articulated concrete block, and others) during stream channel modification projects. There is also a desire to utilize material that promotes and supports natural assemblages of stream fish fauna. In order to understand the effects of these various substances on fish, we conducted a preliminary study to evaluate the influences of these substrates under varying stream channel configurations on the distribution and abundance of fish organisms. Data collection was conducted at 13 sites at 5 wadeable urban streams during three sampling periods (early spring 2007, late spring 2007, and summer 2007). Multivariate analyses of various water quality and physical variables identified multiple factors that seem to influence the distribution of urban fish populations. We found that data from electroshocking collections tended to generally support our hypothesis that substrate type does influence fish communities. Higher diversity values and fish abundances were generally associated with larger more complex substrate which includes man-made concrete materials. In contrast, seining collections did not reveal a strong relationship between substrate and fish communities. This may be due to reduced collection efficiency caused by high stream flows and/or debris/snags which caused loss of catch at areas with complex substrate. The data were also biased due to the inability to collect fish by electrofishing at higher conductivity sites which possessed complex substrate. The results of this study represents the first year of a 3 year project. Future studies utilizing more powerful electrofishing gear will be conducted at the higher conductivity sites to provide a more accurate assessment of habitat use by fish. In addition, secondary habitat characteristics including prey abundance and invasive fish species will be evaluated.

Preliminary Results on the Life Histories of the River Darter (*Percina shumardi*) and the Guadalupe Darter (*Percina apristis*)

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The River darter, *Percina shumardi,* is a widely distributed fish ranging throughout the Mississippi River basin and north into Canada, with a disjunct population in the Guadalupe River, Texas. The Guadalupe darter, *Percina apristis,* is a newly described species, formerly a subspecies of *Percina sciera,* found in the San Marcos and Guadalupe Rivers. Specimens of *Percina shumardi* and *Percina apristis* were collected from two sites on the Guadalupe River and two sites on the San Marcos River, respectively, from October 2007 to September 2008. *Percina shumardi* are associated with packed gravel substrate in moderate current, while *Percina apristis* are associated with shallow, flowing areas over gravel and vegetation. Each fish was weighed and measured, and the gonads and stomach removed. Gonads were weighed and gonadosomatic index (GSI) calculated as the percentage of body weight made up by the gonads. Early results suggest that *Pecina shumardi* spawn between approximately December and April, whereas *Percina apristis* lacks a well-defined spawning season, as is typical of spring associated fishes.

Use of Dual Stable Isotope Analyses to Describe the Trophic Dynamics of Sciaenids in Galveston Bay, Texas

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Several different species of sciaenids are present in the Galveston Bay estuary that support important commercial and recreational resources along the northern Gulf of Mexico including spotted seatrout, sand seatrout, red drum, black drum, croaker, and spot. Because of their importance, the proper classification and assignment of these species to various food webs and trophic status for future modeling use in the estuary is essential. To do this, dual stable isotope analyses was incorporated with dietary data from the literature. The primary source of productivity utilized by an organism was determined through ^{13}C content while the trophic level was determined through ^{15}N. The final results should reveal the main source of primary productivity and the trophic position of each species for five different bays within the Galveston Bay Estuary Ecosystem (GBEE).

Seasonal Patterns of Population Structure, Reproductive Ecology, and Prey Selectivity of Texas Logperch in the Pedernales River, Texas

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Texas logperch *Percina carbonaria*, a Western Gulf Slope endemic, spends much of its life in rocky riffles and runs of small to medium-sized streams where it reproduces and forages. Although the conservation status of Texas logperch is currently stable, habitat encroachment and degradation collectively threaten long-term viability and therefore warrant further understanding of life history traits. Furthermore, forty-four percent of the species within the phylogenetic clade to which Texas logperch belongs are considered vulnerable or endangered. These sister-taxa are sensitive to environmental change and exhibit extinction-prone ecological and life history characteristics. Information from this study will lend insight to causation and provide a mechanistic understanding of observed patterns in Texas logperch decline and extirpation. Beginning February 2007, twelve monthly collections of Texas logperch and four seasonal samples of aquatic macroinvertebrates were taken from the Pedernales River. Texas logperch lived ~3+ years with the reproductive season extending December to April. Individuals of both sexes reached maturity within one year at ~72 mm total length (TL) and males reached a maximum length of 138 mm TL and females 121 mm TL. Aquatic macroinvertebrates were qualitatively and quantitatively sampled from the same habitat in which Texas logperch were collected and a total of 97 Texas logperch stomachs were analyzed. Compositions of available macroinvertebrates and Texas logperch diets were compared using Ivlev's selectivity index and Chesson's index. Preliminary results suggest prey selection by Texas logperch did not vary following macroinvertebrate availability, but primary prey items did vary seasonally with fluxes in macroinvertebrate abundances.

Fish as Possible Sources of Indicator Bacteria in Urban Streams

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Many waterbodies within the United States are classified as not supporting contact recreation uses based on elevated indicator bacteria. Indicator bacteria groups include *E. coli*. Indicator bacteria groups have been correlated with increased risks from waterborne diseases. The use of indicator bacteria and their control is considered a central strategy in reducing risks from waterborne pathogens. Recent Total Maximum Daily Load (TMDL) studies and subsequent implementation strategies have focused on identification and management of various sources of indicator bacteria including humans, livestock, pets and wildlife. It has been assumed that all indicator bacteria originate from warm-blooded organisms including humans, other mammals and birds. In addition, the concentration of bacteria in water is assumed to be a function of loading from these sources and instream ambient conditions that affect the survival of these indicator groups. However recent studies suggest that reptiles and other cold-blooded vertebrates may also represent a previously unknown source and/or transport pathway for indicator bacteria. If this is the case future and past TMDL studies may have to re-evaluate estimates of loading from various sources and potential management strategies. During 2008 we conducted preliminary studies to evaluate the potential loading of E. coli bacteria from various fish species in several freshwater coastal streams and bayous within Houston, Texas. Preliminary results suggest that some fish species may represent a significant pathway in *E. coli* production and/or transport. The potential mechanisms of E. coli production and transport are described. The implications of these sources in regards to water quality management and modeling are discussed.

Sawfish in the United States: A Past, Present and Future Look

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Sawfish are one of the largest and most distinctive rays, with 7 species currently recognized worldwide. Historically the coastal waters of the United States, and Texas, were home to two species: the largetooth sawfish, *Pristis perotteti*, and the smalltooth sawfish, *P. pectinata*. However, decades of mortality from recreational and commercial fisheries, habitat destruction, and a low reproductive capacity have eliminated these species from most of their historic ranges. The last record of a largetooth sawfish in US waters was from Texas in 1943. The smalltooth sawfish is now found primarily in southwest Florida with the last confirmed report from Texas waters occurring in 1984, captured by Texas Parks & Wildlife Department in Aransas Bay. Both species are listed as Critically Endangered by the World Conservation Union and protected from international trade under CITES. Although now considered extirpated in the US the largetooth sawfish remains a Species of Concern. In 2003 the smalltooth sawfish was listed as Endangered under the US Endangered Species Act. A recovery plan has been developed and the designation of critical habitat is underway.

POSTER SESSION ABSTRACTS

Use of the Zebrafish Embryo in Studies of Harmful Algal Blooms

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Lubbock's Canyon Lakes System (CLS) consists of a series of wastewater effluent dominated lakes along the Brazos River (Texas), where golden algae are known to bloom seasonally (winter). Zebrafish embryos were used to assess toxic effects of water from five locations within and downstream of the CLS, locations 1 to 5 in downstream order. Site 1 is at the head of the CLS, which receives reclaimed wastewater following secondary treatment and land application; sites 2 and 3 are within the CLS; site 4 is where tertiary effluent is discharged; and site 5 is about 5 km downstream of site 4. Water was collected from each site on 03/09/08 and embryos were exposed in 24-well plates. Average embryo survival at 72 hours postfertilization (hpf) was 100,53,0,0,93 and 80% for control water and Site 1 through Site 5, respectively. An additional sample from Site 2 was collected on 03/13/08 and, following frozen storage for several weeks, used to assess toxicity after dilution in the presence or absence of DADPA, which increases prymnesin toxicity. Prymnesin concentration was 2 ppm, and embryo survival at 72 hpf of exposure to 100,50,25,12.5,6.25,3.125 and 0% sample water was 0,0,96,96,100,96 and 96% in the absence; and 0,0,0,0,0,33 and 96% in the presence of DADPA. In conclusion, (1) CLS water collected on 03/08 was extremely toxic to fish embryos, whereas downstream water near tertiary effluent discharge was moderately toxic; and (2) prymnesin may contribute to the toxicity.

Temporal Phytoplankton Nutrient-dependent Growth Responses and Seasonal Zooplankton Grazing Estimates of the Highland Lakes, Colorado River, Central Texas

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The U.S. Geological Survey (USGS) and the Lower Colorado River Authority (LCRA) are cooperating on a study to understand plankton trophic dynamics in four reservoirs of the Highland Lakes system on the Colorado River in Central Texas. Water was collected monthly for phytoplankton bioassays from 6 sites in Lake Travis (2005–06), and 5 sites in Lakes Inks, LBJ, and Marble Falls (2007–08). These lab-based experiments had four replicates each of controls, nitrogen, phosphorus, and nitrogen + phosphorus additions, and were incubated 5 to 7 days with ambient temperature and light (n=2,400). Daily *in-vivo* fluorescence (IVF), verified by Chl-*a*, was used to calculate phytoplankton growth rates using an exponential growth model. Results were analyzed using an ANOVA, and Bonferroni post-hoc treatment mean comparisons. Growth rates were lowest in controls and at mid- to up-lake sites, and were highest in nitrogen+phosphorus treatments and at near-dam sites. With all sites and months compared, phytoplankton communities responded to added nitrogen 30%, and to phosphorus 52% of the time; while co-limitation for both nutrients occurred 14% of the time ($p<0.05$). Lake-specific seasonal zooplankton grazing experiments were performed (n=56), and significant phytoplankton loss rates indicate strong top-down control by consumers.

Results from the Interagency Statewide Fish Tissue Monitoring Program

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Three state agencies, Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD), and Texas Department of State Health Services (DSHS), have significant interests in and responsibilities related to contaminants in fish tissue. Beginning in 2003, the agencies initiated a cooperative effort to share resources and implement a pilot statewide fish tissue monitoring program, enabling the assessment of contaminant levels in fisheries resources across the state for possible water quality and ecological risks. A four-

year Tier 1 screening effort, including (82) reservoirs and (15) riverine segments, was the first component of the program. Samples from (11) water bodies had metal (mercury or arsenic) concentrations above TCEQ screening levels. Sample concentrations of PCB's and p,p DDE were above screening levels for three additional reservoirs. The Tier 2 human health risk assessment component of the program concentrated on water bodies identified in Tier 1. There was an additional risk assessment study to address possible mercury in fish tissue contamination in (12) East Texas water bodies identified from an earlier TPWD project. Thus far, ten risk assessments have been conducted by DSHS resulting in three fish consumption advisories, due to mercury in fish tissue, and one for PCB in fish tissue. An additional nine risk assessments are currently in the analysis stage.

Mercury Concentrations in Red Snapper (*Lutjanus campechanus*) from the Northern Gulf of Mexico

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The Gulf of Mexico (Gulf) supports some of the most productive fisheries in the world. Two thousand metric tonnes of red snapper (*Lutjanus campechanus*) are harvested annually, making red snapper the most valuable commercial and recreational reef fish in the Gulf. Despite the importance of red snapper as a food fish, few studies have examined the level of Hg contamination in this species. Red snapper collected by recreational fishermen off the coasts of Texas (n =121), Louisiana (n = 295), and Alabama (n =264) USA were sampled during 2007 and 2008. We analyzed total mercury concentrations in epaxial muscle tissues using combustion atomic absorption spectrometry. Mercury concentrations in red snapper tissues were positively correlated with fish total length (TL). Approximately 96% of legal-sized fish (USA federal length limit = 406 mm TL) had mercury concentrations below the United States Environmental Protection Agency's (USEPA) limit for the protection of human health (300 ng/g ww). The majority of fish with mercury concentrations exceeding USEPA limits were collected off the coast of Alabama. Specifically, 8% of legal-sized fish collected off the coast of Alabama exceeded the USEPA limit. No fish collected off the coast of Texas and < 1% of the fish collected off the coast of Louisiana exceeded USEPA limits. Although most of the individuals we examined would pose a limited risk to consumers, results from our study suggest regional differences in Hg concentrations within the northern Gulf, with the highest Hg concentrations found off the Alabama coast. Future studies should determine if other species exhibit spatial variation in mercury concentration and explore potential mechanisms responsible for this pattern.

Mass Development of the Toxic Algae *Pseudo-nitzchia* in the Phytoplankton of the Caspian Sea

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Studies made in the central deep water part of the middle Caspian Sea in 2004-2008 indicated increasing invasions of toxic phytoplankton species (*Pseudo-nitzschia seriata*, *Pseudo-nitzschia delicatissima*) in the pelagic ecosystem. The traditional diatom dominant species (*Pseudosolenia calcar-avis*, *Dactyliosolen fragilissimus*, *Thalassionema nitzschioides*) are being changed by new Caspian Sea species such as *Cerataulina pelagica*, *P.*

seriata, and *Chaetoceros peruvianus*. The pennate diatom *P. seriata*, which cells can produce toxin has become a leading species of the autumn-winter diatomic blooms in the last ten years. The maximum cell number of *P. seriata* ($3.0 \cdot 10^5$ cells/liter) was registered in October-November 2006 during the autumn maximum of the phytoplankton at the lower border of the seasonal thermocline at a depth of 38 meters at a temperature of 10°C and at a salinity of 11%. The cell number of *P. seriata* reached $2.0 \cdot 10^5$ cells/liter during the winter phytoplankton bloom in February 2008. The algae was found throughout the entire water column to a depth of 200 meters, the maximum quantity was registered between 0 to 25 meters at a temperature of 11.4°C and at a homothermy level of 0-100. The cell number of another species (*Pseudo-nitzschia delicatissima*) was rather small and did not exceed $2.0 \cdot 10^4$ cells/liter. The mass development of the toxic algae *Pseudo-nitzschia* in the phytoplankton of the Caspian Sea can have a catastrophic impact for the Caspian Sea ecosystem.

Effects of Vegetation Architecture and Stem Density on Predation of Largemouth Bass Fingerlings

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Hydrilla, *Hydrilla verticillata*, often exists either as immature stands of vertical stems or mature floating mats in spring and early summer when Texas Parks and Wildlife Department conducts stockings of fingerling largemouth bass, *Micropterus salmoides*. We tested the relationship of these two architectural types and stem density on fingerling predation rates using simulated hydrilla and adult largemouth bass predators in indoor tanks. Approximating these architecture types, experimental treatments of equal vertical stem distribution and unequal distribution in which 60% of the mass was at or near the water surface were tested at three stem densities: 125 (low), 250 (medium), and 500 (high) stems/m^2. We found architecture type (immature vs. mature) did not significantly affect predation rates at any of the three stem densities (P>0.05). Predation rates were significantly higher in both low density architecture treatments than in high density treatments (P <0.0033). Predation within the medium-density treatments did not differ significantly from high- or low-density treatments. These findings indicate that stem density regardless of architecture should guide stocking and largemouth bass fingerlings should be stocked into habitats with stem densities of at least 250 stems/m^2.

Stream Fish Assemblages in an Urbanizing Watershed

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Carter Creek is a third-order stream located in the Navasota River drainage. It runs through urban and agricultural lands along the eastern edge of Bryan and College Station, TX and receives secondary treated wastewater at three locations. Fish samples were taken from five different sites in fall 2007 and 3 different sites in spring 2008 and compared based on the metrics used for an Index of Biotic Integrity (IBI). All fish caught were by the use of straight seines and bag seines. Preliminary analysis indicates that ten species made up 95% of all fish collected across both years, and among these were five native cyprinids (blacktail shiner, red shiner, Mississippi silvery minnow, bullhead minnow, and pugnose minnow), seven invertivores (including longear sunfish and blackstripe topminnow), three omnivores, five tolerant (including Western mosquitofish and bluegill), and one intolerant species (Ribbon shiner). The IBI shows us that there is a difference in sites between areas upstream and downstream of the Waste Water Treatment Plant outflow. This is measured by different metrics about the groups of fish listed above. The difference cannot be pointed solely at the WWTP, but we can deduce that there is an obvious fluctuation in the stream's ecology by the drastic drop in aquatic use scores beginning with the WWTP moving downstream.

Numerical Approach to Modeling *Prymnesium parvum* Population Dynamics Under Varied Conditions of Nutrient Availability: Validation with In-lake Mesocosm Data

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The large fish kills in semi-arid Texas lakes and fish hatcheries, resulting from blooms of *Prymnesium parvum*, have driven the study of this alga. Numerical models, validated by culture studies have ranged from single species and nutrient models to more complex food web and multi-nutrient representations. This modeling effort will fit the results of in-field mesocosm experiments conducted in Lake Possum Kingdom during bloom initiation and bloom persistent periods. The results show that as waters became toxic, *P. parvum* displaced other phytoplankton and zooplankton numbers dropped in control treatments. As nutrients were added, toxicity was suppressed, other phytoplankton prospered and zooplankton persisted. Using MATLAB®, a numerical model will be constructed that incorporates the Monod equation as well as half saturation coefficients and maximum specific growth rates for *P. parvum* under nitrogen- and phosphorus-limiting conditions, previously established from culturing experiments. The model will also incorporate competing algae common to Texas lakes as well as zooplankton groups including cladocerans, rotifers, and protozoa. We anticipate our validated model will provide new insight on conditions favorable to *P. parvum* blooms as well as assist in modeling efforts to be validated with whole-system data.

First Recorded Bloom of the Toxic Dinoflagellate *Dinophysis acuminata* on the Texas Coast

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In February 2008 increasing levels of a potentially toxic dinoflagellate, later confirmed as *Dinophysis acuminata*, were identified at a sampling site at the University of Texas Marine Science Institute, Port Aransas, Texas. This was followed by a bloom in a Port Aransas marina. Initial water samples tested positive for okadaic acid (OA). *D. acuminata* is a known producer of (OA) which can result in Diarrhetic Shellfish Poisoning in those who consume affected oysters. Sampling of the water and oyster tissues for OA began immediately. Initial water samples contained levels of OA ranging from 38 μg/100g to 105.8 μg/100g and *D. acuminata* concentrations ranging from 4000 cells/L to 3,300,000 cells/L. Upon confirmation of OA in oyster samples, the Texas Department of State Health Services closed three bays to shellfish harvesting on 7 March 2008. This closure was later expanded to ten bays and also included a recall on oyster meat dating back to 1 March 2008. Of note is that a local community had purchased hundreds of pounds of locally-harvested oysters for an oyster festival occurring the same weekend. However, due to intense interagency cooperation and communication, this bloom was detected and the shellfishery closed before any large-scale health effects occurred. This is the first time in the U.S. that a shellfishery has been closed due to concentrations of OA. No illness due to affected shellfish was ever reported. By mid-April all bays had been reopened to shellfish harvesting.

Spatiotemporal Water Quality Monitoring for Lakes Granbury, Whitney, and Waco, Texas

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Globally, harmful algal blooms have increased in frequency and magnitude. In Texas, USA, *Prymnesium parvum* has affected 21 lakes in five river basins. Fish mortality has exceeded 17.5million valued over $6.5 million, with the majority occurring in the last 6 years. Interestingly, while *P. parvum* appears ubiquitous in Texas lakes, it does not form blooms in all lakes. To better assess the timing and magnitude of *P. parvum* blooms, and to better elucidate environmental conditions under which blooms initiate, year-round monitoring of three Texas lakes is underway. Monitoring in Lakes Granbury and Whitney (where fish-killing blooms occur) and Lake Waco (where *P. parvum* occurs but does not form blooms) involves system-wide high-resolution spatial mapping of select water quality parameters and fixed-station sampling of many water-column parameters. Because previous in-lake experiments suggested interaction between cyanobacteria and *P. parvum* through allelopathy may be an important factor suppressing *P. parvum* blooms, a focus of this monitoring is on population demographics of phytoplankton taxonomic groups, which include *Microcystis*, *Anabaena* and *Oscillatoria*. Allelopathy is estimated through direct measurement of microcystins using ELISA and indirect measurement of prymnesins using toxicity bioassays. Another focus of this study is the identification of possible bloom initiation "hot spots" where management efforts may be focused.

Possible Extirpation of Three *Centrarchidae* Species in Response to Golden Alga in Three North Texas Reservoirs

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North Texas reservoirs Diversion and Possum Kingdom were initially affected by lake wide, golden alga, *Prymnesium parvum,* induced fish kills during 2001 while Kemp was first impacted in 2002. Golden alga kills have continued sporadically at all three reservoirs through 2008. Previous to 2001, all three reservoirs had relatively abundant populations of spotted bass, *Micropterus punctulatus*, with redbreast sunfish, *Lepomis auritus*, occurring at Possum Kingdom and Kemp, and smallmouth bass, *M. dolomieui* only at Possum Kingdom. Nine electrofishing and ten trap net surveys (reservoirs combined) have been conducted since those times without documenting any of the three species remaining in the respective reservoirs. Electrofishing surveys before 2001 had always documented the species as listed above. While the three species are in the *Centrarchidae* family, other historically present species such as bluegill, *L. macrochirus*, longear sunfish, *L. megalotis*, green sunfish, *L. cyanellus* and largemouth bass, *M. salmoides* have all rebounded and maintained reproductive populations at all three of the reservoirs. One possible explanation for the species absences is that they are more sensitive and thus more adversely affected by the golden alga toxin. However, to our knowledge this has not been studied and is a possible avenue for further research. A possible fisheries management implication would be to limit stocking of spotted bass, smallmouth bass or redbreast sunfish into reservoirs that continue to be severely impacted by golden alga.

A Survey of Ten Texas Intertidal Rivers for *Prymnesium parvum*

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Since 2001 Texas has experienced a marked increase in the frequency, duration and intensity of blooms of the toxic Chrysophyte *Prymnesium parvum*, commonly known as the golden alga. *P. parvum* blooms have affected five Texas river basins: the Canadian, Red, Brazos, Colorado, and Rio Grande. Biologists have expressed concern over the possibility of *P. parvum* entering and blooming in Texas' estuaries because, though the United States experiences blooms in inland waters, *P. parvum* is primarily an estuarine species in other parts of the world. This study surveyed *P. parvum* concentrations in the tidal portion of ten Texas rivers: the Sabine, Trinity, Brazos, Colorado, Lavaca, Guadalupe, Aransas, Nueces, Arroyo Colorado, and the Rio Grande. The 2008 season proved to be atypical, as the warm, wet winter may have prohibited large-scale blooms from occurring. No *P. parvum* were found in any of the samples.

Effects of Toxigenic Golden Algae on Feeding Behaviors and Life Histories of Daphnid Zooplankton in Lake Texoma, TX-OK USA

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Prymnesium parvum, more notably known as golden algae, is a toxigenic protist that invaded and bloomed in Lake Texoma in 2004. The common occurrence of a massive fish kill during a *P. parvum* bloom is well known, but we know little regarding *P. parvum*'s potential to negatively impact zooplankton, particularly daphniids, which are a primary food resource for Lake Texoma fishes. The purpose of this study was to assess any effects of golden algae on daphniid (1) feeding behaviors, (2) grazing rates, and (3) life-history characteristics. Using high-speed digital imagery of 30-min feeding trials using naïve individuals or individuals exposed to golden algae for 6 hrs., we detected no behavioral differences or signs of acute toxicity relative to *Scenedesmus*-fed individuals. Feeding trials revealed similar grazing rates by daphniids feeding on either *P. parvum* or *Scenedesmus* over 24 hours and again no toxicity was apparent. However, in seven- to ten-day exposures to *P. parvum*, chronic (long-term) toxicity effect were observed in Texoma daphniids, as revealed by reduced juvenile growth rates, fecunidy, and survivorship. Although our research is continuing, these results suggest that the presence of *P. parvum* in Lake Texoma could have indirect negative impacts on the lake's fish and fisheries.

Using Quantitative Real-time PCR to Assess the Distribution of Toxigenic Golden Algae in Lake Texoma (USA) and its Watershed

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The toxigenic golden alga, *Prymnesium parvum*, was first reported in Lake Texoma's watershed in 2001 and in Lake Texoma in 2004. Since 2004, Lake Texoma has been continually monitored for golden algae using standard microscopical methods (e.g., hemaecytometer). These methods are time and labor intensive and reasonably

estimate cell densities of hundreds to thousands per milliliter. Beginning in summer of 2007, we monitored *P. parvum* in Lake Texoma using quantitative real-time PCR. Results over a 1-yr period revealed the method can detect cell densities as low as 5 cells mL^{-1} with reliable detection at 250 cells mL^{-1}. Because of a higher limit of detection, standard hemaecytometer counts failed to detect *P. parvum* ~61% of the time it was detected by qPCR. When both methods detected *P. parvum*, cell density estimates were significantly correlated (r^2=0.331, N=31, p=0.001), although the differences in precision between the two methods yielded a relatively weak correlation. We further explored the use of qPCR in detecting and quantifying *P. parvum* within the lake's watershed, where we sampled 62 water bodies and compared detection of *P. parvum* with predictions based on salinity, and nutrient and chlorophyll concentrations. Stepwise Discriminant Function Analysis of environmental parameters correctly classified 87.5% of examined lakes with and without *P. parvum* (either previously reported or based on qPCR). These results suggest that qPCR is a reliable timesaving technique that can be employed in current monitoring programs, and that researchers must use caution in relying on microscopical methods to accurately assess the presence and quantity of *P. parvum* in lakes.

In Vitro Hemolytic Toxicity of *Prymnesium parvum* During Growth

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The euryhalina haplophyte *Prymnesium parvum* (golden algae) produces toxins that manifest hemolytic, ichthyotoxic, and cytotoxic activities. The hemolytic agents can attack exposed gill tissue and associated red blood cells and cause significant fish kills. As yet, little is known about variations of toxicity of *P. parvum* during population growth cycles. Using an erythrocyte lysis assay (ELA) to measure hemolytic toxicity, this study revealed that in vitro *P. parvum* hemolytic toxicity reaches a global maximum just prior to the end of the early log phase of cultures and that this maximum coincides with maximum toxicity per cell over the entire growth curve. Initial work also indicates that a second, less pronounced phase of high toxicity occurs in the stationary phase. Overall, the ELA procedure is an integral part of the bioassay-guided fraction research being performed by our group to elucidate toxic constituents produced by golden algae. An overview of the ELA procedure and its application for performing the aforementioned studies is presented.

Standardized Procedure for Lipid Extraction and Pigment Extraction from the Toxic Haptophyte *Prymnesium parvum*

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P. parvum is responsible for devastating fish kills in Texas brackish waters, an increasing problem every year due to secreted toxins such as hydrophobic prymnesins and other uncharacterized compounds. There is an increasing interest to isolate, purify, and identify these known and unknown compounds for further research in

order to minimize the detrimental effect on the ecosystem. The concentrations of toxins are of a far lesser magnitude than that of the pigments and the lipids ubiquitous to these algal cells. It is therefore important to separate the highly concentrated lipids and pigments from the toxins before analysis. Common lipid extraction methods vary in efficiency depending on the composition of the cytoplasm of interest. These solvents often extract hydrophibic toxins, causing a lowering of apparent concentration. To approach this problem, 13 common solvent extraction methods were compared, among which the use of ethyl acetate appears to be the most promising. The relative toxicity of the extracts is quantified using an erythrocyte lysis assay which measures the percent lysis of sheep erythrocytes. UV-Vis spectrophotometry is used to characterize the pigments removed, and MALDI-TOF is used to fingerprint the extracted lipids. The efficiency of MALDI matrices also varies depending on the composition of the target analyte. In order to determine the most efficient matrix for MALDI analysis of extracted compounds, six matrices were used and compared, with α-cyano-4-hydroxycinnamic acid giving the greatest signal to noise ratio. This work has resulted in an optimized extraction method to remove pigments and lipids from *P. parvum* cells while minimizing loss of toxicity.

Multiplex PCR Assays for the Species-specific Detection and Quantification of *Prymnesium parvum* Carter (Haptophyta) in Natural Bloom Samples

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The toxic, bloom-forming haptophyte, *Prymnesium parvum* is responsible for massive fish mortalities worldwide, so sensitive, rapid methods of detection are needed to improve management strategies. Multiplex PCR assays were developed for the detection and quantification of *P. parvum* wherein suites of primers simultaneously amplify four species- and gene-specific products using genomic DNA or whole cells. With conventional PCR, amplification products were easily resolved by gel electrophoresis, generating a diagnostic banding pattern. Gene-specific fluorescent molecular beacons were designed for use with real-time quantitative PCR (qPCR). Both methods were capable of detecting as few as 1 or 2 cells in 50 cycles. The species- and gene-specificity of the assays were evaluated using isolates (and mixtures) of *P. parvum*, related species and outgroups. The diagnostic banding pattern in electrophoresis gels and real-time trace profiles were exclusive to reactions containing *P. parvum* with no interference from nonspecific template. Cell number estimations using qPCR to evaluate environmental samples from natural bloom events were close to mean values obtained from manual counts. This presents a significant improvement in DNA-based detection technology, enhanced by the rapid and simultaneous confirmation of four species-specific products, and the ability to specifically detect several widely-separated geographic isolates of *P. parvum*, including the conspecific, *P. parvum f. patelliferum*.

Continuous Real-time and Discrete Water-quality Monitoring of Lake Houston, a Source-water Reservoir, and Three Major Tributaries, Near Houston, Texas

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Lake Houston, a shallow, turbid reservoir, currently (2008) provides about 20 percent of the water supply for Houston, Texas. Because the reservoir will become the city's primary water source by 2010, a comprehensive understanding of factors affecting reservoir water quality is needed. In 2006, the U.S. Geological Survey and the City of Houston established a water-quality monitoring network for the Lake Houston watershed to evaluate

water-quality effects of (1) large inflows and (2) in-lake processes. Three major tributaries and three sites on Lake Houston are continuously monitored for physical water properties—pH, dissolved oxygen concentration, water temperature, specific conductance, and turbidity. Monthly and event-driven discrete water-quality samples are collected and analyzed for constituents of interest (nutrients, taste-and-odor compounds, and phytoplankton). Real-time water-quality data indicate the monitoring network can provide information on factors affecting water quality in Lake Houston and might provide an early warning of changes that could affect water quality. For example, after an extreme hydrologic event, continuously measured turbidity data indicate travel time from inflow to the downstream end of Lake Houston is approximately 2 days. Vertical-profile data from continuous in-lake monitors have shown several occurrences of water temperature and dissolved oxygen stratification. Stratification occurs rapidly and can persist for days, allowing release of nitrogen, phosphorus and manganese from lake-bed sediment. Preliminary results from discrete sampling of the lake indicate trends in phytoplankton community composition, nutrients, and taste-and-odor compounds. Other relations between discrete data and continuous data are being examined for possible indicators of conditions favorable to taste-and-odor events.

Spatiotemporal Relationships between *Prymnesium parvum* and Environmental Variables in Texas Lakes

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Lake Granbury, a reservoir located on the Brazos River, serves as both a recreational area and a drinking water source. In recent years, *Prymnesium parvum* blooms have caused massive fish kills and raised concerns about overall water quality. To address this problem monthly sampling data, currently spanning from September 2006 to August 2008, has been collected to examine a variety of parameters that may affect *P. parvum* growth and toxicity. Within Lake Granbury we have established 20 fixed stations, allowing us to collect data on inorganic nutrients, total and dissolved organic carbon, phytoplankton biomass and community composition, coliform bacteria concentration and toxicity. We also gather various water quality parameters such as DO, pH, temperature, conductivity, turbidity and oxidation-reduction potential. In addition to this information, a dataflow is used to take measurements from closely spaced transects at 4 second intervals approximately 20 cm below the surface; combined GPS technology is used to mark the transects and create high-resolution spatial maps representing each of the parameters collected. These include chlorophyll *a*, dissolved organic matter, transparency, photosynthetically active radiation, conductivity and temperature. A goal of this research is to use GIS to assess the spatiotemporal relationships between environmental and biotic variables and the incidence of *Prymnesium parvum*. One focal point will be the potential link between aging septic systems, bacteria (total, fecal coliform and *E. coli*), and *P. parvum*. Also of interest is whether competitors, such as other toxin producing phytoplankton and zooplankton grazers, affect *P. parvum* population density.

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