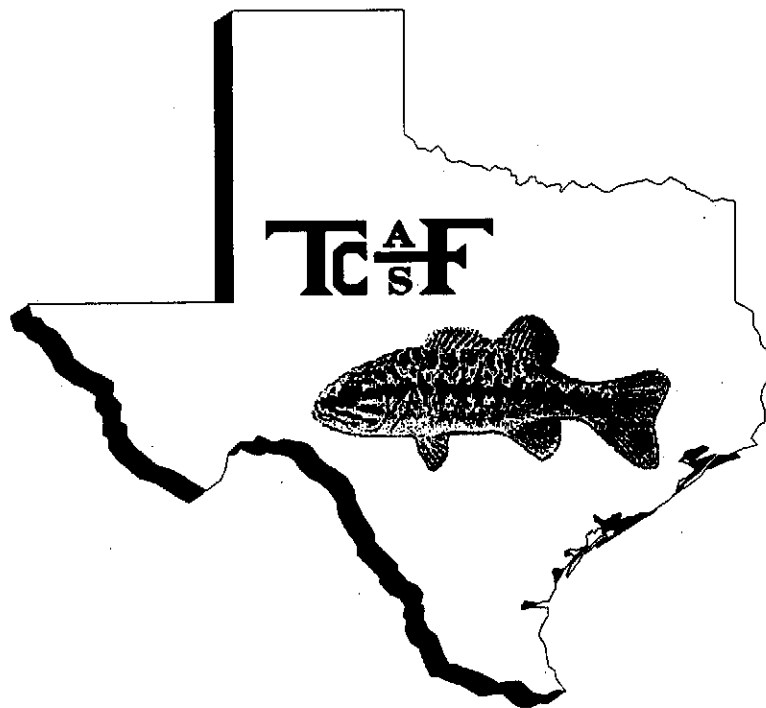


ANNUAL PROCEEDINGS
of the
TEXAS CHAPTER
AMERICAN FISHERIES SOCIETY



Pottsboro, Texas
15 - 17 September 1996

VOLUME 19

TEXAS CHAPTER
AMERICAN FISHERIES SOCIETY

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

MEMBERSHIP

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

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

Annual membership dues are \$8 for Active Members and \$5 for Student Members.

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

Annual Meeting
(Joint Meeting with the Oklahoma Chapter of the AFS)
15 - 17 September 1996
Pottsboro, Texas

1996 - 1997 Officers

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Texas Parks and Wildlife Department

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PAST TEXAS CHAPTER PRESIDENTS AND MEETING LOCATIONS

<u>DATE</u>	<u>PRESIDENT</u>	<u>LOCATION</u>
1976		College Station
1976	Ed Bonn	Lake Brownwood
1977	Jim Davis	San Antonio
1978	Bill Rutledge	San Marcos
1979	Bobby Whiteside	College Station
1980	Richard Noble	Arlington
1981	Charles Inman	Austin
1982	Gary Valentine	Kerrville
1983	Don Steinbach	Lake Texoma
1984	Gary Matlock	Port Aransas
1985	Maury Ferguson	Junction
1986	Brian Murphy	San Marcos
1987	Joe Tomasso	Kerrville
1988	Dick Luebke	Abilene
1989	Mac McCune	San Antonio
1990	Bobby Farquhar	Lake Texoma
1991	Gene McCarty	Galveston
1992	Bill Provine	Kerrville
1993	Barbara Gregg	Port Aransas
1994	Loraine Fries	Lake Travis
1995	Pat Hutson	College Station
1996	Mark Webb	Pottsboro
1997	Katherine Ramos	

TEXAS CHAPTER AWARDS

Eight awards may be presented annually. Only members in good standing may make nominations. If nominations reviewed by the Awards Committee are found to be inadequate in one or all categories, awards need not be given. If multiple nominations are received and more than one nominee is considered outstanding, multiple recipients are permissible. The awards and their associated criteria are:

Outstanding Fisheries Worker of the Year - The nominees must be Chapter members in good standing. There are six specialization categories: Administration, Culture, Education, Management, Research, and Technical Support. An award may be presented in each area of specialization. All nominations must be accompanied by supporting data on contributions to one particular area of focus.

Special Recognition in Fisheries Work - The nominees do not have to be Chapter members. They may be individuals or organizations that have made substantial contributions to fisheries in Texas.

Outstanding Presentation at the Annual Meeting - The basic requirements are:

- a. The presentation must be made by one of the authors.
- b. At least one of the authors must be a Chapter member in good standing.
- c. Members of the current Awards Committee shall be ineligible.

The award is for the presentation, not a manuscript or paper. Criteria for evaluation, made by the Awards Committee, and their relative values are:

- a. Introduction - 10 points
- b. Methods - 10 points
- c. Organization - 10 points
- d. Originality - 15 points
- e. Technical Merit - 20 points
- f. Delivery - 15 points
- g. Visual Aids - 15 points
- h. Other considerations - 5 points

Judges will evaluate each presentation immediately after it is given. They will not confer until after the last presentation. The decision will be made based on relative rankings assigned by the judges.

Scholarship Selection - Selection of scholarship recipients is made by members of the Scholarship Selection Committee. University representatives nominate students from their institutions for scholarship consideration. Selection is based on the following criteria:

- a. Academic excellence
- b. Professional activities
- c. Promise of future professional involvement and significant contribution to the field of fisheries science.

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 (SWTSU)
 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 (CCSU), Michelle Badough (SWTSU)
- 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 (SWTSU), 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 (SWTSU)
 Scholarships - Kathryn Cauble (SWTSU), 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 (SWTSU)
- 1996 Fisheries Education - Billy Higginbotham (TAMU)
 Fisheries Management - Gary Garrett (TPWD)
 Fisheries Administration - Gene McCarty (TPWD)
 Fisheries Research - Ivonne Blandon (TPWD)
 Special Recognition - Reeves County Water Improvement Board
 Best Presentation (s) - to be announced at 1997/1998 Annual Meeting
 Scholarships - Chad Thomas (SWTSU), Anna-Claire Fernandez (UTMSI),
 Kenneth Ostrand, Dawn Lee Johnson
 Technical Support - Jimmy Gonzales (TPWD)
 Honorable Mention (technical support) - Eric Young (TPWD)

Abbreviations:

TPWD - Texas Parks and Wildlife Department	TAMU - Texas A&M University	TAES - Texas Agricultural Extension Service
SWTSU - Southwest Texas State University	UTMSI - University of Texas Marine Science Institute	
UT - University of Texas at Austin	SCS - Soil Conservation Service	USFWS - US Fish and Wildlife Service
UTPA - University of Texas/Pan American	TTU - Texas Tech University	CCSU - Corpus Christi State University
TUGC - Texas Utilities Generating Company	ACE - Army Corps of Engineers	

TECHNICAL SESSION ABSTRACTS

Mesh Size Selectivity of Penaeid Shrimp in 6.1-m Shrimp Trawls, Galveston Bay, Texas

BILL BALBOA (Texas Parks & Wildlife Department, Palacios Marine Laboratory, 2200 Harrison, Palacios, Texas 77465)

LANCE ROBINSON (Texas Parks & Wildlife Department, Seabrook Marine Laboratory, P. O. Box 8, Seabrook, Texas 77586)

Since 1972 landings of large brown shrimp *Penaeus aztecus* have decreased with a subsequent increase in landings of small brown shrimp (>147 count per kg) on the Texas coast. The Texas Parks and Wildlife Department, Coastal Fisheries Division, initiated an evaluation of shrimp trawl mesh size selectivity as means to address a potential growth overfishing problem in the Texas bay shrimp fishery. Trawl mesh sizes of 35 mm, 38 mm, and 44 mm were randomly paired and pulled simultaneously to allow for a comparative evaluation of shrimp catch between mesh sizes. Selection curves for white shrimp *P. setiferus* and brown shrimp were developed for each trawl mesh size. The effect of trawl mesh size and fall bay shrimp season (August 15 - October 31 1995) minimum shrimp size limit of 112 mm TL (total length) were used to evaluate each selection curve. Approximate proportions of catch less than 112 mm TL in 35 mm, 38 mm, and 44 mm trawl mesh were, respectively, 90%, 85%, and 70% for brown shrimp and 97%, 95%, and 37% for white shrimp.

Status and Trends of Commercial Fisheries in the Corpus Christi Bay System

TOM WAGNER (Texas Parks and Wildlife Department, Coastal Fisheries Division, 702 Navigation Circle, Rockport, Texas 78382)

Data from Texas Parks and Wildlife Department's (TPWD) Monthly Aquatic Products Reports and routine Resource Monitoring Program were used to assess the status of commercial finfish and shellfish fisheries of Corpus Christi Bay. Monthly Aquatic Products Reports submitted by seafood dealers to TPWD from 1972 through 1994 were used to establish trends in landings and ex-vessel value of marine finfish and shellfish species. Additionally, data from routine bag seine, gill net, and bay trawl samples in Corpus Christi Bay, and Gulf trawls in the adjacent Texas Territorial Sea were used to evaluate abundance of commercially important species. During 1994, brown shrimp *Penaeus aztecus* (66%), white shrimp *P. setiferus* (14%), black drum *Pogonias cromis* (12%) and blue crab *Callinectes sapidus* (4%) comprised the majority of commercial landings of 3 million pounds worth \$4.7 million.

A Review of the Distribution and Status of Fishes in the Red River Basin Upstream from Lake Texoma

GENE R. WILDE, ROBERT R. WELLER, CHRISTOPHER D. SMITH, AND RICARDO JIMENEZ, JR. (Department of Range, Wildlife, and Fisheries Management, Texas Tech University, Lubbock, Texas 79409-2125)

We compiled museum and literature records for fish collections made in the Upper Red River Basin, upstream from Lake Texoma. A total of 70 species have been reported from this area, 60 of which are native to the basin. Between 1920 and 1994, more than 1.1 million fish were collected from the basin, 92% of these are accounted for by ten species: red shiner *Cyprinella lutrensis* (31.3%), plains minnow *Hybognathus placitus* (28.1%), Red River shiner *Notropis bairdi* (9.9%), mosquitofish *Gambusia affinis* (5.4%), plains killifish *Fundulus zebrinus* (4.7%), emerald shiner *Notropis atherinoides* (4.5%), Red River pupfish *Cyprinodon rubrofluviatilis* (4.4%), bullhead minnow *Pimephales vigilax* (1.7%), fathead minnow *Pimephales promelas* (1.1%), and speckled chub *Macrhybopsis aestivalis* (1.1%). Fish collections have been made from 330 uniquely identifiable sites. The most widely distributed species are the red shiner (present at 76% of sites), mosquitofish (58% of sites), plains killifish and green sunfish (52% of sites), fathead minnow (47% of sites) plains minnow (46% of sites), bullhead minnow (44% of sites), longear sunfish *Lepomis megalotis* (43% of sites), Red River pupfish (37% of sites), and Red River shiner (36% of sites). Only five species (sharpnose shiner *Notropis oxyrinchus*, silverband shiner *Notropis shumardi*, freckled madtom *Noturus nocturnus*, paddlefish *Polyodon spathula*, and shovelnose sturgeon *Scaphirhynchus platorhynchus*) have apparently been lost from the basin. Comparable numbers of species have been lost from localized reaches of the river; notable examples include the Pease and Wichita rivers, from which five and six cyprinid species, respectively, have apparently been lost. There also has been a general decline in relative abundance of plains minnow and a general increase in relative abundance of red shiner throughout the basin. Our results suggest that, although the fish fauna of the Upper Red River basin is largely intact, it is under considerable stress as evidenced by ongoing changes in both the distribution and relative abundance of several native species.

Distribution, Abundance, and Reproductive Activity of Paddlefish in the Keystone Reservoir System, Oklahoma: First Year Results

CRAIG PAUKERT AND WILLIAM FISHER (*Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University, 404 Life Sciences West, Stillwater, Oklahoma 74078*)

The paddlefish *Polyodon spathula* is a large pelagic species native to the Arkansas River, including Keystone Reservoir. During the past century, paddlefish stocks have declined significantly in the Mississippi, Ohio, and Red rivers. Stocks have increased in the Tennessee, Cumberland, and Arkansas rivers. Our objectives were to determine distribution and abundance of paddlefish in the Arkansas River below Kaw Dam, the lower Cimarron River, and Keystone Reservoir and to identify location and habitat characteristics of paddlefish spawning sites throughout the system. Paddlefish were captured in large mesh gill nets in winter 1996 at randomly selected sections of the reservoir. Fish were measured, weighed, and jaw tagged. A preliminary population estimate of 7,779 fish (95% CI of 5,734 - 26,044) was computed for paddlefish in Keystone Reservoir. Eighty-four percent of paddlefish collected were in the Cimarron Arm, 12% in the Arkansas Arm, and 4% in the main pool. Catch rates were higher in the Cimarron Arm than the Arkansas Arm and main pool, but the mean size of fish in the Cimarron Arm was smaller. There were no differences in mean size and catch rates of fish collected in 127-mm mesh and 203-mm mesh, although incidental catches (blue catfish *Ictalurus furcatus*, flathead catfish *Pylodictis olivaris*, and striped bass *Morone saxatilis*) were higher in 127-mm mesh. Due to low water flow in the Arkansas and Cimarron rivers, no apparent spawning occurred in 1996.

Habitat Preferences of Paddlefish in the Lower Neches River, Texas

IAN M. KLEIN, SEAN D. FINLEY, AND GENE R. WILDE (*Department of Range, Wildlife, and Fisheries Management, Texas Tech University, Lubbock, Texas 79409-2125*)

The paddlefish *Polyodon spathula* is native to the Neches, Red, Sabine, and Trinity river systems of Texas and historically supported commercial and recreational fisheries in the state. Habitat modifications, especially construction of dams that block spawning migrations, and overharvest have resulted in decline of paddlefish stocks throughout its range in Texas. As part of an effort to recover these paddlefish fisheries, the Texas Parks and Wildlife Department has been stocking paddlefish into the Neches River since 1990. During periods of low flow in the Lower Neches River, such as in spring 1996, the Lower Neches Valley Authority installs temporary saltwater barriers in the lower river and Pine Island Bayou to prevent salt water from entering water intake structures. Installation of these barriers becomes necessary approximately once every 10 years. From February through May 1996, we studied habitat preferences of paddlefish in the Lower Neches River to help assess potential effects of saltwater barriers on paddlefish recovery efforts. We assessed habitat preferences with a combination of gill netting and ultrasonic telemetry. Based on over 2000 h of gill netting, we concluded that paddlefish are not abundant in the Lower Neches River; we caught an average of one paddlefish per 50 h of netting. Telemetry results for 15 tagged fish showed that paddlefish frequent the lower end of Pine Island Bayou including its confluence with the Neches River. Upstream movements in the Neches River and Pine Island Bayou are prevented by saltwater barriers while downstream movements apparently are limited by the location of the saltwater wedge in the lower reaches of the river. Tagged fish occasionally move into brackish water, but return to fresh waters upstream after several hours.

Fish Population Community Structure in Brazos River Oxbow Lakes

KIRK O. WINEMILLER, SONER TARIM, JAMES B. COTNER, AND DAVID E. SHORMANN (*Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843-2258*)

The Brazos River is a meandering lowland river that drains nutrient-rich forested and agricultural landscapes in central Texas. We have identified over 30 oxbow lakes in the broad floodplain of the river's middle-lower reaches. These oxbows provide important habitat for flora and fauna of the region. Oxbow fish populations, community composition, and food-web structure were investigated for 3 years along a 160-km reach of the middle-lower Brazos River floodplain corridor. Several species, such as white crappie *Pomoxis annularis* and spotted gar *Lepisosteus oculatus*, were more common in oxbows, whereas others, such as red shiners *Cyprinella lutrensis* and alligator gar *Lepisosteus spatula*, were most abundant in the active river channel. The age and size structure of several fish species showed substantial between-lake variation that can be partially explained by a combination of habitat and biotic parameters. Old, shallow lakes dry out periodically and these unstable environments favor small fishes, like silversides *Menidia beryllina* and western mosquitofish *Gambusia affinis*, that rebuild stocks rapidly whenever these lakes refill. Young lakes are deeper, more frequently flooded by the river, and contain a greater diversity and biomass of fishes. Oxbows with many long-lived piscivorous fishes tend to have lower densities of smaller planktivorous fishes and higher densities of zooplankton during the warmer months (may suggest a trophic cascade). Flooding history and species life-history strategies influence within-year variation in community structure, and oxbow communities undergo more or less predictable changes over the course of a year, plus longer-term successional changes associated with hydrology and sedimentation.

Abundance of Leopard Darters in Big Eagle Creek, Oklahoma

CONRAD S. TOEPFER AND WILLIAM L. FISHER (*Oklahoma Cooperative Fish and Wildlife Res. Unit, 404 LSW, Oklahoma State University, Stillwater, Oklahoma 74078*)

The leopard darter *Percina panterina* is a threatened species endemic to five streams in southeastern Oklahoma and southwestern Arkansas. Previous one-day depletion samples did not account for daily variability in activity or density differences among areas with varying habitat quality. We used Schnabel multiple mark-recapture sampling and habitat maps generated with remote sensing and Geographic Information Systems technologies to estimate leopard darter abundance in Big Eagle Creek (area = 0.7 km²). During float trips, maps of mesohabitat were created using base maps digitized from aerial photographs. Data from transect sampling were used to classify habitat quality. Mark-recapture sampling sites were proportionally stratified by stream segment and habitat quality. The resulting leopard darter density data and the habitat quality maps were used to extrapolate the abundance estimates to cover unsampled areas and calculate total abundance. The population estimate for was 38,114 with upper and lower 95% confidence levels of 27,185 and 61,427. The overall density of leopard darters was 5 darters/100 m².

Effects of Temperature on Egg Production and Early Stages of Fountain Darters

TIM H. BONNER AND BOBBY G. WHITESIDE (*Aquatic Station, Southwest Texas State University, San Marcos, Texas 78666*)

TOM M. BRANDT AND JOE N. FRIES (*National Biological Service, National Fish Hatchery and Technology Center, San Marcos, Texas 78666*)

Studies were conducted to determine the effects of water temperature on egg and larval production, percent hatch, and larval survival of the endangered fountain darter *Etheostoma fonticola*. Adult fish were exposed to water temperatures of 14, 17, 20, 23 (control), 25, 27, and 29°C for 33 d. Egg production was significantly higher at 23 and 25°C than fish held at 27 and 29°C. Percent hatch was significantly higher at 17, 20, and 23°C than fish held at 14, 25, 27, and 29°C. Larval production was significantly higher at 14, 17, 20, and 23°C than fish held at 25, 27, and 29°C. Lethal temperatures for 50% mortalities (LT₅₀) of 24- to 72-h old larvae were estimated at 3.8 and 31.9°C.

Effects of Increasing Water Hardness on Egg Diameter and Hatch Rates of Striped Bass and Hybrid Striped Bass Eggs

STEVEN SPADE (*Oklahoma Department of Wildlife, Byron State Fish Hatchery, Byron, Oklahoma 73722*)

The Byron State Fish Hatchery has had problems with striped bass *Morone saxatilis* and hybrid striped bass *Morone chrysops* X *Morone saxatilis* eggs floating out of the hatching jars during incubation. A review of the literature indicated that the problem probably was related to soft water. This study was conducted to determine the effects of raising total water hardness of hatchery well water on egg diameter and hatch rate of striped bass and hybrid striped bass eggs. Fertilized eggs from each of 13 females were divided into two lots (control and treatment). One lot (treatment) from each female was incubated in hardened water (190 as mg/L of CaCO₃) and the second lot (control) was incubated in untreated water (41 as mg/L of CaCO₃). Both lots were incubated for 48 - 50 h. The initial egg diameter and total number of eggs for each lot were recorded 5 min post-fertilization and then again at 48 - 50 h post-fertilization. The results showed a statistically significant difference ($P \leq 0.05$) between the control eggs and treatment eggs in both egg diameter and hatch rate. The increase in diameter for the control eggs was 1.6 mm as compared to 0.9 mm for the treatment eggs. The hatch rate for the control was 53.6% while that for the treatment was 65.6%. These results indicate that on an average production year an additional 1,000,000 eggs could hatch if the incubation water is hardened.

Genetic Variation in Naturally Occurring and Introduced Populations of Striped Bass

LORAIN T. FRIES AND D. JODY WILLIAMS (*Texas Parks and Wildlife Department, A. E. Wood State Fish Hatchery, P. O. Box 947, San Marcos, Texas 78666*)

BRUCE T. HYSMITH (*Texas Parks and Wildlife Department, Route 4, Box 157, Denison, Texas 75020*)

JAMES E. BULACK (*South Carolina Wildlife Resources Department, 1324 Piney Branch Road, Eastover, South Carolina 29044*)

Fluctuating asymmetry, the most commonly used measure of developmental instability, has been linked to reduced genetic variation. Genetic variation in striped bass *Morone saxatilis* from two introduced populations, the Trinity River, Texas ($N = 52$) and the Red River on the Texas-Oklahoma border ($N = 61$), and one naturally occurring population, the Santee-Cooper Reservoir, South Carolina ($N = 27$) was examined using fluctuating asymmetry and protein electrophoresis. Fluctuating asymmetry was measured as the difference in counts between the left and right sides of individuals for the following features: pectoral and pelvic rays; scales above, along, and below the lateral line; and gill rakers on the first branchial arch. All characters except pelvic rays exhibited fluctuating asymmetry. The Trinity River population had the greatest mean magnitude of asymmetry (mean = 5.1), followed by the Red River (mean = 4.1) then the Santee-Cooper Reservoir (mean = 2.8). Electrophoresis of polymorphic loci, GAPH*, IDHP*, EST-1*, PGM-1*, and PGM-3*, revealed no variation as is characteristic for the species. The high level of fluctuating asymmetry in the introduced populations is cause for concern since it implies reduced genetic variation, though undetected here, which can be associated with decreased performance. These results suggest a potential need for a management plan to increase genetic variation in the introduced populations.

Contribution of Largemouth Bass Reared in Nursery Ponds to Year Classes in Two Texas Reservoirs

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MARK A. WEBB (Texas Parks and Wildlife Department, 1004 E. 26th Street, Bryan, Texas 77803)

LORAINÉ T. FRIES (Texas Parks and Wildlife Department, P. O. Box 947, San Marcos, Texas 78667)

Genetically-marked Florida largemouth bass *Micropterus salmoides floridanus* fingerlings with rare or unique genotypes were stocked into nursery ponds at Lake Conroe (8,484 ha) and Lake Gladewater (323 ha). Nursery ponds at Lake Conroe and Lake Gladewater were stocked with 74,980 fingerlings/ha (mean length = 19 mm) and 33,830 fingerlings/ha (mean length = 26 mm), respectively. Following grow-out (3 months at Lake Conroe and 6 months at Lake Gladewater), advanced-size individuals were stocked into the reservoirs to determine their contributions to corresponding year classes. Largemouth bass survival in nursery ponds at the end of the grow-out period was 15.6% at Lake Conroe and 20.9% at Lake Gladewater. A total of 2.8 fish/ha (mean length = 138 mm) were stocked in Lake Conroe and 8.8 fish/ha (mean length = 121 mm) were stocked in Lake Gladewater. Following reservoir stockings, largemouth bass populations were sampled with electrofishing gear in fall and spring, and electrophoretic analysis was conducted to evaluate contributions of stocked fish to corresponding year classes. Largemouth bass from nursery ponds comprised 0.0%, 1.2%, and 0.0% of the 1991 cohort in Lake Conroe in October 1991, April 1992, and November 1992, respectively, and 4.5%, 6.7%, and 0.0% of the 1992 cohort in Lake Gladewater in December 1992, March 1993, and March 1994, respectively. Returns from nursery pond stockings were low and contributions to year classes were minimal.

The Use of Random Amplified Polymorphic DNA (RAPD) to Identify Largemouth Bass Subspecies and Their Intergrades

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The Texas Parks and Wildlife Department currently uses agarose gel electrophoresis for ensuring the genetic purity of Florida largemouth bass *Micropterus salmoides floridanus* stockings. A limitation of this technique is later generation or backcross intergrades may not be distinguishable. Random amplified polymorphic DNA (RAPD) analysis was investigated as an alternative to conventional electrophoresis for largemouth bass *M. salmoides* subspecies identification. Seventeen primers were examined for their ability to identify polymorphisms using RAPD analysis and three that gave the most polymorphisms were used for the study. Fifteen markers were identified and were shown to indicate fixed differences between the two subspecies (*M. s. floridanus* and northern largemouth bass *M. s. salmoides*). Intergrades of unknown origin were distinguishable from Florida and northern stocks, as well as first generation intergrades. Random amplified polymorphic DNA analysis was shown to be more sensitive than traditional histochemical agarose gel electrophoresis for largemouth bass subspecies identification.

Saugeye Production on a Warmwater Fish Hatchery in Oklahoma

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During 1996 research was conducted to evaluate stage-filling as a pond production method for saugeye. Nine ponds were used: four control (ponds full at stocking) and five treatment (stage-filled, ponds full at 2 weeks post-stocking). Two control, three treatment ponds were stocked on 2 May and two control, two treatment ponds were stocked on 10 May. There was no difference in returns between the 2 May and 10 May stockings. However, comparing data from within stocking dates, returns were higher for the treatment ponds.

Triploid Grass Carp Evaluations in Private Waters: a 1995 Summary

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Data were collected from 1992 through 1995 to evaluate the effectiveness of triploid grass carp *Ctenopharyngodon idella* for biological control of aquatic vegetation in Texas ponds. In 1992, 1993, and 1994, a total of 40, 186, and 178 ponds, respectively, were inspected for vegetation coverage prior to triploid grass carp introduction. Initial total abundance of aquatic vegetation averaged 50% coverage. Stocking rates ranged from 1 to 7 fish/acre but most of the ponds were stocked with 5 to 7 fish/acre. Ponds were inspected for 2 years following grass carp introduction. Fish size at stocking and pond size effects were masked by plant types present. Small fish (total length, 6-9 inches) usually were stocked in the larger ponds which were typically infested with coontail *Ceratophyllum* sp. and/or milfoil *Myriophyllum* sp. Triploid grass carp have not controlled coontail in Texas ponds, but have controlled milfoil when combined with chemical treatments. When naiad *Najas* sp., chara *Chara* sp., and filamentous algae *Pithophora* sp. were found alone in ponds, good control usually occurred, however, in mixed plant type ponds, variable results were frequent. When evaluating the effects on each plant type regardless of other plant types present, it appeared that chara, filamentous algae, and pondweed *Potamogeton* sp. abundance was reduced by half in 60% of the ponds in which they were found. *Najas*, the most frequently occurring and abundant plant type in Texas ponds was successfully controlled in 68% of the ponds where it occurred. Pond size followed by stocking rate were the top factors affecting the successful control of vegetation by triploid grass carp. Vegetation control was less successful in the small ponds even though more fish were stocked per vegetated acre than in the large ponds. Two factors probably contributing to this were enhanced plant growth and greater plant diversity in the small, shallow ponds.

Delayed Mortality of Tournament Caught Largemouth Bass: First Year Results

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The Oklahoma Fishery Research Laboratory began a 2-year project in spring 1995 to determine delayed mortality rates of largemouth bass following tournament release. Three tournaments in the spring and two in the summer were monitored in 1995. Fish were held in large live-nets placed in marina boat stalls after weigh-in. Up to 30 tournament bass per net were held for 6 d after each contest along with control fish collected by electroshocking. Dissolved oxygen and temperature were measured in the live-nets and in contestant's boat live wells as they came to shore. Spring tournament total mortality (initial + delayed) was less than 6%, water temperature averaged 63°F and live-well oxygen level averaged 7.3 mg/L. In the summer, we recorded less than 7% initial mortality but delayed mortality averaged 39%. Most of the fish died between the third and sixth day after weigh-in. High water temperatures (average of 80°F) and low oxygen levels (minimums of 1.3 mg/L) in boat live wells were measured. At one summer tournament, fish were separated according to oxygen in boat live wells: one group from "low-oxygen" live wells (<6.0 mg/L) and another from "high-oxygen" live wells (>6.0 mg/L). Fish in the low-oxygen group experienced a 51% delayed mortality while those in the high-oxygen group had a 35% delayed mortality. Boaters that ran their aerators continuously rather than relying on timers had better oxygen levels in their live wells and 16% lower mortality.

Fish Stocks at Risk in Texas

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Abstract.—In Texas, too many native fishes have been already lost to extirpation or extinction. Approximately 25% of our current fish fauna is either endangered, threatened or approaching that status. In this paper we seek to identify those species of conservation concern that have not yet attained legal status and provide guidance for resource managers before further losses are incurred.

The Fish Stocks at Risk Committee of the Texas Chapter of the American Fisheries Society (TCAFS) is charged with providing insight and guidance on fishes that are not yet, but may soon become threatened or endangered. Currently about one-quarter of the 169 native freshwater Texas fishes are of conservation concern. That is, they are either in danger of extinction or at imminent risk of attaining that status.

The reasons to be concerned about endangered species and extinction are numerous and diverse (e.g., Davis 1977; Soule 1980; Meffe 1986; Minckley and Deacon 1991; Angermeier and Williams 1993; Babbitt 1994). Two major points that should be emphasized:

1) The predicament of these species is usually indicative of a larger problem, they are simply the first to suffer.

2) Legal requirements dictated by legislation protecting endangered species is often complex, controversial and consumes large amounts of time and money.

Many native Texas fishes have already been lost. These include Maravillas red shiner *Cyprinella lutrensis blairi*, Rio Grande silvery minnow *Hybognathus amarus*, phantom shiner *Notropis orca*, bluntnose shiner *N. simus*, Rio Grande cutthroat trout *Oncorhynchus clarki*, Amistad gambusia

Gambusia amistadensis, San Marcos gambusia *G. georgei* and blotched gambusia *G. senilis*. Although some still occur elsewhere (i.e., extirpated from Texas), others are known to be extinct. No matter how enlightened we become or how valuable we may find out some of these extinct species were, they can not be resurrected. At present, seven Texas fish species are federally listed as Endangered and an additional 22 species are afforded some protection by state statutes.

Our discussions here will not deal with the known endangered and threatened fishes, but with those that may soon get to that status. Imperiled species typically are envisioned as occurring in some small, isolated, specialized habitat, and many actually do. Diamond Y Spring in Pecos County is a good example of that and certainly in these types of environments there often are highly specialized, unique creatures. Perhaps surprisingly, however, over half of the imperiled fish species of Texas occur in streams and rivers. Most of these problems are related to the dual impacts of reductions in water quality and quantity.

The goal of the TCAFS Fish Stocks at Risk Committee is to recognize species, subspecies, etc. long before they really get into trouble. Once identified, the Committee will seek to determine causal factors. Resolving the problems will be easier (at least biologically) in the early stages.

To date we recognize the following species:

Shovelnose sturgeon *Scaphirhynchus platyrhynchus* - This species is known to occur in the Red River below Lake Texoma Reservoir (Hubbs et al. 1991). There are also historic records from the Rio Grande at Albuquerque, New Mexico (Cope and Yarrow 1875). There are anecdotal

accounts of occurrence in the Rio Grande in the vicinity of Big Bend National Park, but numerous collections by Garrett, Edwards, Hubbs and others have not yielded specimens. Further surveys of the Rio Grande are planned, but even if found, many questions will remain. Conservation decisions will hinge upon whether a viable population exists or if there are simply some very old "relict" Atlantic sturgeon cut off from the Gulf of Mexico by dams. Additionally, we know little of what is needed for *S. platyrhynchus* in the Red River drainage.

American eel *Anguilla rostrata* - This species occurred at one time in every major river in Texas. Dams are detrimental to migration requirements and their range is therefore greatly diminished. A newly introduced Asian swim bladder parasite, *Anguillicola crassus*, from aquaculture operations in South Texas (Fries et al. 1996) may have the same devastating impact on this species as it has had on populations of the European eel *Anguilla anguilla* (Höglund and Thomas 1992). Studies should focus on waters in the Rio Grande valley.

Mexican stoneroller *Campostoma ornatum* - The native range is throughout the Chihuahuan Desert, but populations are fractured and appear to be reduced in abundance. This is primarily due to pollution and overpumping from aquifers. Determining solutions to problems for this species will also be beneficial to water issues for all organisms in this ecosystem. An ongoing survey of Chihuahuan Desert fishes will provide needed information. A small, but secure, population exists in Cienega Creek on the Big Bend Ranch State Park.

Ironcolor shiner *Notropis chalybaeus* - Primarily distributed in coastal streams from New York through the Mississippi basin to eastern Texas, this species has a disjunct population in the San Marcos River headsprings downstream to about the Blanco River confluence. Large schools are commonly found in pools above and below riffle areas, similar to habitats occupied by Texas shiner *N. amabilis*, found elsewhere in the Edwards Plateau. The primary threat to this disjunct population is the limitation of dependable stream flows from the San Marcos headsprings. Recovery efforts for the San Marcos Springs ecosystem, and the Edwards Aquifer which feeds the springs, are ongoing but successful resolution of the water-related controversies in the region is far from being resolved.

West Mexican redhorse *Moxostoma austrinum* - This is another indicator species of problems in the Chihuahuan Desert. It occurs in northern Mexico and in the Rio Grande from the Rio Conchos confluence to below Eagle Pass. The Texas population may actually be morphologically unique and we have provided specimens to Dr. R. Jenkins (Roanoke College, Virginia) for a study to determine their taxonomic status.

Rio Grande population of blue catfish *Ictalurus furcatus* - This population appears to be morphologically unique, but we know virtually nothing about its range or life history. The Texas Parks and Wildlife Department (TPWD) Heart of the Hills Research Station (HOH) has initiated an electrophoretic survey of *I. furcatus* to determine just how different

this spotted morph is.

Blotched gambusia *Gambusia senilis* - This species occurs in some streams of the Rio Conchos and, at one time, the Devils River in Texas. It was presumably wiped out by the impoundment of Amistad Reservoir and by "stream renovation" projects by TPWD in the 1950s. A permit to move live fish from Mexico back into Texas has been requested from the Mexican federal government. When obtained, these fish will be reestablished and protected in Dolan Creek on the Devils River State Natural Area.

Texas bluegill *Lepomis macrochirus speciosus* - Preliminary electrophoretic studies suggest that two subspecies (*L. m. speciosus* and an unnamed subspecies) occur in Texas, in addition to *L. m. macrochirus* and the introduced *L. m. purpurescens*. Indiscriminate stocking could obliterate these subspecies before they are fully recognized and studied.

Largemouth bass *Micropterus salmoides* - Research shows that the native subspecies, *M. s. salmoides*, is more vulnerable to angling than Florida largemouth bass *M. s. floridanus*, perhaps due to a difference in aggressiveness. A massive stocking program to establish Florida largemouth bass has almost eliminated the native subspecies from the state. We are now trying to identify remaining native stocks and in some instances provide them with some form of sanctuary status. The TPWD will use the native subspecies in conjunction with triploid Florida largemouth bass to provide anglers a wider variety of opportunity. The combined stocking is designed to create a fishery that can provide high catch rates of *M. s. salmoides* as well as trophy potential *M. s. floridanus*. Using triploid Florida largemouth bass will insure that the desirable traits of each subspecies will not be diminished by hybridization. A trial of the combination stocking strategy will occur in 1997 - the TPWD plans to drain and rotenone Lake Balmorhea, Reeves County, to remove sheepshead minnow *Cyprinodon variegatus* and eliminate the hybridization threat they pose for the federally endangered Comanche Springs pupfish *C. elegans*. When the reservoir is restocked for sport fishing, both subspecies of largemouth bass will be used.

Guadalupe bass *Micropterus treculi* - Problems with water quantity and quality as well as hybridization with the exotic smallmouth bass *M. dolomieu* has put this fish at risk. A HOH research project designed to determine the efficacy of swamping hybrid swarms by stocking large numbers of pure *M. treculi* is underway. Since 1992, TPWD has stocked 145,000 in Johnson Creek in the Guadalupe River drainage and 80,000 in the Blanco River. The program is ongoing and it is too soon to draw conclusions on the effectiveness of this effort.

Guadalupe dusky darter *Percina sciera apristis* - This subspecies, described in 1954, inhabits portions of the Edwards Plateau streams of the Guadalupe River basin (Hubbs 1954). It occupies all suitable habitats in the San Marcos and Comal rivers, except those around the spring heads. It also has been collected in the Guadalupe River, but no specimens have been taken west of Kerrville. The primary threat is the limitation of dependable stream flows from the San Marcos and Comal headsprings.

River darter *Percina shumardi* - This is a wide-ranging darter, found in large rivers and streams from southern Manitoba, throughout most of the Great Lakes drainages, Ohio and Mississippi basins south to the portions of the Guadalupe and San Antonio basins east of the Balcones escarpment in Texas. This species inhabits gravel and rubble in fast-moving deep riffles. Rarely are river darters captured in water depths less than about 1 m. River darters are apparently tolerant of "flow-through" reservoir environments and have been found in some mainstem reservoirs. The primary threat to this species in Texas is diminished stream flows, especially during droughts.

It is our hope that this listing of potentially threatened fishes will stimulate research and awareness for these species at risk. The value of these efforts is to not only to avoid permanent loss of genetic information from these fishes, but also to guide us in maintaining quality environments for all of our aquatic organisms. Resource managers are continually faced with difficult issues such as interbasin transfers of fishes, water quality and quantity problems, and how to provide recreational opportunities for our citizens today without compromising our natural resource heritage and opportunities for future Texans.

References

- Angermeier, P. L. and J. E. Williams. 1993. Conservation of imperiled species and reauthorization of the Endangered Species Act of 1973. *Fisheries* 18(7):34-38.
- Babbitt, B. 1994. Protecting biodiversity. *Nature Conservancy* 44(1):16-21.
- Cope, E. D. and H. C. Yarrow. 1875. Report upon the collections of fishes made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871-1874. Chapter 6, pp 645 - 703, in United States Army Engineers Dept. Rept., in charge of George M. Wheeler, Geography and geology of the explorations and surveys west of 100th meridian, 5:1-1021.
- Davis, G. M. 1977. Rare and endangered species: a dilemma. *Frontiers* 41(4):12-14.
- Fries, L. T., D. J. Williams, and S. K. Johnson. 1996. Occurrence of *Anguillicola crassus*, an exotic parasitic swim bladder nematode of eels, in the southwestern United States. *Transactions of the American Fisheries Society* 125: 794-797.
- Höglund, J., and K. Thomas. 1992. The black goby *Gobius niger* as a potential paratenic host for the parasitic nematode *Anguillicola crassus* in a thermal effluent of the Baltic. *Disease of Aquatic Organisms* 13:175-180.
- Hubbs, C. 1954. A new Texas subspecies, *apristis*, of the darter *Hadropterus scierus*, with a discussion of variation within the species. *American Midland Naturalist* 52:211-220.
- Hubbs, C., R. J. Edwards and G. P. Garrett. 1991. An annotated checklist of the freshwater fishes of Texas, with keys to identification of species. *Texas Journal of Science, Suppl.*, 43(4):1-56.
- Minckley, W. L. and J. E. Deacon. 1991. Battle against extinction: native fish management in the American West. University of Arizona Press, Tucson.
- Meffe, G. K. 1986. Conservation genetics and the management of endangered fishes. *Fisheries* 11(1):14-23.
- Soule, M. E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. Pages 151-169 in M. E. Soule and B. A. Wilcox, editors. *Conservation Biology*. Sinaur Associates, Inc, Sunderland, Massachusetts.

Stock, Quality, Preferred, Memorable, and Trophy Length Classifications for Red Drum in Inland Reservoirs

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Abstract.--Proportional Stock Density (PSD) was first proposed in 1974 and then modified over the next several years to include more species and size classes forming the basis for Relative Stock Density (RSD). Proportional Stock Density and RSD are used by fisheries managers to describe fish populations as well as define management goals. Red drum have been stocked into freshwater reservoirs and fisheries managers can use PSD and RSD in the same manner as they do for other species. The midpoints of the ranges of the percentages of the total lengths of the all-tackle world records for each size class from other freshwater species were used to calculate the lengths for size classes for red drum. The minimum sizes for stock, quality, preferred, memorable, and trophy freshwater red drum are 10, 17, 22, 28, and 34 inches, respectively.

Proportional Stock Density (PSD) was first proposed by Johnson and Anderson (1974) when they developed length categories for largemouth bass *Micropterus salmoides* and bluegill *Lepomis macrochirus*. Over the next several years the concept was modified and expanded to cover more species and size categories. The modifications included the labels of "stock" (Anderson 1976) and "quality" (Anderson 1978) for the original two length categories, the addition of several species, and the concept of using percentages of the total length of all-tackle world records to determine stock and quality sizes (Weithman 1978, Anderson and Weithman 1978). Anderson (1978) introduced Relative Stock Density (RSD) with the addition of a "memorable" size category. Gabelhouse (1984) then added "preferred" and "trophy"

size categories based on percentages of total length of all-tackle world records and added many more species. Proportional Stock Densities and RSD's have become valuable tools for fisheries managers by being easily understood descriptors of population structures. These indices are particularly valuable when communicating with peers, tracking trends in fish populations, or for determining management targets. In Texas, red drum *Sciaenops ocellatus* have been stocked into freshwater reservoirs to provide additional recreational fishing opportunities. As these fisheries mature and become more popular, managers will likely desire to use the same freshwater management tools they currently are using for other freshwater species to describe freshwater red drum populations and to define management goals. The longest freshwater red drum on record was selected for determining red drum length categories. This fish was 44.75 inches total length from Lake Colorado City, Texas (Texas Parks and Wildlife Department Water Body Records 1996). To determine the minimum stock, quality, preferred, memorable, and trophy sizes for red drum, the midpoints of the percent ranges of all-tackle world records from Gabelhouse (1984) for stock, quality, preferred, memorable, and trophy fish of other species were selected and rounded up to the nearest whole number (Table 1). These midpoint values were multiplied by the total length of the Lake Colorado City Water Body Record of 44.75 inches to determine the minimum value of each length category (Table 1).

TABLE 1.--Size classes of freshwater red drum used in various population structure indices, as determined by multiplying the length of the longest record red drum caught in freshwater (44.75) by the midpoints of the ranges of all-tackle world records for other species (Gabelhouse 1984).

Size Class	Range (% of all-tackle world records)	Midpoint (%)	Calculated minimum length (inches)
Stock	20-26	23	10
Quality	36-41	39	17
Preferred	45-55	50	22
Memorable	59-64	62	28
Trophy	74-80	77	34

References

- Anderson, R. O. 1976. Management of small warmwater impoundments. *Fisheries* 1(6):5-7, 26-28.
- Anderson, R. O. 1978. New approaches to recreational fishery management. Pages 73-78 in G. D. Novinger and J. G. Dillard, editors. *New approaches to the management of small impoundments. Special Publication 5, North Central Division, American Fisheries Society, Bethesda, Maryland.*
- Anderson, R. O. and A. S. Weithman. 1978. The concept of balance for coolwater fish populations. Pages 371-381 in R. L. Kendall, editor. *Selected coolwater fishes of North America. Special Publication 11, North Central Division, American Fisheries Society, Bethesda, Maryland.*
- Gabelhouse, D. W., Jr. 1984. A length-categorization system to assess fish stocks. *North American Journal of Fisheries Management* 4:273-285.
- Johnson, D. L. and R. O. Anderson. 1974. Evaluation of a 12-inch length limit on largemouth bass in Philips Lake, 1966-1973. Pages 106-116 in J. L. Funk, editor. *Symposium on largemouth bass overharvest and management in small impoundments. Special Publication 3, North Central Division, American Fisheries Society, Bethesda, Maryland.*
- Texas Parks and Wildlife Department Waterbody Records. 1996. Tyler, Texas.
- Weithman A. S. 1978. A method of evaluating fishing quality-development, testing, and application. Doctoral dissertation. University of Missouri, Columbia, Missouri.

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