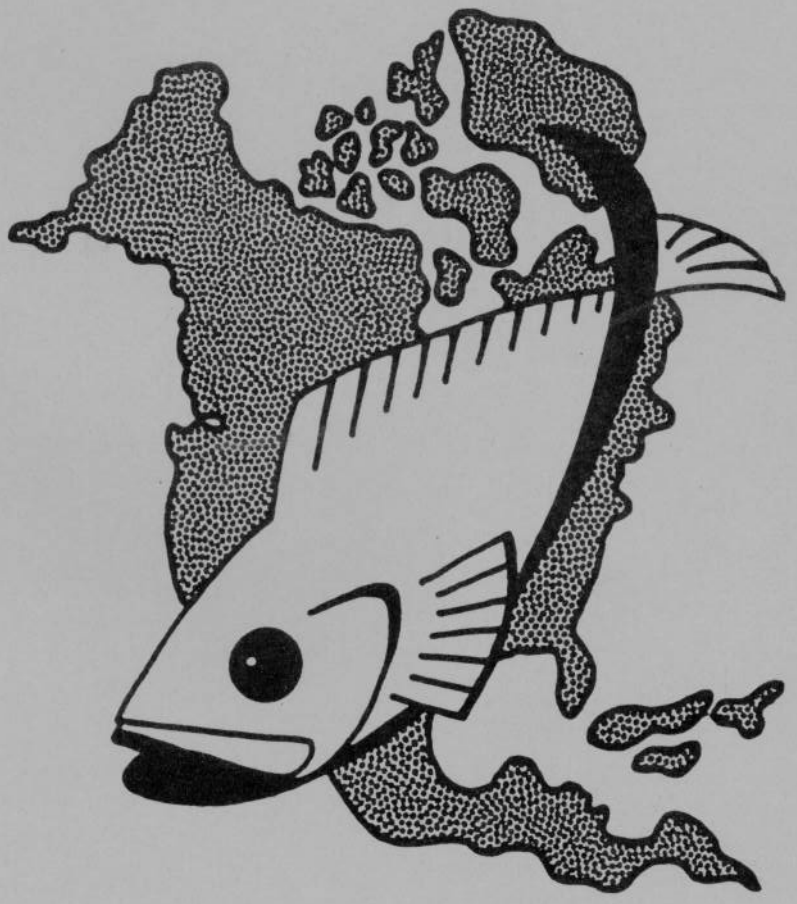
ANNUAL PROCEEDINGS of the TEXAS CHAPTER AMERICAN FISHERIES SOCIETY



Lake Travis, Texas
September 8 and 9, 1994

VOLUME 17

KURZAWSKI

TEXAS CHAPTER
AMERICAN FISHERIES SOCIETY

The Texas Chapter, American Fisheries Society, was organized in 1975. Its objectives are those of the parent Society -- conservation, development and wise utilization of recreational and commercial fisheries, promotion of all branches of fisheries science and practice, and exchange and dissemination of knowledge about fish, fisheries and related subjects. A principal goal is to encourage the exchange of information among members of the Society residing within the State of 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

September 8 and 9, 1994

Lakeway Resort, Lake Travis, Texas

1994-1995 Officers

1995

Published by:
Texas Chapter, American Fisheries Society
c/o Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

TABLE OF CONTENTS

PAST TEXAS CHAPTER PRESIDENTS AND MEETING LOCATIONS

DATE	PRESIDENT	LOCATION
1976		College Station
1976	Ed Bonn	Lake Brownwood
1977	Jim Davis	San Antonio
1978	Bill Rutledge	San Marcos
1979	Bobby Whiteside	College Station
1980	Richard Noble	Arlington
1981	Charles Inman	Austin
1982	Gary Valentine	Kerrville
1983	Don Steinbach	Lake Texoma
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 L. Hutson	College Station

TEXAS CHAPTER AWARDS

A total of eight awards may be presented on an annual basis, assuming nominations are received. 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 in any of all areas. 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

1994 TEXAS CHAPTER AWARDS

Dick Luebke was recognized as the **Outstanding Fisheries Worker of the Year for Administration**. Dick was acknowledged for his leadership in undertaking the development of the Technician Career Ladder for the Wildlife and Fisheries Divisions of the Texas Parks and Wildlife Department (TPWD). This included the creation of the Technician IV position. The required diversity in technician capabilities and performance made this a truly arduous task. Among his own staff (18 members) at Heart of the Hills Inland Fisheries Research Station, he instituted an in-house evaluation, which has greatly enhanced working conditions at the Station by increasing harmony and productivity. Dick is the chief editor for all research proposals, reports, and publications generated within the Inland Fisheries Division, which has had numerous papers published in the Proceedings of the Southeastern Association of Fish and Wildlife Agencies, North American Journal of Fisheries Management, and others.

Ted Engelhardt was recognized as the **Outstanding Fisheries Worker of the Year for Culture**. Ted developed techniques to increase the number of forage fishes produced at the A. E. Wood TPWD Fish Hatchery. One technique included increasing the ratio of male brooders to female brooders while held in troughs. This increase has led to more intensive spawning activity on the part of females, previously neglected by the majority of males, which tended to court one or two females extensively, in addition, he suggested the separation of male and female broodstock, while in holding ponds, to put off spawning until in troughs. Healthier, more gravid females were able to be placed in troughs for a more intensive method of spawning. He has also developed equipment that benefited fish culture by simplifying the procedures involved in spawning substrate placement, removal, and cleaning. He participated in the production of 22,194,745 koi carp fry, which is a crucial part of the largemouth bass program. This was a record koi carp production for all TPWD hatcheries.

Steve Magnelia was recognized as the **Outstanding Fisheries Worker of the Year for Management**. Steve was the lead researcher on a rainbow trout over-summering survival study on the Guadalupe River. He has solicited the cooperation and active participation of the Texas Chapter Trout Unlimited, which have provided monies towards an electrofishing boat and trailer. This study will provide TPWD with information to better

manage a truly unique trout fishery for Texas anglers. Steve initiated the development and distribution of the TPWD weigh-in kit. This kit provides anglers with the equipment needed to insure survival of tournament-caught fish. This kit is loaned out for the purpose of educating tournament anglers on proper live release practices. Steve developed the kit by working closely with the Oklahoma Department of Wildlife Conservation, which has a similar program. Steve actively promoted the kit through public presentations, popular articles, and the distribution of a pamphlet. He published five popular articles in 1993 and 1994. He was also co-author on a scientific paper accepted for publication in the Proceedings of the Southeastern Association of Fish and Wildlife Agencies. Steve was part of a team recognized by the TPWD for having a "Model Public Outreach Program" and for "Excellence in Holding Fishing Events for Youth and the Physically Challenged".

One award for **Special Recognition in Fisheries Work** was presented to **Robert G. Howells**. In 1991, Robert was assigned the task by TPWD to determine the status of freshwater mussel resources in Texas and to make recommendations for their management. He was responsible for the development and implementation of a survey to derive information on extent of musseling activities in Texas. He recommended a comprehensive set of regulations regarding harvest quotas, minimum size limits, and establishment of sanctuaries throughout Texas to help insure replenishment of mussel stocks. His surveys determined the current status of Texas freshwater mussels and provided new life history information on Texas mussels. His "Info-Mussel Newsletter" provided technical information on mussels in Texas to workers throughout the state. Robert has maintained leadership in obtaining information and instituting programs to benefit the mussel resources and users of that resource.

Travis C. Kelsey gave the **Outstanding Presentation** at the 1994 Annual Meeting. The paper was titled "Survey of Fishes of the San Marcos River, Texas" by Travis C. Kelsey and Bobby Whiteside.

PAST TEXAS CHAPTER AWARDS RECIPIENTS

1977	Fisheries Research - John A. Prentice and Richard D. Clark, Jr. (TPWD)
1978	Fisheries Education and Research - Clark Hubbs (UT Austin) Fish Culture - Pat L. Hutson (TPWD) Species Recognition - Edward R. 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	Fisheries Education - Bobby Whiteside (SWTSU)
1982	Fish Culture - Roger L. McCabe Fisheries Research - William C. Guest (TPWD) Special Recognition - Robert P. Hofstetter (TPWD)
1983	Special Recognition - Robert J. Kemp (TPWD)
1984	none
1985	Fisheries Education - Donald E. Wohlschlag (UTMSI) Fisheries Research - Connie R. Arnold (UTMSI)
1986	Fisheries Management - William Higginbotham (TAES) Fisheries Research - Robert L. Colura (TPWD)
1987	Fish Culture - Kerry Graves (USFWS) Special Recognition - The Sportsmen's Club of Texas
1988	Fisheries Research - Gary P. Garrett (TPWD) Special Recognition - Kirk Strawn (TAMU)
1989	Fisheries Administration - Gary C. Matlock (TPWD) Fish Culture - Robert R. Vega (TPWD) Fisheries Management - Joseph E. Kraai (TPWD) Fisheries Research - Roy J. Kleinsasser and Gordon W. Linam (TPWD)
1990	Fisheries Administration - C. Gene McCarty (TPWD) Fish Culture - Glen A. Alexander and David L. Campbell (TPWD) Fisheries Management - David R. Terre (TPWD) Best Presentation - Robert Clay Smith (1989)

1991	Fisheries Administration - Pat L. Hutson (TPWD) Fish Culture - Jake Isaac, Jr. (TPWD) Fisheries Management - Mark Webb (TPWD) Fisheries Research - Ronnie M. Pitman (TPWD) Special Recognition - The Wetland Habitat Alliance of Texas Best Presentation - Joe Kraai (1990)
1992	Fish Culture - Camilo Chavez, Jr. (TPWD) Fisheries Education - Brian R. Murphy (TPWD) Fisheries Management - Kenn Sellers (TPWD) Fisheries Research - Bob Colura (TPWD) Special Recognition - Bobby Farquhar, Andy Sansom, and Rudy Rosen (TPWD) Best Presentation - Mark Stacell (1991)
1993	Fisheries Management - Bruce Hysmith (TPWD) Special Recognition - Joe Martin and Steve Gutreuter (TPWD) Best Presentation - Maurice Muoneke (1992)
1994	Fisheries Administration - Dick Luebke (TPWD) Fish Culture - Ted Engelhardt (TPWD) Fisheries Management - Steve Magnelia (TPWD) Special Recognition - Robert Howells (TPWD) Best Presentation - Jay Rooker (1993)

Donators and Contributors

The following individuals or companies made contributions of money, products or services, or exhibited products and/or services at the annual meeting in 1994.

Pat Hutson
A.E. Wood Fish Hatchery
P.O. Box 947
San Marcos, TX 78667

Kip Portis
A.E. Wood Fish Hatchery
P.O. Box 947
San Marcos, TX 78667

Dundee Fish Hatchery
Route 1
Electra, TX 76360

Loraine Fries
A.E. Wood Fish Hatchery
P.O. Box 947
San Marcos, TX 78667

Ed Nunez
Possum Kingdom Hatchery
HC 51, Box 13
Graford, TX 76449

Nick Parker
Box 42125
Texas Tech University
Lubbock, TX 79409

Lynn Sloan
Rt. 4, Box 157
Denison, TX 75020

Dick Luebke
Heart of the Hills Research Station
HCR 7, Box 62
Ingram, TX 78025

Cabela's
812 13th Avenue
Sidney, NE 69160

Berkley, Inc.
One Berkeley Drive
Spirit Lake, IA 51360-1041

Jerry Dunn
P.O. Box 1546
Three Rivers, TX 78071

Bill Harrington
Hydrolab Corporation
P.O. Box 50116
Austin, TX 78763

Charles Seaborne
Professional Guide Service
14172 FM 316
Eustace, TX 75124

Rebecca McKemie
Yellow Springs Instruments
6719 Dusty Dawn
Houston, TX 77086

Anna Marie Comilla
W.R. Case & Sons Cutlery Co.
P.O. Box 4000
Bradford, PA 16701

Dale Jackson
Dealers Electrical Supply
P.O. Box 845
San Marcos, TX 78666

Buddy Mostyn
Wonder World
P.O. Box 1369
San Marcos, TX 78667

Bubba Wieland
McCoys
2200 Hwy 123 S.
San Marcos, TX 78666

Red Ewald
P.O. Box 519
Karnes City, TX 78118-0519

Sportsmen Conservationists of Texas
807 Brazos, Suite 311
Austin, TX 78701

Barry Rowland
Rowland Fiberglass Inc.
P.O. Box 971
Ingleside, TX 78362

Karen Holland
1779 Wells Branch Pkwy.
110-B, Box 105
Austin, TX 78723

Frank Gibson
Memphis Net & Twine Company
P.O. Box 8331
Memphis, TN 38108

Mark Fisher
Mann's Lures
604 State Docks Road
Eufala, AL 36027

Wade Butler
601 Franklin Drive
San Marcos, TX 78666

Susan Emory
Nalle Plastics
220 E. St. Elmo
Austin, TX 78745

Mark Bowman
Nylon Net Company
P.O. Box 592
Memphis, TN 38101-0592

Bob Waldrop
Tyler Fish Farms
Route 3, Box 3286
Ben Wheeler, TX 75754

Denver Walker
Walker Ranch
P.O. Box 686
Uvalde, TX 78802

Robert Heideman
Aquatic Eco-systems Inc.
2056 Apopka Blvd.
Apopka, FL 32703

Mac McCune
Lake Management Services
P.O. Box 923
Richmond, TX 77469

Bill Lewis Lures
P.O. Box 7959
Alexandria, LA 71306

Texas Reds Steakhouse
120 West Grove
San Marcos, TX 78666

Joe McBride
McBride's, Inc.
30th at N. Lamar
Austin, TX 78705

Katherine Keating
Shiner Beer of Austin
1917 E. 7th
Austin, TX 78702

Ross Watkins
Turkey Creek Ranch
P.O. Box 2490
Uvalde, TX 78802

Floyd Hoffman
Brown Distributing Co.
924 Bugg Lane
San Marcos, TX 78666

James Alexander
WalMart Stores
933 Hwy 80 East
San Marcos, TX 78666

Ken Hale
Boat Cycle
P.O. Box 494
Henderson, TX 75653

Sam Caldwell
Gulf Coast Conservation Association
4801 Woodway Suite 220 W
Houston, TX

Dottie Huckle
Lonestar Brewery
600 Lone Star Blvd.
San Antonio, TX

T.G. Canoe Livery
P.O. Box 127, Hwy. 80
Martindale, TX 78655

Dr. White
Hill Country Chiropractic
1321 Aquarena Springs Dr.
San Marcos, TX 78666

John Ferguson
Quail Creek Country Club
Drawer 232
San Marcos, 78667

Ann Martinez
Chilympiad
c/o Crockett School
San Marcos, TX 78667

Mike and Greg Davis
3D Welding & Industrial Supply Inc.
1218 Hwy 123
San Marcos, TX 78666

David Dunseth
Redfish Unlimited
HC 2, Box 386
Palacios, TX 77465

Lowell Warren
KCM Inc.
1917 First Ave.
Seattle, WA 98101

Blaine Wise
Brush County Chapter - GCCA
Rt 2, Box 320-Q
Kingsville, TX 78363

Jim Ehman
Asst. Director, GCCA
4801 Woodway, Suite 220W
Houston, TX

Jimmy Evans
Beach Bait & Tackle
P.O. Box 2025
Freeport, TX 77541

Fisherman's Wharf
P.O. Box 387
Port Aransas, TX 78373

Cheryl Reed
Bio-medics Inc.
1720 130th Ave. N.E.
Bellevue, WA 98005

Annual Proceedings, Volume 17

Triploid Grass Carp Evaluation in Private Waters: 1993 Summary

Clell Guest, Texas Parks and Wildlife Department, 6200 Hatchery Road, Ft. Worth, TX 76114

Data were collected in 1993 to evaluate the effectiveness of triploid grass carp as a biological control of aquatic vegetation in Texas ponds as part of a 4 year study. In 1992 and 1993, 40 and 187 ponds were inspected prior to grass carp introduction. Average total coverage of vegetation for ponds inspected both years before grass carp introduction was 55% and 50%, respectively. *Najas* and *Chara* were the most common plant types observed. *Najas*, *Chara*, coontail, milfoil, fanwort, Eurasian watermilfoil, hydrilla, sago pondweed, and egeria were observed in densities greater than 30%. From the 40 ponds stocked in 1992 and inspected again in 1993, total coverage of aquatic vegetation declined from 55% to 34%. The fish appeared to successfully control *Najas*, but *Chara* densities tended to fluctuate for the one year period.

The Biology of Free-ranging Grass Carp in East Texas River and Bay Systems

Howard S. Elder and Brian R. Murphy, Department of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843

Recent confirmation of grass carp spawning in the river systems entering Galveston Bay is a serious concern to many fisheries ecologists. The impacts that free-ranging grass carp might impose on native aquatic plants, associated fish species, and waterfowl in the Galveston Bay system cannot be predicted. Grass carp captured in the Trinity River by commercial fishermen were examined to determine ploidy, population structure, diet, and fecundity. The fish were primarily diploids and represented a broad range of age classes. Diets consisted of terrestrial detritus, aquatic vegetation, and Graminae species. Gonadosomatic indices indicated spawning of grass carp in the Trinity River occurs in late spring and early summer. Mean fecundity estimates ranged from 32 thousand to 217 thousand eggs per kg body weight. Grass carp in the Trinity River appear to reach maximum reproductive potential at approximately 7 kg in weight and at 4 to 5 years of age. This study provided strong evidence that naturally spawned grass carp are being recruited to adult sizes in the Trinity River.

Grass Carp Reproduction in the Lower Trinity River, Texas

Mark A. Webb, Texas Parks and Wildlife Department, 1004 East 26th Street, Bryan, TX 77803 and Robert G. Howells, Texas Parks and Wildlife Department, Heart of the Hills Research Station, Texas Parks and Wildlife Department, HCR-7 Box 62, Ingram, TX 78025

Texas Parks and Wildlife Department personnel conducted ichthyoplankton sampling in the Lower Trinity River of southeastern Texas during spring 1992 and 1993 in response to concerns over growing grass carp populations and possible predation on smooth cord grass downstream in the Galveston Bay system. Ichthyoplankton samples taken in 1992 were found to contain large numbers of grass carp eggs, including many that were apparently viable and developing at the time of collection. Although successful grass carp spawning had been reported at many locations within the Mississippi River basin, the Trinity River collections appeared to be the first in another U.S. river system. However, no larval or juvenile grass carp were found during the 1992 sampling, leaving questions as to the success of hatching and survival to juvenile stage. As in 1992, samples collected in the Trinity River during spring and summer 1993 contained grass carp eggs which appeared viable and were developing; however, 1993 samples also contained recently-hatched larvae in substantial numbers. These samples confirmed not only that a second successful spawn had occurred but also that large numbers of larvae were being produced. Additionally, a grass carp (ca. 65 mm TL) was collected from the Houston Ship Channel (downstream from the TPWD collection sites) by the Texas Water Commission in July 1993. TPWD's Resource Protection Division also reported 65 grass carp juveniles between 102 and 178 mm TL during a fall 1993 fish kill investigation in a bayou off the Houston Ship Channel. Although stocking grass carp has recently been allowed under permit in Texas, legally stocked triploid grass carp and illegally stocked diploid grass carp are generally 150 to 200 m TL or larger at the time of stocking. Collection of the aforementioned small juveniles suggests origin from a natural spawn, indicating that successful grass carp recruitment as well as spawning, egg development, and hatching occur in the Trinity River, Texas.

Use of Scale Circuli Pattern Analysis for Differentiation of Wild and Hatchery Red Drum (*Sciaenops ocellatus*) Stocks in Texas

Paul S. Silva, GCCA/CPL Marine Development Center, Texas Parks and Wildlife Department, Corpus Christi, TX 78418

Using Optical Pattern Recognition system (OPRS) software, scale circuli distances from 30-day-old hatchery reared red drum fingerlings and wild red drum juveniles (< 121 mm TL) were analyzed to establish a linear discriminant function. The linear discriminant function was used to classify hatchery and wild red drum. Re-entry of the circuli measurements of the 30-day-old hatchery reared and wild fish into the discriminant function resulted in correct reclassification of 77% of the hatchery fish and 68% of the wild fish. Using the same data a linear discriminant function was created to evaluate variations of spring and fall hatchery-reared and wild red drum. Resubstitution of the circuli measurements of the hatchery-reared fish and the wild fish into the discriminant function resulted in correct reclassification of 44% of the spring fish, 50% of the fall fish and 68% of the wild fish.

Spatial and Temporal Patterns in Habitat Utilization by Reef Fishes on an Offshore Petroleum Platform: Preliminary Results

Jay R. Rooker and G. Joan Holt, Department of Marine Science, The University of Texas at Austin, Port Aransas, TX 78373
and
Quenton Dokken, Center for Coastal Studies, Texas A&M at Corpus Christi, Corpus Christi, TX 78412

Visual censusing was used to investigate spatial and temporal patterns in habitat utilization by adult and juvenile (i.e., young of the year) reef fishes occupying an offshore petroleum platform (Mobile High Island A389-A) in the northwestern Gulf of Mexico. Forty-five taxa were visually identified by divers in upper waters (< 24 m) of the jacket structure. Serranidae, Carangidae, Kyphosidae, Labridae, and Pomacentridae were the dominant families with serranids (i.e., *Paranthias furcifer*, *Epinephelus adscensionis*) and carangids (i.e., *Caranx crysos*, *Caranx hippos*) accounting for the majority of all identifiable fishes in quantitative transects (33% and 25%, respectively). Juvenile stage fishes represented 9% of all fishes censused and were comprised almost exclusively of labrids, pomacentrids, and acanthurids (98% of juveniles). Distinct trends in reef fish abundance and assemblage composition were present among designated depth zones: 1.5 to 9.0 m, 9.0 to 16.5 m, 16.5 to 24.0 m. Abundance and diversity were lowest in the upper depth zone (1.5 to 9.0 m). Diel variation (day versus night) was examined by comparing diurnal (1000 to 1200) and nocturnal (2000 to 2200) counts. Nighttime counts were characterized by marked reductions or complete absence of diurnally observed species. Low nighttime abundance was partly due to twilight migrational activities and cover-seeking behavior. No apparent diurnal-nocturnal changeover of species assemblages, typical of coral reef habitats, occurred. Seasonal variations in species abundance and composition of the artificial reef assemblage were also evident.

Florida Largemouth Bass Raceway Spawning Observations

Jake Isaac, Jr., Max Kimmel, Bob Bagley, and Vernon H. Staats, Texas Parks and Wildlife Department, San Marcos, TX 78667

Raceway spawning activities of Florida largemouth bass, *Micropterus salmoides floridanus*, were observed to determine the percent of fish that spawned, how many fish contributed to a spawn, and other spawning behaviors. Twenty pair of 6 to 7-year-old hatchery broodfish were tagged with combinations of colored surveyor tape to identify individuals. Fish were placed into an indoor raceway divided into two compartments (2.4 x 10 m) where observations of spawning behavior of individuals were recorded for an 8-day period. Spawning was confirmed daily by checking for egg deposition and once confirmed, the raceway location of each spawn was recorded. Nests with eggs were then harvested and replaced with new nests to encourage additional spawning. The 19 spawns found during the observation period involved confirmed participation by 55% of the males and 65% of the females in the study. In addition, two males and three females which participated could not be identified because of either tag loss or spawns that occurred at night. Two spawns included activity from more than one male or female but their contributions were undetermined. These results indicate that Florida bass raceway spawning can be managed for a large percent of broodfish participation

Heritability of Angling Vulnerability in Largemouth Bass, *Micropterus salmoides*

Gary P. Garrett, Heart of the Hills Research Station, Texas Parks and Wildlife Department, HC 7 Box 62, Ingram, TX 78025

A random sample of 154 largemouth bass, *Micropterus salmoides*, from a non-fished, reservoir population was used to determine if variations in angling vulnerability had a heritable component. After three generations of selective breeding, two different populations existed, one significantly easier to catch than the naive population from nature and one significantly harder to catch. Subsequent electrophoretic analysis revealed that all of the 19 hard-to-catch fish were hybrids between *M. s. salmoides* and *M. s. floridanus*, seven of eight easy-to-catch fish were *M. s. salmoides*. In streams and reservoirs, angling harvest creates a selective pressure for wariness in fishes. If there is genetic variation in a population particularly at the extreme level existing between these two subspecies, angling harvest would remove the most vulnerable and leave those less susceptible to breed and pass on their traits. The Texas Parks and Wildlife Department is now developing a program designed to exploit the behavioral differences in these two subspecies in such a way as to provide the angler with high catch rates as well as a good potential for catching large fish. An additional benefit of this approach will be protection of the genetic integrity of our native largemouth bass.

Tissue Degradation - Effects of Temperature on Banding Patterns of Koi Carp Muscle Proteins

Rocky Ward, Eric Young, Ivonne Blandon, and Britt Bumguardner, Perry R. Bass Marine Fisheries Research Station, Texas Parks and Wildlife Department, HCO2 Box 385, Palacios, TX 77465

The use of isoelectric focusing (IEF) for species identification assumes stability of muscle proteins obtained from samples collected and stored under varying conditions. In order to assess the effects of temperature on protein banding patterns, tissue samples were incubated at three temperatures (4°C, 22°C, and 37°C) for periods ranging from 0 to 96 hours. Comparison of banding patterns obtained from electrophoresis of the samples demonstrate a decrement in the intensity of certain bands, with a total loss of activity after prolonged exposure to high temperatures. However, the appearance of extraneous bands was not observed, and several bands appear to be remarkably stable even after 96 hours at 37°C. It is concluded that IEF is a robust method for the identification of tissues even if degradation has occurred due to prolonged exposure to high temperatures.

A Preliminary Report on Biochemical Analyses of the Population Structure of Southern Flounder (*Paralichthys lethostigma*) Inhabiting the Texas Gulf Coast

Ivone Blandon, Rocky Ward, William Karel, and Eric Young, Perry R. Bass Marine Fisheries Research Station, Texas Parks and Wildlife Department, HCO2 Box 385, Palacios, TX 77465

Southern flounder from Galveston Bay, Matagorda Bay, and Lower Laguna Madre were collected and surveyed using allozyme electrophoresis to assess genetic variation in populations resident in Texas bays. Isoelectric focusing was used to insure correct species identification of all fish included in the survey. Sixty specific enzyme systems were surveyed of which 30 were resolvable on muscle, liver, or heart/kidney tissues. Preliminary data are presented on eight putative polymorphic loci. Populations are genetically characterized, measures of population structure are given, and management implications of these findings are discussed.

A Preliminary Allozyme Survey of the Black Drum (*Pogonias cromis*) From the Texas Gulf Coast

William J. Karel, Rocky Ward, and Ivonne R. Blandon, Perry R. Bass Marine Fisheries Research Station, Texas Parks and Wildlife Department, HCO2 Box 385, Palacios, TX 77465

Horizontal starch gel electrophoresis was used to survey the genetic variability of populations of black drum from Matagorda Bay, the Upper Laguna Madre, and the Lower Laguna Madre. Eighty-one enzyme systems were surveyed on muscle, liver, heart/kidney, and neural tissues. Nineteen enzyme systems have been resolved and data on seven presumptive polymorphic loci will be shown. Measures of genetic variability and population structure will be presented and the potential management implications of these finding considered.

Reaching the Fisheries Microcomputer User Audience

Charles Munger, Texas Parks and Wildlife Department, 5325 North Third Street, Abilene, TX 79603

A presentation of the Computer User Section of the American Fisheries Society that gives an overview of the Section including organization and scope. The computer use section is the second largest Section in AFS. Activities of the Section include sponsoring symposia and managing a software library of fisheries related programs.

Toxicity of Oxytetracycline-HCl to Juvenile Striped Bass

Britt W. Bumguardner and Tim L. King, Perry R. Bass Marine Fisheries Research Station, Texas Parks and Wildlife Department, HCO2 Box 385, Palacios, TX 77465

Acute toxicity of a chemical potentially useful in marking hard structures of small fish was determined by immersion of juvenile striped bass, *Morone saxatilis*, (48 ± 5 mm total length) in a geometric sequence of oxytetracycline-HCl (OTC) (55.8 to 893 mg/L). Fish were immersed in test solutions for 6-h and observed for 96-h after chemical exposure. OTC binds to calcium and fluoresces under ultraviolet light, which makes it useful for marking bony structures of fish. Information on toxicity of this chemical to juvenile striped bass would help establish maximum chemical concentrations that could be used to mark hatchery fish stocked for population enhancement or establishment purposes. The no observed effect concentration (NOEC) and 96-h LC_{10} and LC_{50} values for the 6-h chemical exposure were, respectively, 447, 333, and 629 mg/L.

Effects of Three Fertilization Regimens on Water Quality and Striped Bass Fingerling Production in Plastic-Lined Ponds

Aaron Barkoh, Texas Parks and Wildlife Department, 3100 Seymour Hwy, 100-D, Wichita Falls, TX 76301

Three pond fertilization treatments were compared in plastic-lined ponds to determine their effects on water quality, zooplankton and striped bass production. Treatment 1 involved fertilizing with alfalfa meal (100 to 200 kg/ha) only, Treatment 2 involved fertilizing with alfalfa meal (100 to 150 kg/ha) followed by ammonium nitrate and phosphoric acid after 24 h to achieve 210 μg N/L and 30 μ g P/L target levels, and Treatment 3 involved fertilizing with alfalfa meal (100 to 150 kg/ha) followed by ammonium nitrate and phosphoric acid after 24 h to achieve 300 μg N/L and 20 μg P/L target levels. Treatment with alfalfa meal only best promoted desirable water quality conditions, including moderate pHs, that were conducive to striped bass survival and production. Mean values of observed total nitrogen and un-ionized ammonia were similar ($P > 0.05$) among treatments. Mean phosphorus (PO_4-P) concentrations were significantly lower in Treatment 1 ponds than in Treatment 2 or 3 ponds. Differences in daily phytoplankton standing crops among treatments were significant only during the first week of culture when fish were 4 to 6 days old; values were lower in Treatment 1 ponds and highest in Treatment 3 ponds. Afternoon dissolved oxygen concentrations also were significantly lower in Treatment 1 ponds than in Treatment 2 or 3 ponds, however, they never fell below levels that could reduce survival or growth of striped bass. Mean pH was 8.3 for Treatment 1, 8.5 for Treatment 2, and 8.6 for Treatment 3; differences among treatments were significant. Mean adult crustacea densities were lower in Treatment 1 ponds and highest in Treatment 3 ponds, however, mean total zooplankton densities were similar among treatments. Mean adult crustacea density correlated negatively with survival rate ($r^2 = 0.74$; $P = 0.003$) and positively with growth rate ($r^2 = 0.90$; $P = 0.0001$) suggesting these zooplankters were important food items for striped bass. Production of striped bass fingerlings (range = 160.6 to 173.6 kg/ha) was similar among treatments. Mean survival rate at harvest was 86.7% for Treatment 1, 53% for Treatment 2, and 36.4% for Treatment 3. Survival rate negatively correlated with growth rate ($r^2 = 0.86$; $P = 0.0003$) suggesting growth was density-dependent, and food was probably limiting in ponds with high survival rates. Survival rate negatively correlated with pH ($r^2 = 0.77$; $P = 0.002$) suggesting pH could be a source of fish mortality. Because the primary goal of most striped bass producing hatcheries is to produce maximum numbers of fingerlings, the practical significance to hatcheries of the differences in survival rates of striped bass is noteworthy.

To Feed or Not to Feed: Phase-1 Striped Bass in Ponds

Joe N. Fries, National Biological Survey, 500 McCarty Lane, San Marcos, TX 78666

Ten 0.04-hectare plastic-lined ponds each were stocked with 15,000 4-d-old striped bass (*Morone saxatilis*). Ponds were fertilized with alfalfa meal, urea, and phosphoric acid. Five of the ponds (fed) received Silver Cup Trout Fry Feed two to three times daily, by hand, when the fish were ≥ 15 days of age; the other five ponds (unfed) received no feed. Alfalfa meal fertilization rates were reduced in fed ponds to equalize amounts of total nitrogen added to ponds. Fish were sampled using light traps at night at ages 9 and 16 d, using a seine at age 23 d, and at ages of 30 and 31 d (harvest) using a dip net in the hauling unit. Dissolved oxygen and temperature were measured twice daily (about 0800 and 1430 hours) and pH was measured daily in the afternoon (about 1500 hours). There were no significant differences ($P > 0.05$) between fish in unfed and fed ponds in survival (mean percent survival, 57 and 45), number harvested (mean number/hectare, 210,000 and 170,000), and weight harvested (mean kg/hectare, 81 and 71). Fish preserved at harvest from unfed ponds were about as long as those from fed ponds (mean total length, 31.7 and 31.4 mm) but were significantly heavier (mean weight/fish, 0.35 versus 0.32 g) and had a significantly higher relative condition (mean *Kn*, 1.01 versus 0.98). None of the 59 fish sampled within 6 h after feeding had commercial feed in their guts. There was no relation between numbers collected either by light trap 3 weeks prior to harvest or by seine 1 week prior to harvest and numbers harvested. However, numbers collected by light trap 2 weeks prior to harvest were positively related to numbers harvested. There were no significant differences in dissolved oxygen or pH levels between the treatments. However, the unfed ponds were significantly cooler than the fed ponds in the mornings (mean temperature, 21.1°C versus 21.2°C). The reason for this small difference is not known and likely was biologically meaningless. There were no substantial production benefits gained from the limited hand-feeding in this study.

Evaluation of Nutrient Density (Dietary Protein) on Growth of Red Drum, *Sciaenops ocellatus*, and Water Quality in Closed Systems

D. O. Jirsa, D. A. Davis, and C. R. Arnold, The University of Texas at Austin, Marine Science Institute, Port Aransas, TX 78373-1267

Two growth trials were conducted to determine the effects of dietary protein level on the growth of red drum (*Sciaenops ocellatus*) and on water quality in closed aquaculture systems. The experimental system consisted of 12, 220L closed recirculating systems each containing a settling chamber, biological filter, airlift circulation and supplemental aeration. The four test diets (diets 1 to 4) were formulated to contain 32%, 36%, 40%, and 44% protein and 3.4, 3.5, 3.6, and 3.8 kcal/kg energy respectively. Total ammonia, nitrite nitrogen, nitrate nitrogen BOD, COD, total suspended solids, total settleable solids and total phosphorus were measured periodically throughout the experiments. Initial mean weight of fish used in experiments 1 and 2 were 1.7g and 89g, respectively. Significant differences in weight gain and total biomass corresponded to increasing dietary protein content. Feed conversion efficiencies were significantly different for fish fed diets 1 through 4 in experiment 1 (67.2%, 80.4%, 94.7%, and 106.5%, respectively) and experiment 2 (38.1%, 53.3%, 66.4%, and 80.1%, respectively). Waste (total settleable solids) recovered from each system increased with increasing dietary protein content although significant differences were only found in experiment 1. Based on the observed results, the effects of dietary protein on water quality parameters and waste production was not as evident as the effects on weight gain and feed conversion efficiency.

Carrying Capacity, Life History, and Fisheries Management

Kirk O. Winemiller, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258

Many approaches in fisheries management either explicitly or implicitly infer the existence of density-dependence and environmental carrying capacity. This notion has been challenged for some species and environments, but there is no general means to predict *a priori* when density-dependence should be weak or strong. Life-history theory provides guidance for predicting modes of population regulation and response to disturbances of varying scales. A framework based on the evolution of primary life-history strategies predicts that different kinds of fishes should respond in different manners to disturbances such as habitat degradation and harvest. The model has strong implications for the expected effectiveness of management practices (e.g. supplemental stockings, optimal harvest rates, aquatic refugia) based on the life histories and environmental settings of target species. Examples are cited from sportfish stock management, forecasting of marine fish populations, and endangered species conservation.

Relationships Between Environmental Variables and Length at Age in Texas White Bass Populations

Gene R. Wilde and Maurice I. Muoneke, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, TX 78744

Production of fish in lakes and reservoirs has been related to a number of environmental factors. At larger geographic scales, variation among lakes and reservoirs in fish production is related to climatic variables such as latitude and air temperature; on a local or regional scale, variation in fish production is generally best explained by various direct and indirect measures of lake productivity. Because growth of existing individuals is a major mechanism by which production of new fish biomass is accomplished, we would expect to see relationships between growth rate and these same variables. We related length at ages 1,2, and 3 in white bass, *Morone chrysops*, populations in 53 Texas reservoirs to nine climatic and morphoedaphic variables. Length at age was best explained as a linear function of longitude (R^2 = 0.38 to 0.53) and as a quadratic function of latitude (R^2 = 0.37 to 0.51) or length of growing season (R^2 = 0.49 to 0.52). Length at ages 1, 2, and 3 was greatest in central portions of Texas and decreased north and south; growth also decreased to the west in reservoirs of the Rio Grande. This pattern suggests a thermal optimum for growth of white bass in central Texas.

Survey of Fishes of the San Marcos River, Texas

Travis Kelsey and Bobby G. Whiteside, Aquatic Station, Department of Biology, Southwest Texas State University, San Marcos, TX 78666

A survey of fishes of the San Marcos River was conducted from May 29, 1992 to August 30, 1993. The purpose of this survey was to collect baseline data on fish community structure. Sampling was conducted from the river's headwaters to its confluence with the Guadalupe River, with 52 species of fishes identified. Species composition varied with changes in water quality and habitat availability longitudinally downstream. Downstream fish community structure before and after dechlorination of the San Marcos Wastewater Treatment Facility effluent discharge was also examined. Species abundance increased from 7 species before to 15 species after dechlorination.

Evaluation of Reduced Striped Bass Bag Limit, Lake Texoma, Texas-Oklahoma

John H. Moczygemba and Bruce T. Hysmith, Lake Texoma Fisheries Station, Texas Parks and Wildlife Department, Route 4 Box 157, Denison, TX 75020

We evaluated the effects of changing harvest regulations from 15 fish/day (no more than 5 fish ≥ 508 mm) to 15 fish/day (no more than 1 fish ≥ 508 mm) for striped bass (*Morone chrysops*) in Lake Texoma, Texas-Oklahoma. A stratified random creel survey was conducted for 2 years before and 4 years after the regulation change to determine striped bass harvest and directed angling pressure. Experimental gill nets were set at 15 stations each February for 3 years before and 4 years after the regulation change to estimate changes in the striped bass abundance and size structure. Overall striped bass harvest did not change ($P > 0.05$) after the regulation change, but, as expected, the harvest of striped bass ≥ 508 mm did decrease ($P < 0.05$), while directed angling pressure did not change ($P > 0.05$). There were no significant changes ($P > 0.05$) in the striped bass abundance and numbers ≥ 508 mm after the regulation was implemented. Factors preventing the regulation change from increasing the numbers of striped bass ≥ 508 mm could have been angler induced mortality, growth overfishing, weak year classes, inbreeding, or a combination of these factors. The solution may be new regulations, stocking or both.

Sampling Channel Catfish in Small Impoundments

Michael S. Robinson, Texas Parks and Wildlife Department, 409 Chester, Wichita Falls, TX 76301

Baited slat traps and baited hoop nets were compared to unbaited experimental gill nets for sampling channel catfish, *Ictalurus punctatus*, in seven small (< 21 ha) impoundments in north Texas during the period May through August, 1993. All three gears were fished simultaneously in each impoundment twice, once using cottonseed/soybean meal cake for bait and once using cheese. Gears were evaluated by number and size of channel catfish caught and worker hours required to set and retrieve the gear. Gill nets were the most effective of the sampling gears tested. They accounted for 70% of the channel catfish caught during the study, while slat traps and hoop nets accounted for 11% and 19%, respectively. Gillnets also caught significantly ($P < 0.05$) more channel catfish per worker hour than either slat traps or hoop nets. Size range of catfish caught was 17.8 to 81.3 cm for gill nets, 17.8 to 27.9 cm for hoop nets, and 10.2 to 30.5 cm for slat traps. Mean size of catfish caught by gill nets was significantly ($P < 0.05$) greater than the mean size of catfish caught by hoop nets and slat traps. Baited slat traps and hoop nets were not effective for sampling channel catfish under the conditions of this study because of low catch rates and their tendency to capture only relatively small individuals.

Panel Discussion "Clean Water For Texas"

Dick Luebke, Moderator

Water Quality Assessment of Texas Surface Waters

Stephen Twidwell, Texas Natural Resources Conservation Commission, Austin, Texas

The TNRCC maintains an ambitious Surface Water Quality Monitoring (SWQM) Program in order to characterize existing water quality and emerging problems, define long term trends, determine standards compliance, and describe seasonal variation and frequency of occurrence of selected water quality constituents. Approximately 700 fixed SWQM sites are sampled by the TNRCC, with the frequency of sampling and parametric coverage dependent on specific needs and location. Analysis of data from the SWQM fixed station network is also used to prioritize waters that need intensive surveys and special studies.

Control of sources by the TNRCC through its regulatory programs has been very successful at reducing organic loading to the State's surface waters and improving water quality. Through TNRCC's regulatory control programs, implementation of advanced waste treatment has become a common requirement (68% of all plants); secondary treatment accounts for the remaining 32%; and primary treatment only has been eliminated entirely. In response to these substantial improvements in effluent quality, streams and rivers, which had historical problems in assimilating the wastes without developing depressed dissolved oxygen levels, have shown dramatic improvements. Classified stream and river segments that have shown improvements in dissolved oxygen levels include: Sabine River (Segment 0505), Neches River (Segments 0601 and 0606), Taylor Bayou (Segment 0701), Upper and Lower West Fork Trinity River (Segments 0841 and 0805), East Fork Trinity River (Segment 0819), Houston Ship Channel (Segments 1005 to 1007), Buffalo Bayou (Segment 1014), Brush Creek (Segment 1244), Colorado River (Segment 1428), Cibolo creek (Segment 1902), and San Antonio River (Segment 1911).

The State of Texas Water Quality Inventory Report is prepared biennially by the TNRCC to describe the status of the State's waters based on historical surface and ground water quality data. Analysis of historical water quality data from the 1994 version of the report indicates statewide there are 15 classified segments where the aquatic life use is not supported due to depressed dissolved oxygen levels; the aquatic life use is not supported in 12 classified segments due to elevated toxic substances in water. Nonsupport of the contact recreation use is more common with 49 classified segments impacted by elevated fecal coliform levels. Concerns exist in 157 classified segments due to elevated levels of nutrients. Concerns for contaminated sediments, due to elevated metal and/or organic substances exist in 95 classified segments.

Water Quality and The Texas Antidegradation Standard--When Does Water Pollution Have To Be Justified?

Myron Hess, Henry, Lowerre, Hess & Frederick, Austin, Texas

The Texas Surface Water Quality Standards include a three-tiered antidegradation provision consistent with the requirements of EPA's regulations implementing the federal Clean Water Act. An open question remains, however, about the degree to which these three tiers are actually implemented.

In accordance with EPA regulations, the first tier requires that water quality sufficient to support existing uses be maintained. The second tier provides that water quality of waters that exceed fishable/swimmable levels may not be degraded by more than a *de minimis* amount unless that degradation is necessary for important social or economic development. The third tier provides for the designation of Outstanding National Resource Waters (ONRW), in which degradation will not be allowed regardless of the claimed justification. Texas does not have an designated ONRWs.

In theory, Tier Two protections should be quite significant. In practice, however, implementation appears to be quite inconsistent. There is no definition of what is meant by lowering of water quality to more than *de minimis* extent. obviously, this is a crucial issue. Unless that threshold has been reached, the other requirements are never triggered. The antidegradation provisions are intended to provide protections in addition to those provided by the narrative and numerical criteria. Accordingly, it seems reasonable to construe that provision as a requiring that any discharge into a high quality body of water resulting in a detectable increase in pollutant levels should be considered to trigger the requirement for justifying the discharge.

One of Congress' stated goals in adopting the federal Clean Water Act was to phase out all discharges of pollutants into navigable waters by 1985. Accordingly, in 1994, we ought to require those seeking new or continuing authorization to discharge pollutants into high quality waters to show either that the discharge will not degrade the water or that the degradation is necessary for important economic or social development. A showing of necessity also should require a demonstration that there are no reasonably available alternatives to the proposed discharge.

Clean Water For Texas -- Texas Parks and Wildlife Department View

Dave Buzan, Resource Protection Branch, Texas Parks and Wildlife Department, Austin, TX 78744

Despite having spent nearly $6 billion on improvements to wastewater collection and treatment systems during the 1980s, Texas continues to face significant issues related to water quantity and quality. Issues include loss and modification of instream, riparian and other critical habitat; consumption and population growth and associated urban, industrial and agricultural development; and public awareness and involvement in water protection. The Texas Parks and Wildlife Department through legislative and regulatory mandates has an active role in addressing these issues.

Contaminants, Advisories, Discharges

Elizabeth Materna, Ecological Services, U.S. Fish and Wildlife Service

Numerous contaminant sources face our world today, from point source discharges to atmospheric deposition to hazardous material releases. When source concentrations are great enough to affect human health, advisories can be issued to restrict swimming, drinking water, or fish consumption. Fish and wildlife, however, do not have the capacity to react to advisories when contaminants are at levels which may be detrimental to their populations. Therefore, it's up to us to protect them and their habitats.

To protect and improve water quality for our fish and wildlife resources, the Service conducts itself under the following federal legislation: the Clean Water Act; Endangered Species Act; Comprehensive Environmental Response, Compensation, and Liability Act (Superfund); Oil Pollution Act; National Environmental Policy Act; Resource Conservation and Recovery Act; Federal Insecticide, Fungicide, and Rodenticide Act; Fish and Wildlife Coordination Act; Clean Air Act; Migratory Bird Treaty Act; Marine Protection, Research, and Sanctuaries Act; North American Free Trade Agreement; and more. Various activities carried out by the Service under this legislation are presented during this panel discussion.

The Service is currently conducting investigations throughout the state into contaminant sources and impacts to fish and wildlife. Investigations are being conducted at the Playa Lakes, Rincon Bayou/Nueces River, Caddo Lake, Lavaca Bay, and the Lower Rio Grande Valley National Wildlife Refuge. Proposed future contaminant investigations include: a study of contaminants and nutrient discharges into the Arroyo Colorado; assessment of the quality of water supplying National Fish Hatcheries; and monitoring of municipal storm water discharges into the San Marcos River.

Water Quantity and Quality: West Texas As An Indicator of the State's Future

Gary P. Garrett, Heart of the Hills Research Station, Texas Parks and Wildlife Department, Ingram, Texas

Approximately 1/4 of the fishes in Texas are of conservation concern. In most cases the problem is related to water quantity and quality. The two parameters, quantity and quality, are closely correlated and should be considered as an interactive unit in conservation efforts.

To date, we know of 8 fishes that no longer occur in Texas, most were in the Chihuahuan Desert part of the state. This area is extremely valuable for a number of reasons, in particular there is its value as an indicator of things to come for the rest of the state and as a proving ground for methods to conserve our resources for future generations. Just as endangered species often serve as "indicator species" because their life history requirements are a little less flexible than others, fragile environments can warn us.

We think of habitat degradation as a fairly recent phenomenon and it certainly is more prevalent today. But it had begun to affect aquatic habitats in the American Southwest in the late 1800s. Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) used to occur in Texas but is not extirpated. Overgrazing by cattle was a major factor, but there were others. We think that activities at Ft. Davis had a lot to do with the demise of Rio Grande cutthroat trout. From diaries and Army reports we know that trout fishing was very popular, but, we also know that their cesspools typically overflowed into the creek. Often to the extent that the water was not drinkable.

Surface practices do create problems, but another major factor is groundwater pumping. The type locality of *Cyprinodon elegans*, Comanche Springs, was once the eighth largest spring in the state. Groundwater pumping and irrigation diversion changed the flow from approximately 2,000 liters/second in the 1800s to 0 by 1961. Not only did the spring inhabitants suffer, but people who depended on the spring water for irrigation lost their livelihood. If we could have learned lessons here, we may have avoided many of the controversies and confusion associated with the Edwards Aquifer issue.

Many of our important aquatic resources are somewhat protected (e.g. Independence Creek by the Nature Conservancy, Clear Creek by a private landowner, Dolan Creek by TPWD). But they have no control over aquifer depletion.

We sometimes mistakenly think of certain areas as having lots of water, such as the Rio Grande. Downstream of Presidio there actually is quite a bit of water, but upstream of the confluence with the Rio Conchos there is very little flowing water. Some of the native organisms are revealing that even where there is flowing water, things are not so great. Agriculture, municipal and industrial uses combine to create some substantial water quality problems in the Rio Grande.

In Balmorhea we are trying to do some positive things, not just for the two

federally endangered fishes, but for the entire system. Irrigation diversion has destroyed natural habitat and made it hard for aquatic organisms to survive, many have not.

Currently there are three areas we are working in: 1) Rock-reed water treatment systems (planned future project); 2) Phantom Springs Refugium; 3) Balmorhea Cienega Project. Each of these are designed to protect aquatic resources, as well as educate the public on the value of these habitats and methods to conserve them.

Acknowledgments:

The contributions and assistance of the Editorial Committee (Aaron Barkoh, Joe N. Fries, Rebecca Hensley, Ken Kurzawski and Anthony Mazeroll) and for the additional contributions of John Moczygemba (Awards Committee) and Mark Stacell (Publicity Committee) in the preparation of the 1994 Annual Proceedings of the Texas Chapter of the American Fisheries Society is much appreciated.

Citation:
Author(s). 1995. Title. Pages ___ *in* R. J. Edwards, editor. Annual Proceedings of the Texas Chapter, American Fisheries Society, Volume 17. Texas Chapter, American Fisheries Society, Austin, Texas.

ISSN 1060-2224