

Ichthyology

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Department of Biology/Aquatic Station
San Marcos, Texas



Texas Fish Identification



Instructors: Dr. Tim Bonner and Mr. Brad Littrell

Times: Day 1: 8:00 a.m - 5:00 p.m.
Day 2: 8:00 a.m - 3:00 p.m.

Location: Freeman Aquatic Biology (FAB)
Building Room #104, Texas State
University campus, San Marcos, Texas

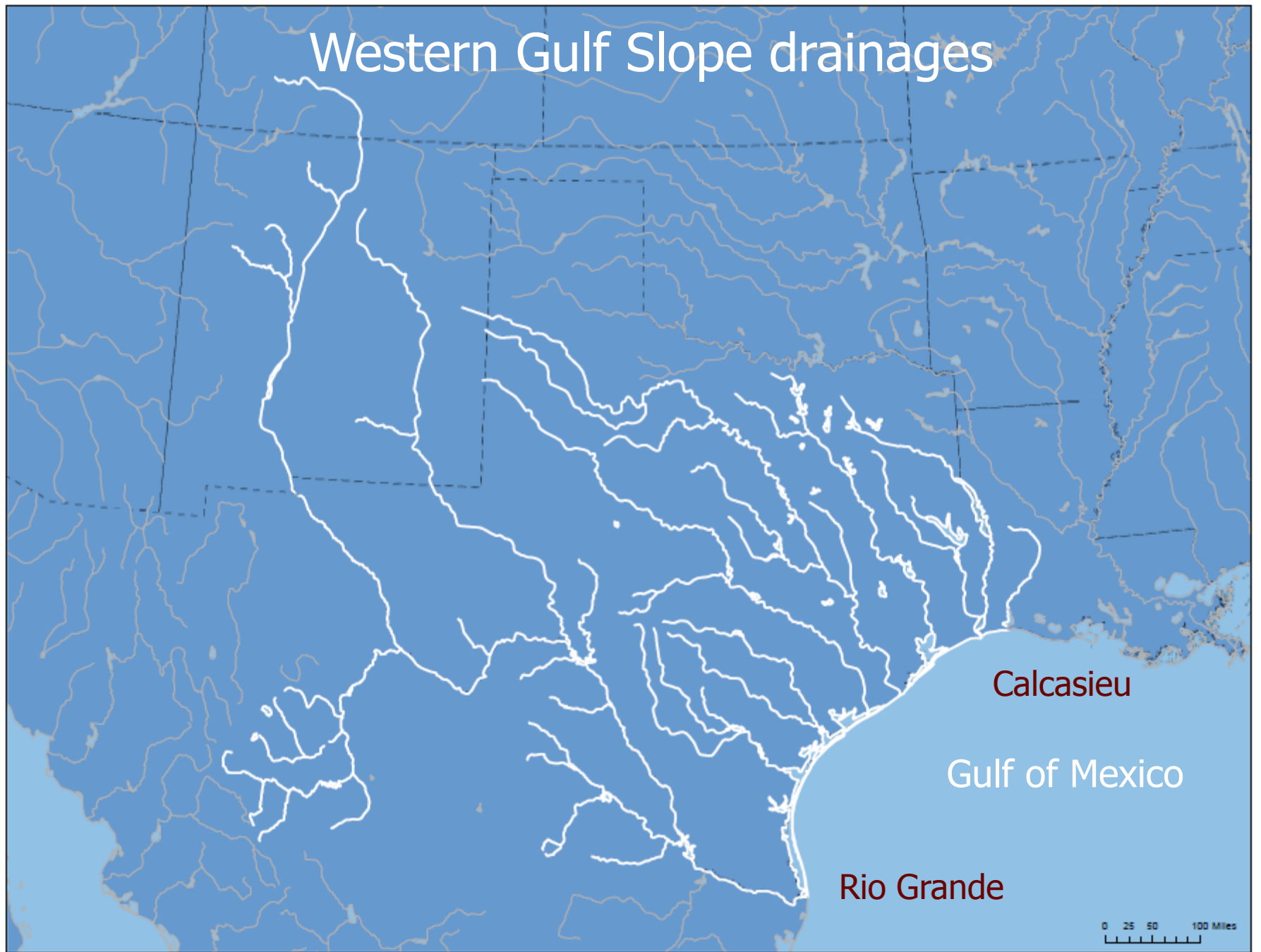
Course Materials: *A Fishes of Texas*
book will be provided to each participant.

Cost: \$225.00

In progress...

- Fish Website (search: Tim Bonner, Fish)
- Drainage basin keys
- New book
- Number of fishes (total, threatened, endangered) in Texas
- Zoogeography...

Western Gulf Slope drainages



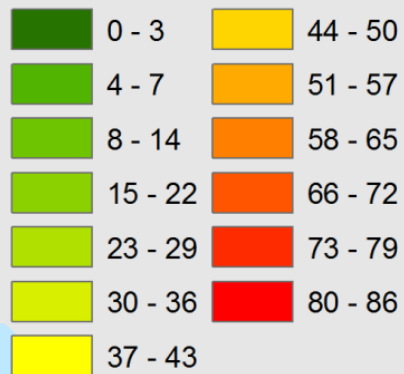
Calcasieu

Gulf of Mexico

Rio Grande

0 25 50 100 Miles

Total Species



0 80 160 320 480 640 km

A horizontal scale bar with alternating black and white segments, marked with the numbers 0, 80, 160, 320, 480, and 640, followed by the unit 'km'.

Mexico

Gulf of Mexico

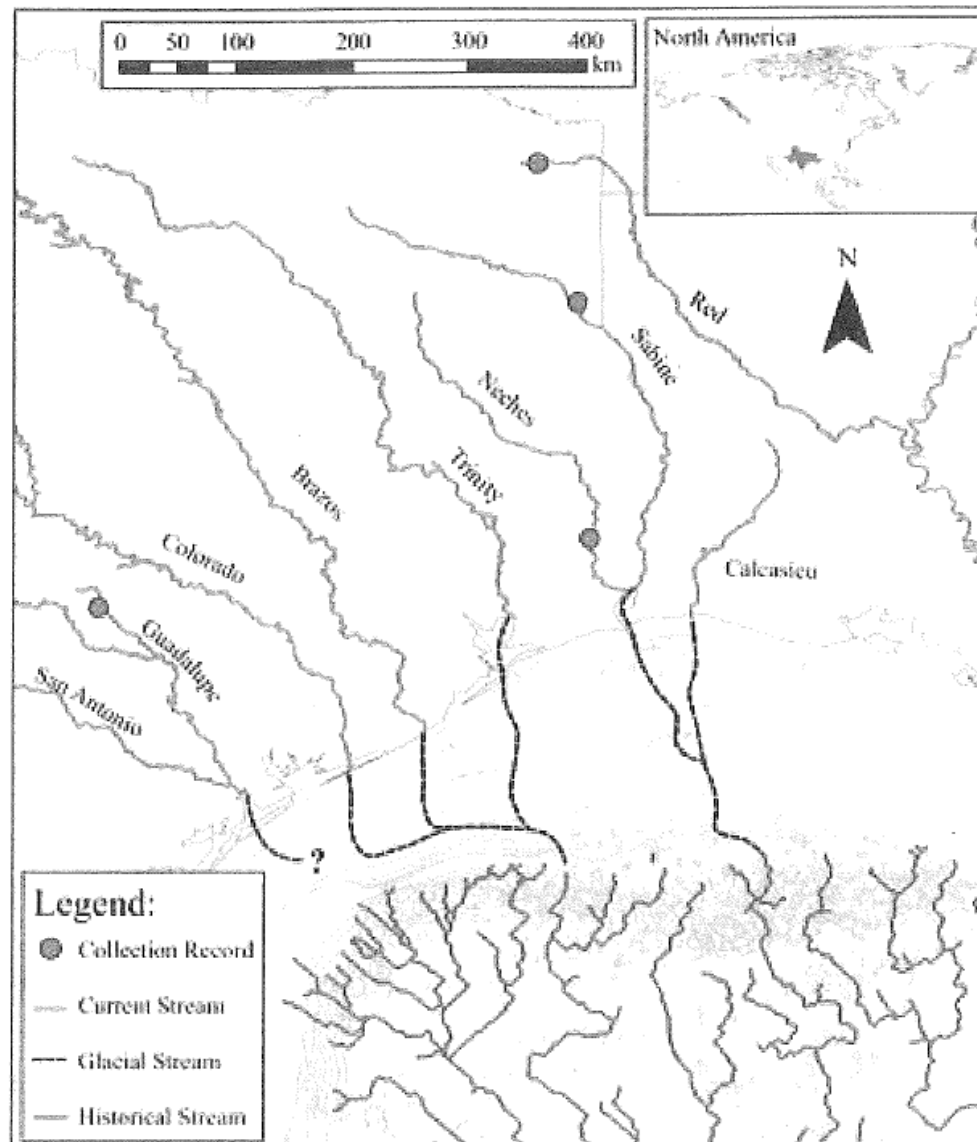


Figure 1. Distribution of Ironcolor Shiner in Western Gulf Slope drainages. The disjunct population in the Guadalupe River Basin is relict, arising because of historical stream connections during the last period of glaciation (11,000 years before present; black dashed lines) or earlier (>11,000 years before present; gray solid lines). Connectivity of the San Antonio Bay drainage is unresolved but likely connected to the Colorado-Trinity network during the last period of glaciation.

Endemics



Species



Mexico

Gulf of Mexico



North America (21%)

(Leidy and Moyle 1998)



USA (39%)

Jelks et al. 2008

SW (48%)

Warren and Burr 1994

TX (38%)

SE (28%)

Warren et al. 2000

Urban Ecosyst (2015) 18:293–320
DOI 10.1007/s11252-014-0384-x

Influence of urbanization on a karst terrain stream and fish community

**Kristy A. Kollaus • Kenneth P. K. Behen •
Thomas C. Heard • Thomas B. Hardy •
Timothy H. Bonner**

SPRING LAKE

LOCATION: **Texas State University, San Marcos, TX** SOURCE: **Edwards Aquifer**
ENDANGERED SPECIES COUNT: **8** SPRINGS BENEATH THE SURFACE: **200+**
CONSTANT TEMPERATURE: **72°**

A TEXAS ORIGINAL

YOUR WORLD From the sandy floor of Spring Lake, ancient waters bubble forth just as they've done for 10 million years. The heart of one of the oldest continuously inhabited sites by humans in North America, the San Marcos Springs have sustained life for millennia; now we are working to sustain them.

OUR RESEARCH Spring Lake holds the key to scientific discoveries that inform sound water management decisions. Dr. Thomas Hardy explores the vital relationship between spring flow and the survival of the lake's endangered flora and fauna. Underwater archaeologist Fritz Hanselmann unearths long-hidden evidence of prehistoric cultures submerged and preserved beneath the lake, a window to our common past. And what our researchers learn here cascades outward and is helping find ways to provide sustainable water supplies for humanity and the environment all across Texas, the nation and the world.

MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

Texas blind salamander

Comal Springs night beetle

San Marcos salamander

Texas wild rice

Texas blind salamander

San Marcos gambusia

Comal Springs dryopid beetle

A WATERSHED GIFT

Thanks to a generous gift from The Meadows Foundation, the River Systems Institute has been renamed The Meadows Center for Water and the Environment. The foundation's initial gift of \$1 million and an expected \$4 million over the next few years will be matched to create a \$10 million endowment for the center.

This gift makes it possible for The Meadows Center, led by noted conservationist and author Andrew Sansom, to ensure that both water and knowledge flow freely.

Your world. Our research.

www.txstate.edu/discover

TEXAS  STATE
UNIVERSITY
The rising STAR of Texas

Texas Monthly

A photograph of a waterfall with white, frothy water cascading over dark rocks. The water is captured with a slight motion blur, giving it a sense of movement and energy. The background is a deep, dark green, suggesting a lush, natural setting.

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Results

Paleohistory of the upper san marcos river narrative

Near the end of the last glacial maximum (14,000 to 11,000 B.P.), Edwards Plateau valleys consisted of vast alluvial deposits and laterally mobile streams (Blum et al. 1994), especially in areas east and south of the Balcones Escarpment where higher gradient streams of the plateau exit onto the lower gradient coastal plains of Texas (Sylvia and Galloway 2006). Laterally mobile streams with voluminous discharges up to four times of that in contemporary times (Sylvia and Galloway 2006) provided sufficient erosive capabilities to down-cut confining limestone layers of the Edwards Aquifer, creating the major portion of the Edwards Aquifer (Deike 1990) and artesian springs along the southeastern edge of the Edwards Plateau (Woodruff and Abbott 1979; Grimshaw and Woodruff 1986). Eventually, laterally mobile streams migrated away from the newly tapped spring openings and abandoned the eroded stream channel to create oxbows. Newly created spring outflows of the Edwards Aquifer maintained connectivity to the mobile main channel, forming a spring run rather than a more traditional oxbow. This sequence of events likely describes the origin of the San Marcos springs and San Marcos River by down cutting from a former channel of the Blanco River (Grimshaw and Woodruff 1986). Timing is supported by the age of the alluvial deposits on top of the confining limestone layer near San Marcos springs (11,500 B. P.; Bousman and Nickels 2003) and rates of dolomite dissolution within the Edwards Aquifer (11,000 B. P. during early Holocene; Deike 1990).

- 10,000 – 12,000 years old
- Variable environments, over longer time intervals

Table 3 (continued)

Date	General topic	Details	Reference
1914-1924	Riparian alteration	Introduction of dipterocarp as a possible replacement for fish species	Kimmel 2006
1916	Stream morphology	River left downstream of Aqueduct Bridge, west channel was originally a millrace but a flood moved main river flow into this channel, forming an island	Sarben, CW (1944) The Story of Riverside, Texas, Texas State University
1931	Water quality	City of San Marcos installed an activated sludge wastewater treatment plant	Kimmel 2006
1917	Stream morphology	Summer dredging of mill race with introduction of gravel and rock and wooden walls constructed in Sewell Park	Sarben 1944
1926	Biological alteration	A catfish hatchery in U.S. Fish Hatchery to clear Spring lake surface of vegetation, species introduced (e.g., Crayfish, carp, sunfish, and bluegill)	San Marcos Daily Record (9/7/1989)
1924	Biological alteration	Harvesting of river mussel	Kimmel 2006
1928	Stream morphology	Construction of concrete retaining walls in Sewell Park	Sarben 1944
1929	Riparian alteration	Construction of Spring Lake Dam and Gill Chase	San Marcos Daily Record (6/16/1973)
1936	Water quality	Swimming in Sewell Park area was not recommended due to polluted waters	Kimmel 2006
1934-1978	Biological alteration	Establishment of aquatic plant business, harvesting as much as 600 kg daily January-May. During this time, Redigan planted a variety of exotic vegetable species	San Marcos Daily Record 1942 Kimmel 2006
1935	Riparian alteration	Concrete slab poured in Sewell Park. Swimming area used as a bedding ground for cattle driven	Sarben 1944
1949	Stream morphology	Dredging in Spring Lake covered to provide greater depths for underwater theater for Aqueduct Springs Theme Park opening in 1950	San Marcos Daily Record (9/16/1973)
1949	Water quality	Creation of Texas Park and Wildlife, A.E. Wood Fish Hatchery	Texas Park and Wildlife (2011) A. E. Wood Fish Hatchery. http://www.tpw.state.tx.us/

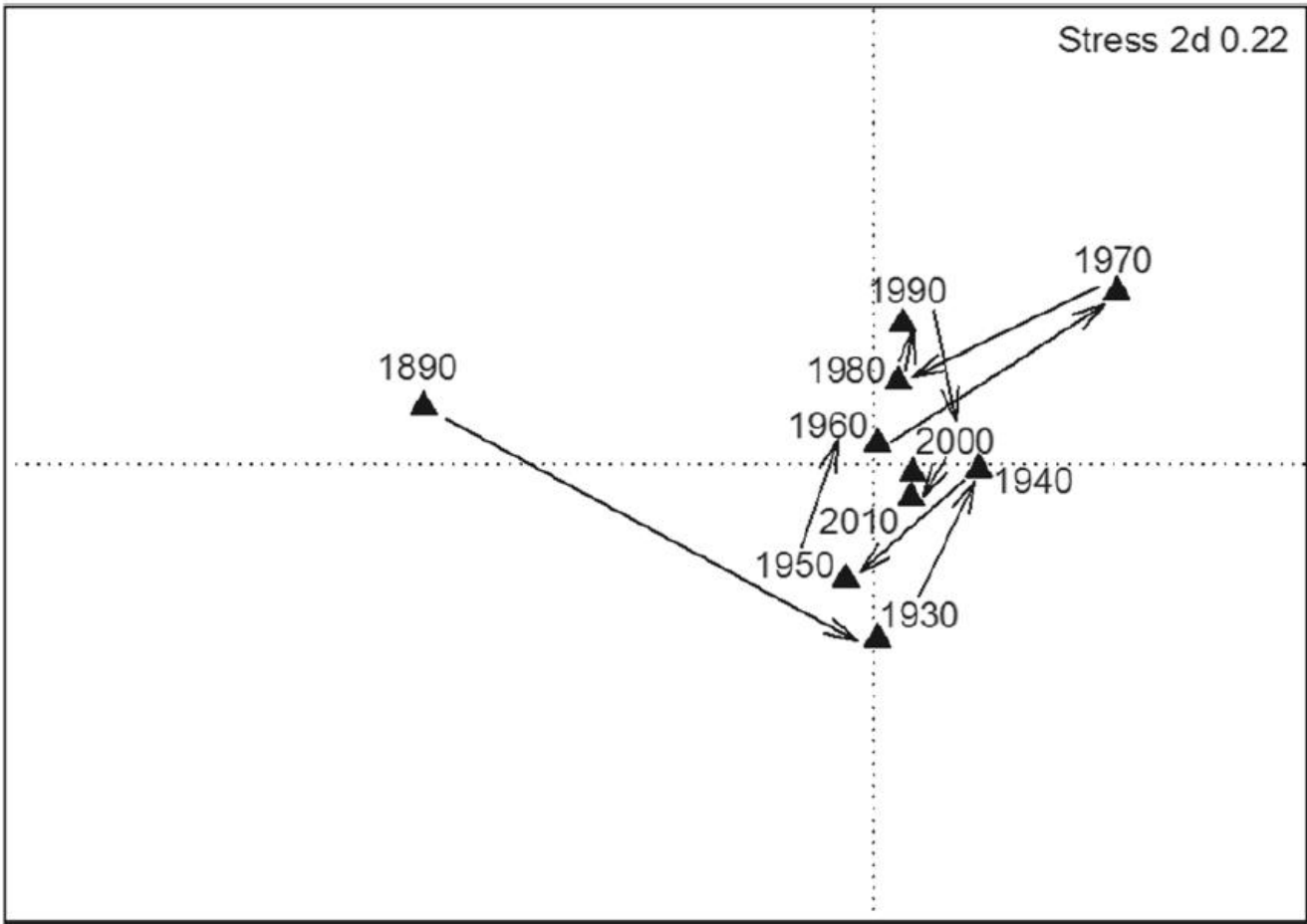
Table 3 (continued)

Date	General topic	Details	Reference
1982	Water quality	Upper San Marcos River quarantined due to dangerous levels of fecal coliform from a sewage line break on university campus, then repaired in December 1982	San Marcos Daily Record (10/6/1982) San Marcos Daily Record (12/21/1982)
1982	Stream morphology/ Water quality	City dredging operation removed siltbar near Clay Park, caused increased turbidity and potential contamination downstream	San Marcos Daily Record (10/6/1982)
1984	Water quality	Unsafe water conditions, high levels of fecal coliform found in Sewell Park area	San Marcos Daily Record (9/30/1984)
1984	Protection	Establishment of San Marcos River Community Trust Fund, founding the San Marcos River Foundation in 1985	San Marcos Daily Record (12/7/1984)
1985	Protection	River Corridor Ordinance Adopted by City of San Marcos, preventing 75% of waterfront lots to be impervious cover	San Marcos Daily Record (6/27/1985)
1996	Water quality	Water waste treatment plant was upgraded	Kimmel 2006
1993	Protection	Texas Legislature in May passed Senate Bill 1477 creating The Edwards Aquifer Authority who is authorized to issue permits and regulate groundwater withdrawals	Fickhardt, G (2013) Texas Senate Bill 1477. The Edwards Aquifer Authority. http://www.edwardsaquiferauthority.com/ . Accessed 20 Mar 2013
2000	Stream morphology	Section of Capes dam lifted, dropping water level temporarily	Austin American Statesman (11/04/2000)
2000	Water quality	High fecal coliform levels detected in river, cause unknown	Houston Chronicle (10/01/2000)
2002-2008	Stream morphology	Channel dredging occurred within the lower 2.9 km of the upper San Marcos River to remove exotic water plant, <i>Ceratophyllum demersum</i> . Dredging removed approximately 2,220 m ³ of sediment with no indication of accelerated stream bed adjustments	Hudson PF (2012) Geomorphic monitoring of the upper San Marcos River to assess channel adjustment in response to removal of an invasive exotic water plant, <i>Ceratophyllum demersum</i> . Report submitted to Texas Parks and Wildlife (12 Mar 2012)
2006	Protection	Edwards Aquifer Recovery Implementation Program established to develop a plan that contributes to the protection and recovery of federally-listed species	Edwards Aquifer Authority (2013) http://www.edwardsaquiferauthority.com/ . Accessed 08 Apr 2013
2010	Water quality	Texas State University - San Marcos shuttles spill into river (approx. 446 gal of surface water)	San Marcos Daily Record (10/31/2010)
2011	Protection	Habitat Conservation Plan approved for the upper San Marcos River	Austin American Statesman (10/21/2011)

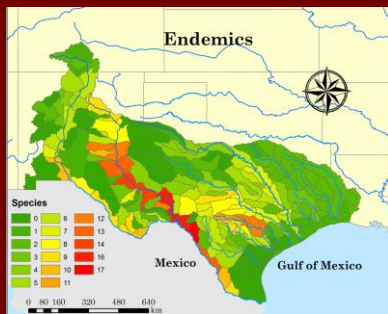
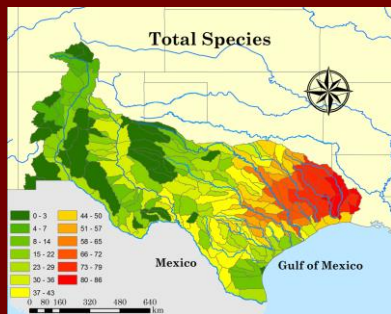
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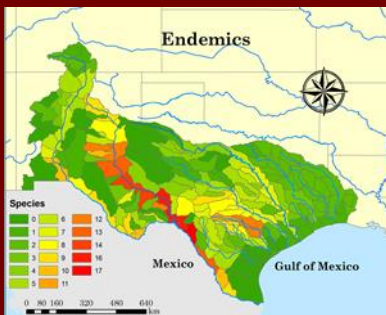
Date	General topic	Details	Reference
1964&1965	Stream morphology	Area from Sewell Park to Clay park was dredged	Harris/Hoff/Management/huchersnewswood@gmail.com. Accessed 19 Mar 2013
1967	Biological alteration	First record of introduced vegetation species, <i>Hydrilla verticillata</i>	San Marcos Daily Record (06/03/1977)
1968	Water quality	Polluted water from Senneca drains, drainage basin, septic tanks and sewer lines after flood	San Marcos Daily Record (10/19/68)
1970	Protection	<i>Edwardsia formicicola</i> listed under USFWS protection, status endangered	USFWS (1970) Appendix D - United States list of endangered species and other fish or wildlife. Federal Register 35:16067-16068 (13 Oct 1970)
1976	Water quality	Polluted water from wastewater treatment plant ruined irrigation system at Cooneydam	Kimmel 2006
1976	Protection	Establishment of river clean up days with first official full river clean up occurring in 1989	San Marcos Daily Record (10/6/1989)
1973-1990	Water quality	Construction of three retention dams on Sink Creek and two on Purgatory Creek	Earl RA, Wood CH (2002) Upstream changes and downstream effects of the San Marcos River of central Texas. <i>Tex J Sci</i> 54(1):69-88
1977	Protection	Recreational diving prohibited in Spring Lake to protect environmental sensitive area	San Marcos Daily Record (6/27/1977)
1978	Protection	Zebra mussels listed under USFWS protection, status endangered	USFWS (1978) Determination that 11 plant taxa are endangered species and 2 plant taxa are threatened species. Federal Register 43:19319-19797 (26 Apr 1978)
1980	Protection	Gambusia proper listed under USFWS protection, status endangered	USFWS (1978) Proposed listing and critical habitat determination for a fish and a salamander. Federal Register 43:30136-30319 (4 Jul 1978)
1982	Riparian alteration	Reconstruction of river walk (first built in 1974) along upper 2 km of the San Marcos River	San Marcos Daily Record (2/14/1982)

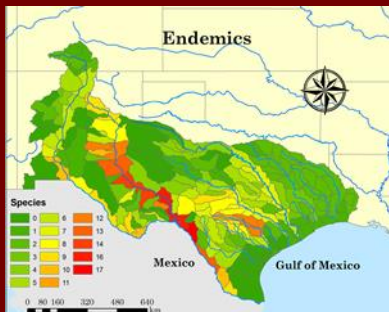
Date	General topic	Details	Reference
2011	Protection	Upper San Marcos River designated as a National Wild and Scenic River by the Department of the Interior	San Marcos Daily Record (10/19/2011)

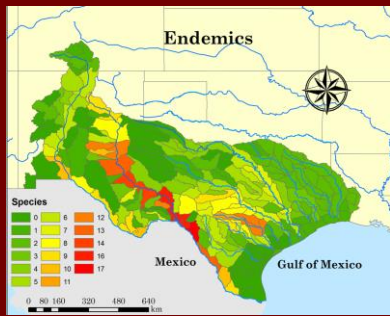
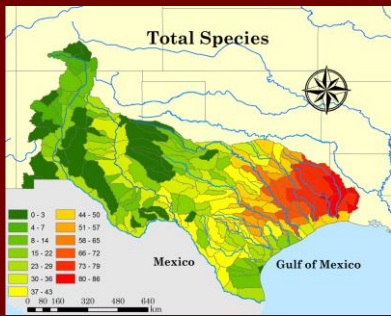


Fishes of the San Marcos River









Relationships among spring flow, habitats, and fishes within evolutionary refugia of the Edwards Plateau

2 CODY A. CRAIG,^{1,†} KRISTY A. KOLLAUS,² KENNETH P. K. BEHEN,³ AND TIMOTHY H. BONNER¹

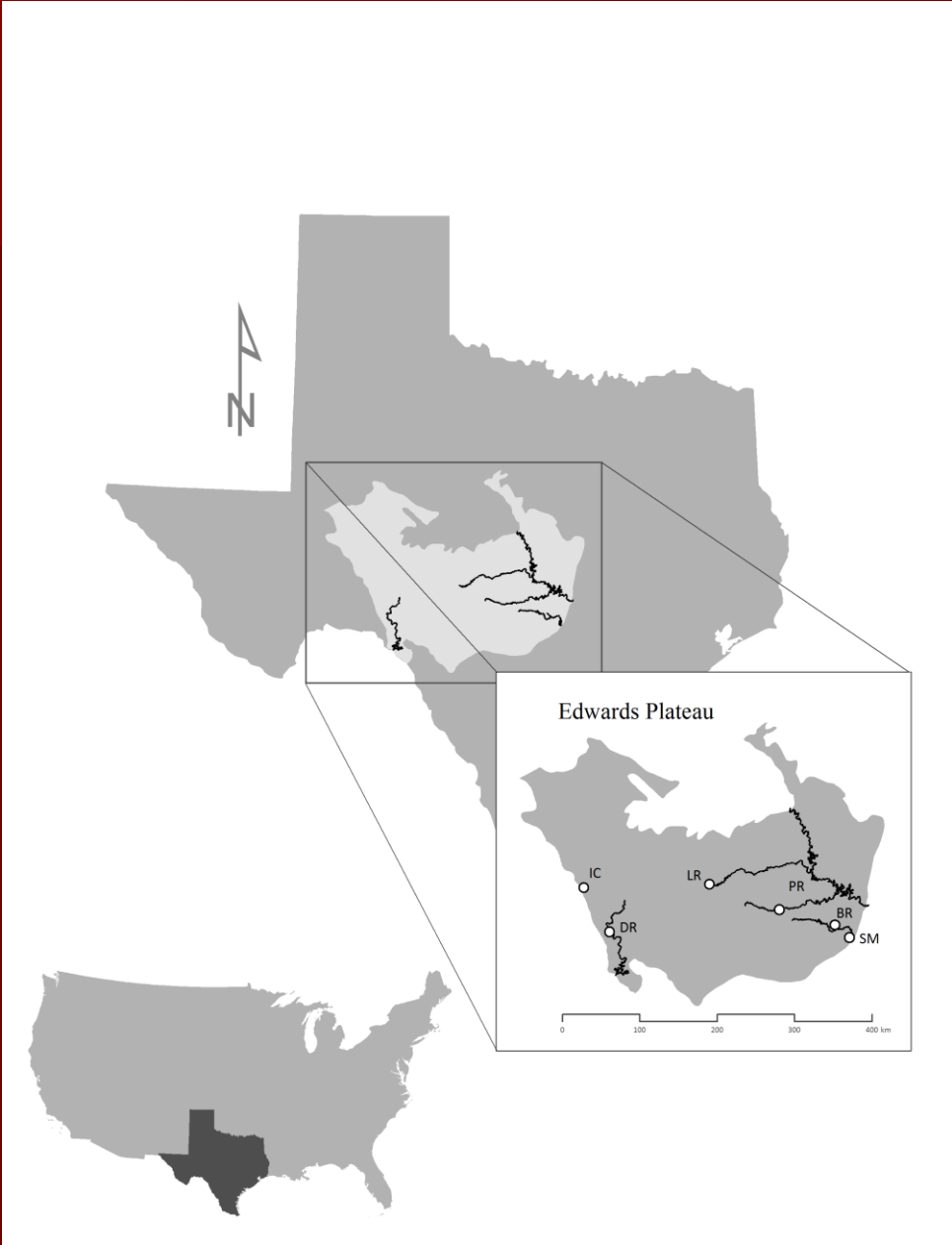
¹Department of Biology/Aquatic Station, Texas State University – San Marcos, 601 University Drive, San Marcos, Texas 78666, USA

²The Meadows Center for Water and the Environment, Texas State University – San Marcos, 601 University Drive, San Marcos, Texas 78666, USA

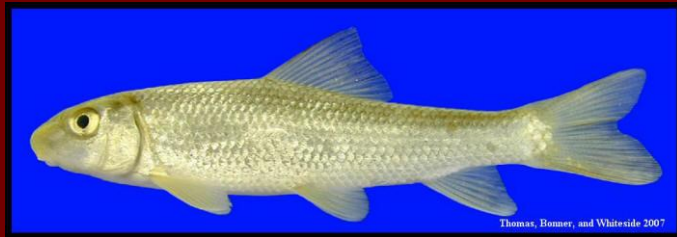
³Washington Department of Fish and Wildlife Fish Program Fish Management Division, Olympia, Washington 98501, USA

Citation: Craig, C. A., K. A. Kollaus, K. P. K. Behen, and T. H. Bonner. 2016. Relationships among spring flow, habitats, and fishes within evolutionary refugia of the Edwards Plateau. *Ecosphere* 000(000):1–13. 10.1002/ecs2.1205

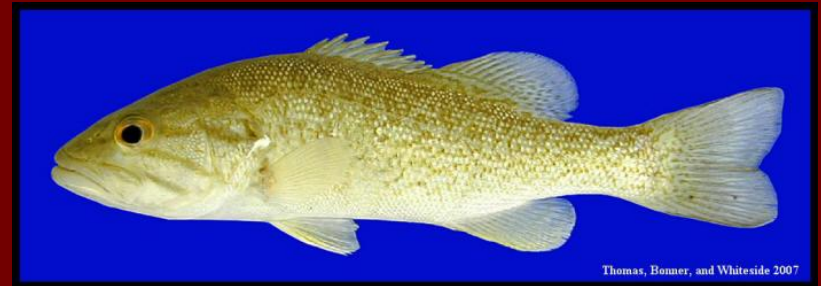
Spring systems: +2 million years



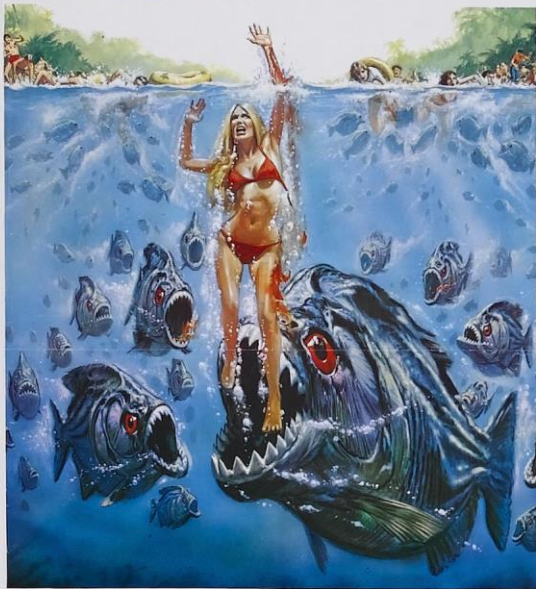
San Marcos River Fishes



Introduced Fishes



LES ARTISTES ASSOCIÉS, S. A. B. présente



PIRANHA

avec / met BRADFORD DILLMAN • HEATHER MENZIES • KEVIN McCARTHY
KEENAN WYNN • BARBARA STEELE et / en DICK MILLER • BELINDA BALASKI

Screenplay by JOHN SAYLES - Story by RICHARD ROBINSON and JOHN SAYLES - Produced by JON DAUSON
Directed by JOE DANTE - Executive Producers ROGER CORMAN and JEFFREY SCHECHTMAN
Co-produced by CHAKO VAN LEEUWEN - COLOR - A ROGER CORMAN / CHAKO VAN LEEUWEN Presentation

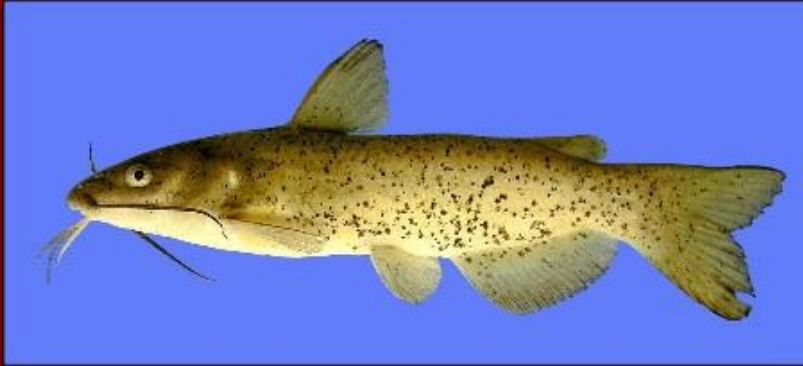
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Thomas, Bonner, and Whiteside 2007

Species Lost

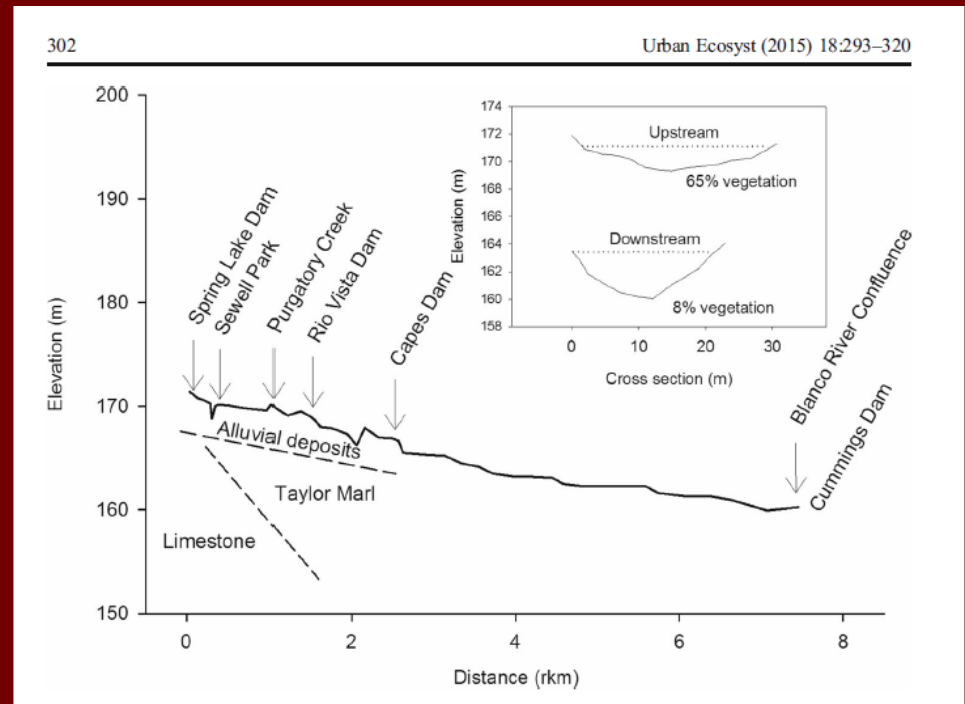


Thomas, Bonner, and Whiteside 2007



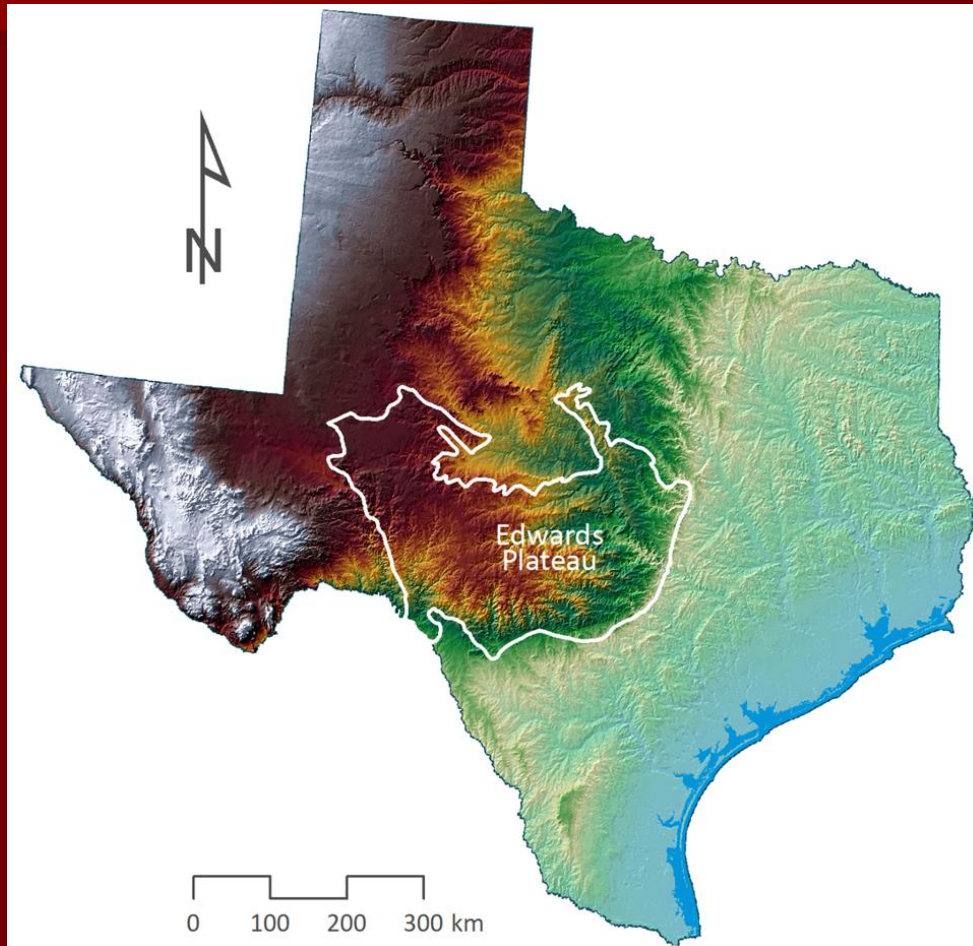
Thomas, Bonner, and Whiteside 2007

Declining Species



Ed Capes Dam Removal

Summary – Urbanization Effects



Devils River

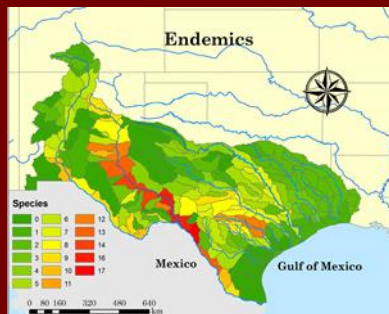
San Marcos River



Comal River



Independence Creek Pinto Creek



Las Moras: Not so good



San Antonio Springs: Death



Comanche Springs: Death



Goodenough Springs: Death



Future? Sustainable Water Quality and Quantity Management

