Texas Parks & Wildlife Department: Regulatory Roles and Conservation Programs for Prairie Stream Fishes

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TPWD, Inland Fisheries, River Studies

Brazos River Shiners and other Prairie Fishes
Natural Resource Program, Texas Comptroller's Office
May 6, 2021

SPORT FISH & WILDLIFE RESTORATION

TEXAS PARKS & WILDLIFE

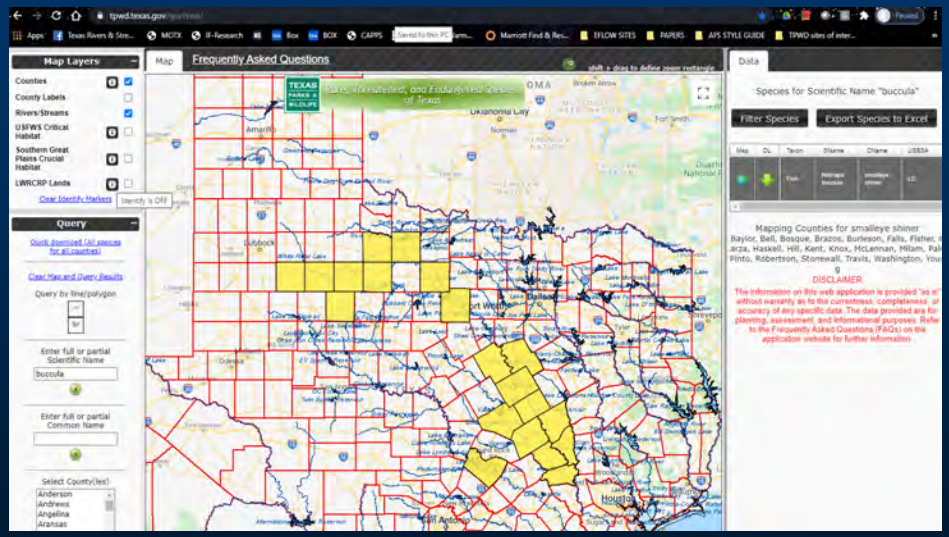
Table 1. Examples of voluntary and regulatory based conservation programs that support the conservation of freshwater fishes in Texas recognized as State Threatened or Endangered (STE) or as Species of Greatest Conservation Need (SGCN) by Texas Parks and Wildlife Department (TPWD).

Conservation program	Responsible organization(s)	Type of authority	Program description
Texas Parks & Wildlife Code, §§ 67.001–67.0041, Nongame Species	TPWD	Regulatory	Provides authorities and mandates for conservation of non-game freshwater fishes, including research, species propagation, survey and monitoring, etc. to ensure the continued ability of non-game fishes "to perpetuate themselves"
Texas Parks & Wildlife Code, § 12.0011, Resource Protection	TPWD	Regulatory	Provides authorization to seek full restitution or restoration of fish and habitat losses occurring as a result of anthropogenic activities
Texas Parks & Wildlife Code, § 69.23, Fish and Wildlife Values	TPWD	Regulatory	Authorizes a substantial increase in the restitution value of STE species, with each State Endangered fish valued at US$1000 per individual and each State Threatened fish valued at $500 per individual
Texas Administrative Code, §§ 69.301–69.311, Scientific, Educational, and Zoological Permits	TPWD	Regulatory	Authorizes regulatory oversight by TPWD of scientific and zoological collection of freshwater fishes; listing as STE prohibits the take, possession, transport, or sale of a species in the absence of a Scientific Permit for Research
Texas Parks & Wildlife Code, §§ 52.101–52.401, Introduction of Fish, Shellfish, and Aquatic Plants	TPWD	Regulatory	Authorizes regulatory oversight by TPWD of stocking of fishes into public waters, ensuring that no adverse impacts occur to STE freshwater fishes
Texas Parks & Wildlife Code, sections §§ 57.377–57.386, Permits to Possess or Sell Nongame Fish Taken from Public Freshwater	TPWD	Regulatory	Authorizes regulatory oversight by TPWD of commercial fishing activities in public waters, ensuring that no adverse impacts occur to STE freshwater fishes
Texas Parks & Wildlife Code, §§ 57.111–57.137, Harmful or Potentially Harmful Fish, Shellfish, and Aquatic Plants	TPWD	Regulatory	Authorizes regulatory oversight by TPWD for management of aquatic invasive species, ensuring that no adverse impacts occur to STE freshwater fishes
Texas Parks & Wildlife Code, §§ 69.101–69.121, Issuance of Marl, Sand, and Gravel Permits	TPWD	Regulatory	Regulates disturbance of instream habitats within state-owned streambeds; projects that disrupt or remove stream bed materials may only be permitted if determined to not damage or injuriously affect the river or freshwater fishes

From: Birdsong et al. 2020. Conservation Status of Texas Freshwater Fishes: Informing State-based Species Protections. JSAFWA 8:40–52

TPWD Consultation Roles

- **Habitat Assessment Program (Wildlife Diversity)**
  - Permit review for construction/development projects (e.g., 404 of Clean Water Act, ESA, TPWD code)
  - Texas Natural Diversity Database
    - location data on rare, threatened, and endangered species
  - Rare, Threatened, and Endangered Species of Texas



https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/habitat_assessment/

TPWD Consultation Roles

- **Surface Water Right and Discharge Permits**
  - Review applications; make recommendations to avoid or minimize impact
- **Federal Energy Regulatory Commission Hydropower Licenses**
  - Review new licenses and relicenses; identify measures to protect, minimize, and enhance resources

Figure 4. Toledo Bend Project Tailrace trap installations, non-generation

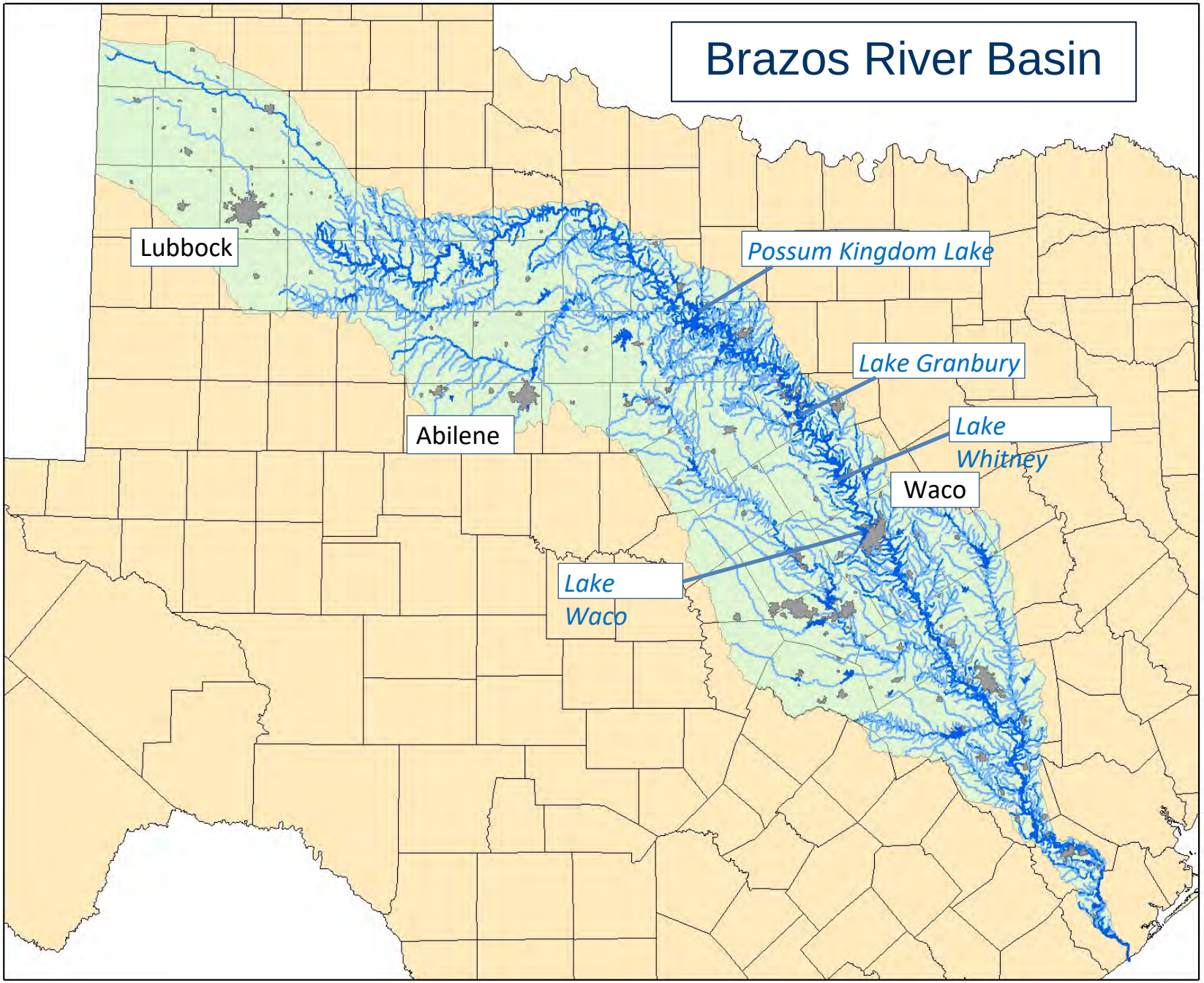
Voluntary Conservation Programs

Table 1. Examples of voluntary and regulatory based conservation programs that support the conservation of freshwater fishes in Texas recognized as State Threatened or Endangered (STE) or as Species of Greatest Conservation Need (SGCN) by Texas Parks and Wildlife Department (TPWD).

Conservation program	Responsible organization(s)	Type of authority	Program description
National Fish Habitat Partnership	Desert Fish Habitat Partnership, Southeast Aquatic Resources Partnership, TPWD	Voluntary	Since 2008, nearly 60 fish habitat restoration projects have been supported in Texas through the Desert Fish Habitat Partnership and Southeast Aquatic Resources Partnership; projects restored more than 4000 ha of fish habitats
Crucial Habitat Assessment Tool (CHAT)	Western Association of Fish and Wildlife Agencies	Voluntary	GIS-based tool developed for the western USA; informs consideration of fish and wildlife habitats in land-use planning, zoning, and development decisions
Southeast Conservation Blueprint	Southeastern Association of Fish and Wildlife Agencies	Voluntary	Serves as a living, spatial plan that identifies important areas for fish and wildlife conservation across the southeastern USA and Caribbean
Texas Aquatic Gap Sampling Program	TPWD, University of Texas at Austin	Voluntary	Fills gaps in distributional data for freshwater fishes and mussels recognized as STE or SGCN; surveys are primarily conducted within riverscapes recognized by TPWD as Native Fish Conservation Areas
Cooperative Endangered Species Conservation Fund	TPWD, U.S. Fish and Wildlife Service	Voluntary	Provides cost-share funding to fill critical science needs and implement conservation measures to conserve federally listed species
State Wildlife Grants Program	TPWD, U.S. Fish and Wildlife Service	Voluntary	Provides cost-share funding to fill critical science needs and implement conservation measures to conserve freshwater fishes recognized as STE or SGCN
Landowner Incentive Program	TPWD, USFWS Partners for Fish and Wildlife Program, and numerous local cooperators	Voluntary	Provides cost-share funding to cooperating landowners to implement fish and wildlife habitat restoration projects on private lands; since 2010, the program has cooperated with approximately 140 landowners to support 160 projects that restored over 24,000 ha
Texas Farm and Ranch Lands Conservation Program	TPWD	Voluntary	Provides cost-share funding to cooperating land trusts for the purchase of conservation easements on private lands
Texas Instream Flow Program	TPWD, Texas Water Development Board, and Texas Commission on Environmental Quality	Voluntary	Performs studies to identify instream flow regimes needed to maintain sound ecological environments in Texas rivers and streams; studies use SGCN and STE freshwater fishes as focal species
Collaborative Conservation Agreements	TPWD and numerous cooperators	Voluntary	Through multi-agency conservation plans, TPWD cooperates with partners to implement interjurisdictional, watershed-scale, and range-wide conservation efforts for focal species
Texas Native Fish Conservation Areas	TPWD	Voluntary	Consists of a network of 20 watershed-based management units that serve as strongholds for freshwater fish SGCN and STE freshwater fishes

From: Birdsong et al. 2020. Conservation Status of Texas Freshwater Fishes: Informing State-based Species Protections. JSAFWA 8:40–52

Background


Brazos River Basin
Lubbock
Possum Kingdom Lake
Lake Granbury
Abilene
Lake Whitney
Waco
Lake Waco

Brazos River Native Fishes

Plains Minnow

Silverband Shiner

Shoal Chub

Sharpnose Shiner (End.)
SNS

Smalleye Shiner (End.)
SES

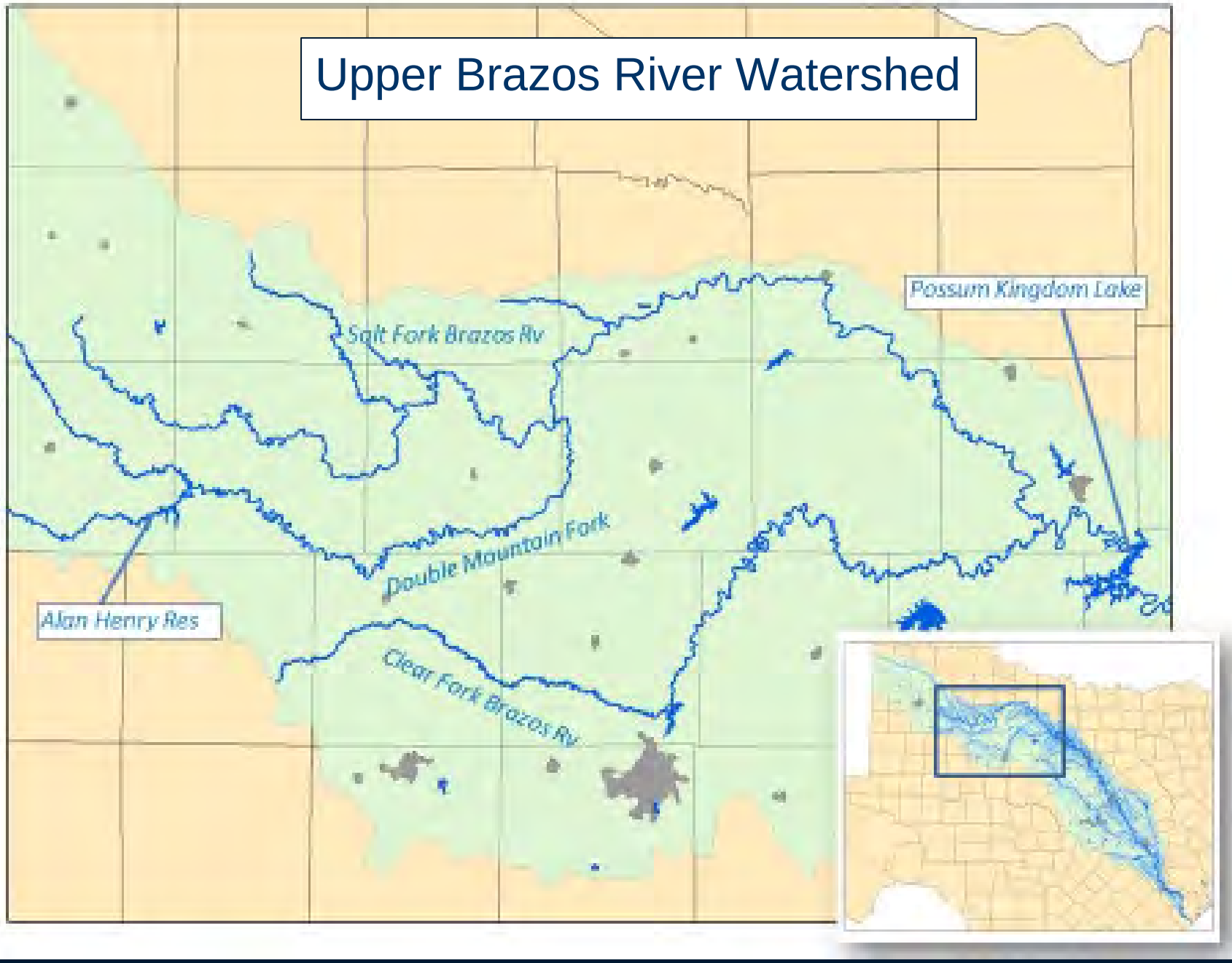
Smalleye Shiner (SES) and Sharpnose Shiner (SNS)

- Short life span, typically 2 yrs
- Pelagic, broadcast-spawning cyprinids
- Spawning season ~ Apr-Sept
- Flowing, river reaches long enough to support ova and larval drift
- Wide, shallow, sandy habitat (i.e. braided)
- Natural flow regimes for spawning and recruitment (e.g. base and pulse flows)

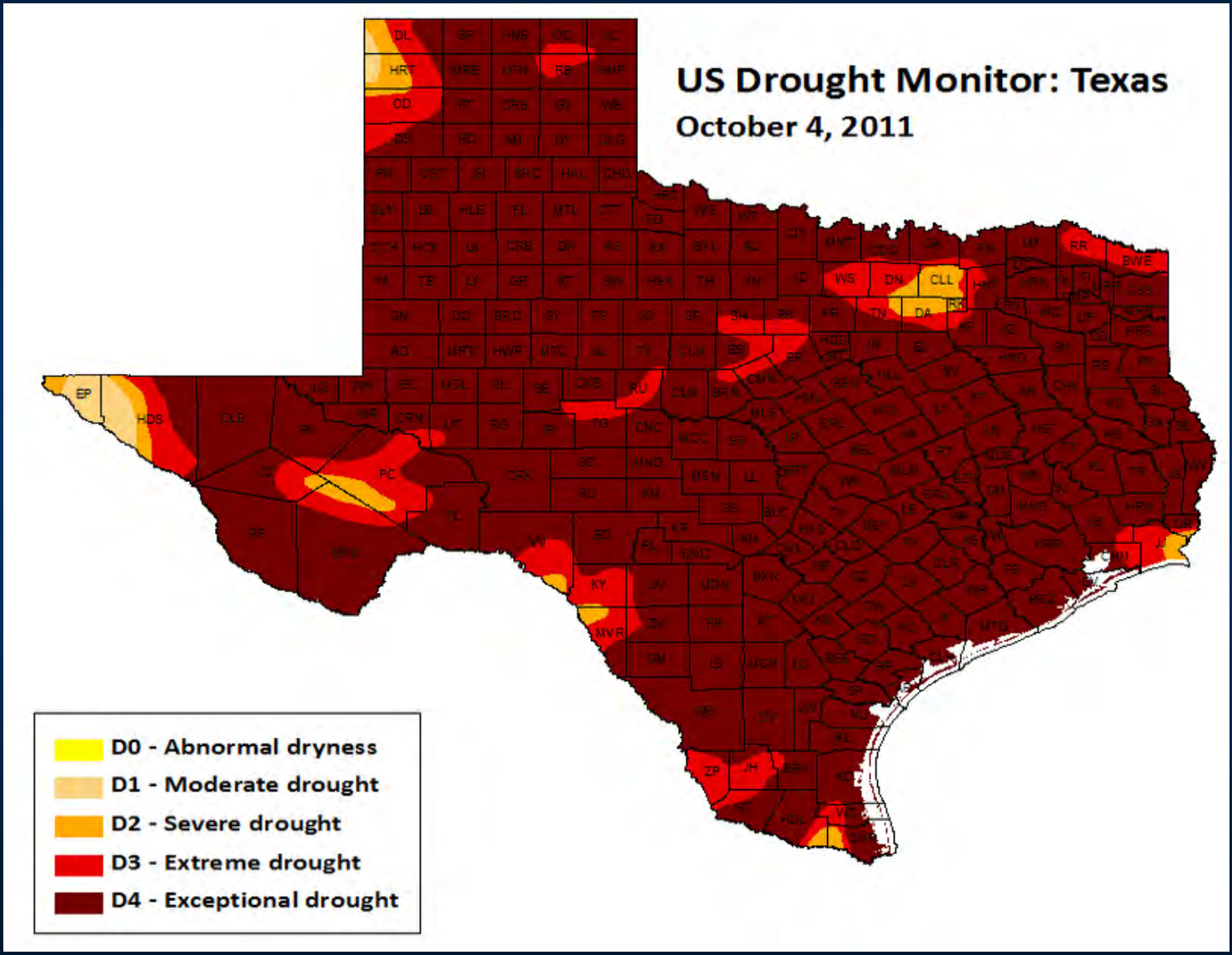
Brief Timeline

- Native Texans, Brazos R. (SES and SNS) and Wichita R. (SNS); Colorado?
- Smalleye Shiner once thought to be extinct (mid-late 80s) Hubbs et al. 1991
- Moss and Mayes (1993) confirms both abundant in upper; absent from middle
- Low # of SNS in lower Brazos and absent from Wichita R.; no SES in lower
- Federal candidates since 2002
- TTU initiates long-term monitoring and research program ~2002

Upper Brazos River Watershed



2011 Drought




Shiner Rescue
September 15-16, 2011

Peppered Chub

Photos by Clint Robertson, TPWD

Possum Kingdom Fish Hatchery

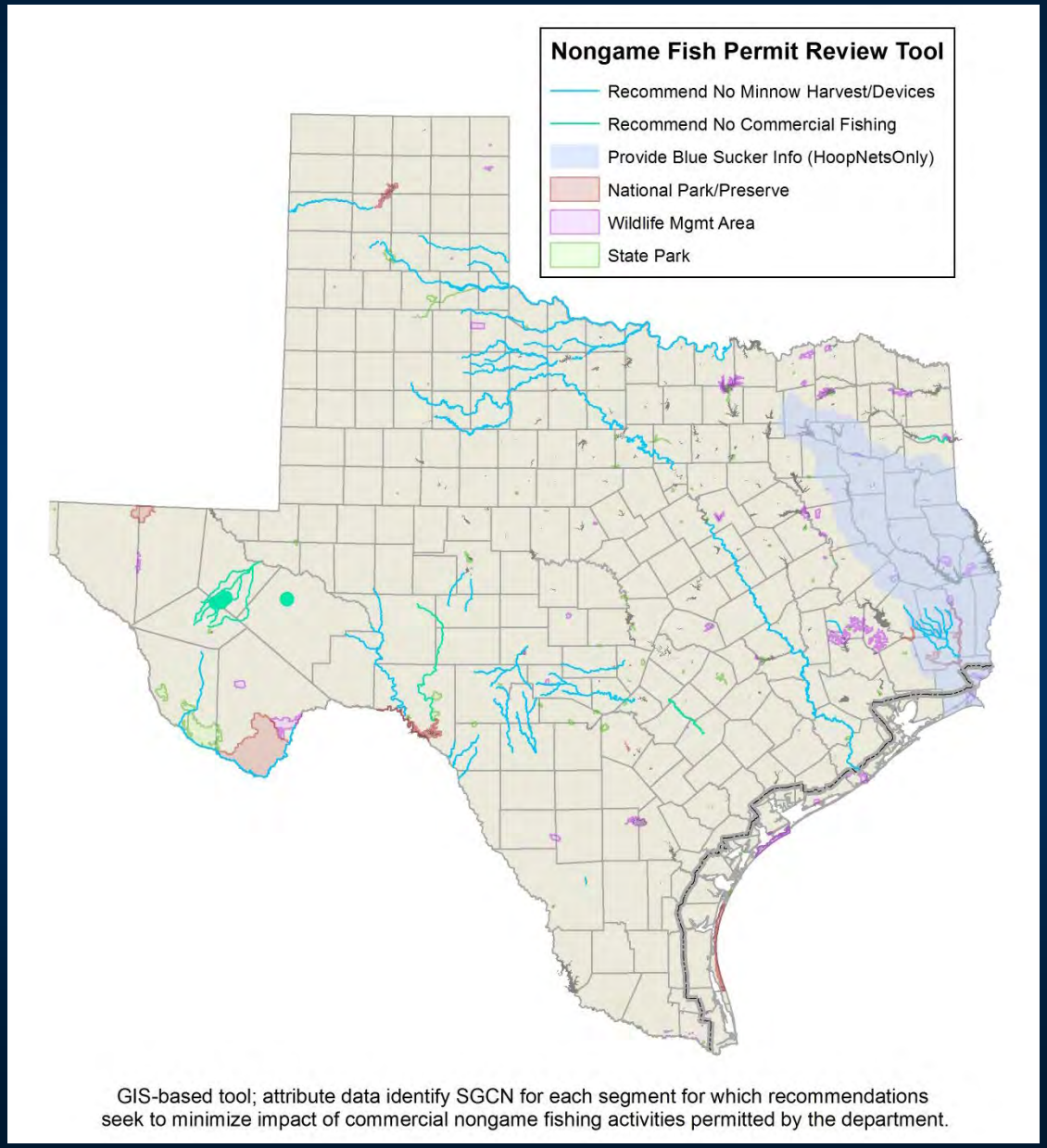

Repatriated ~800 Sharpnose Shiner and Smalleye Shiner
Lower Brazos River near Hearne
5/29/12

2014 ESA Listing Endangered
Smalleye Shiner and Sharpnose Shiner

Factors

- severe range reduction
- river fragmentation
- alterations of the natural flow regime
- water quality
- commercial harvest for baitfish
- invasive species (e.g., saltcedar)

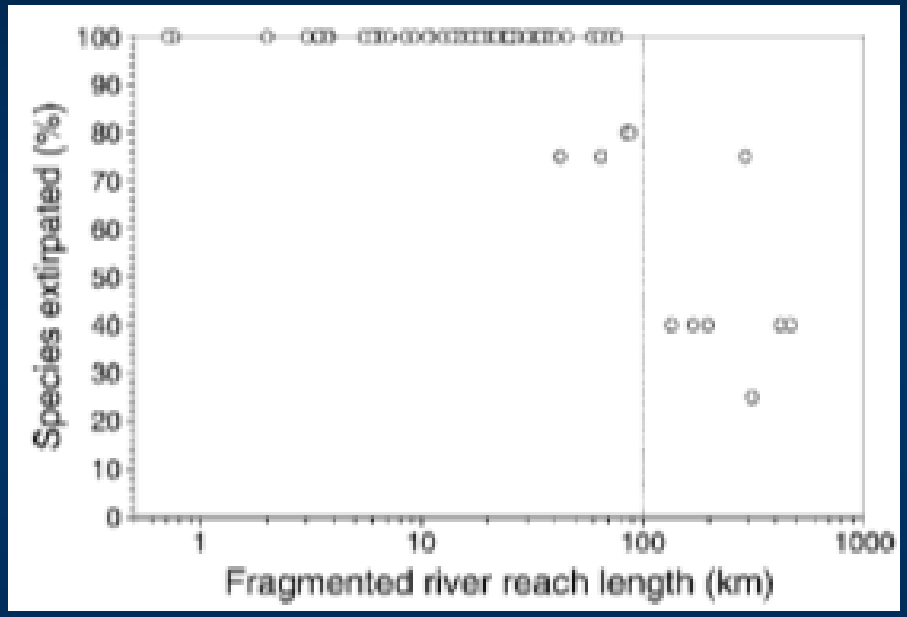
Nongame Fish Permits



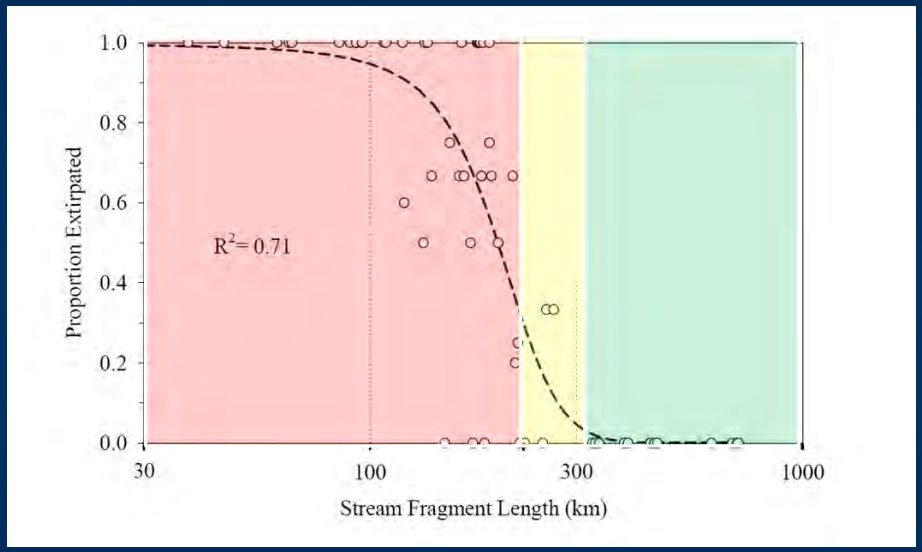
GIS-based tool; attribute data identify SGCN for each segment for which recommendations seek to minimize impact of commercial nongame fishing activities permitted by the department.

Research

Fragment Length & Extirpation of Pelagic Spawning Minnows



Dudley and Platania (2007)
Ecological Applications



Perkin and Gido (2011) *Fisheries*
[Colors added]

Fragment Length and Presence

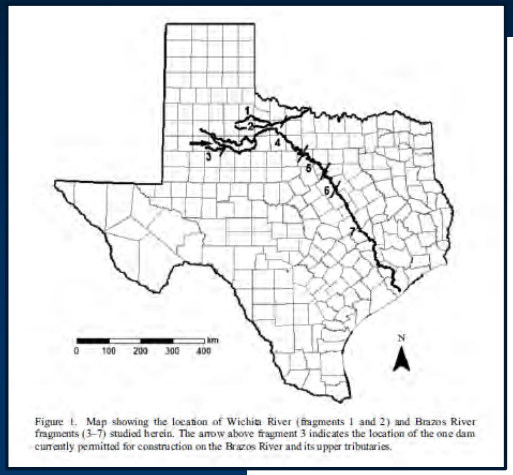


Figure 1. Map showing the location of Wichita River (fragments 1 and 2) and Brazos River fragments (3–7) studied herein. The arrow above fragment 3 indicates the location of the one dam currently permitted for construction on the Brazos River and its upper tributaries.

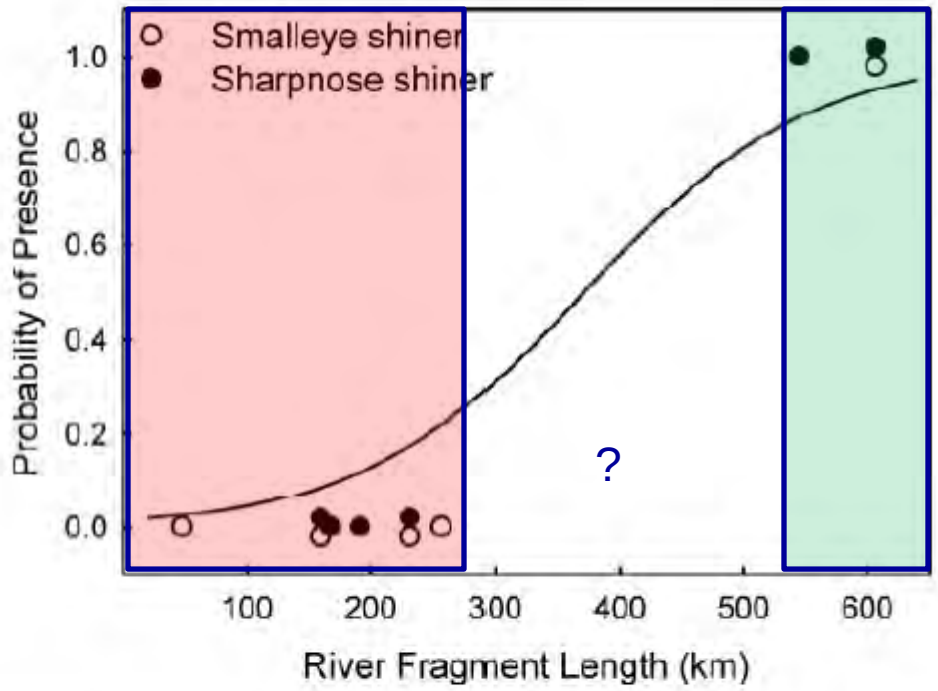
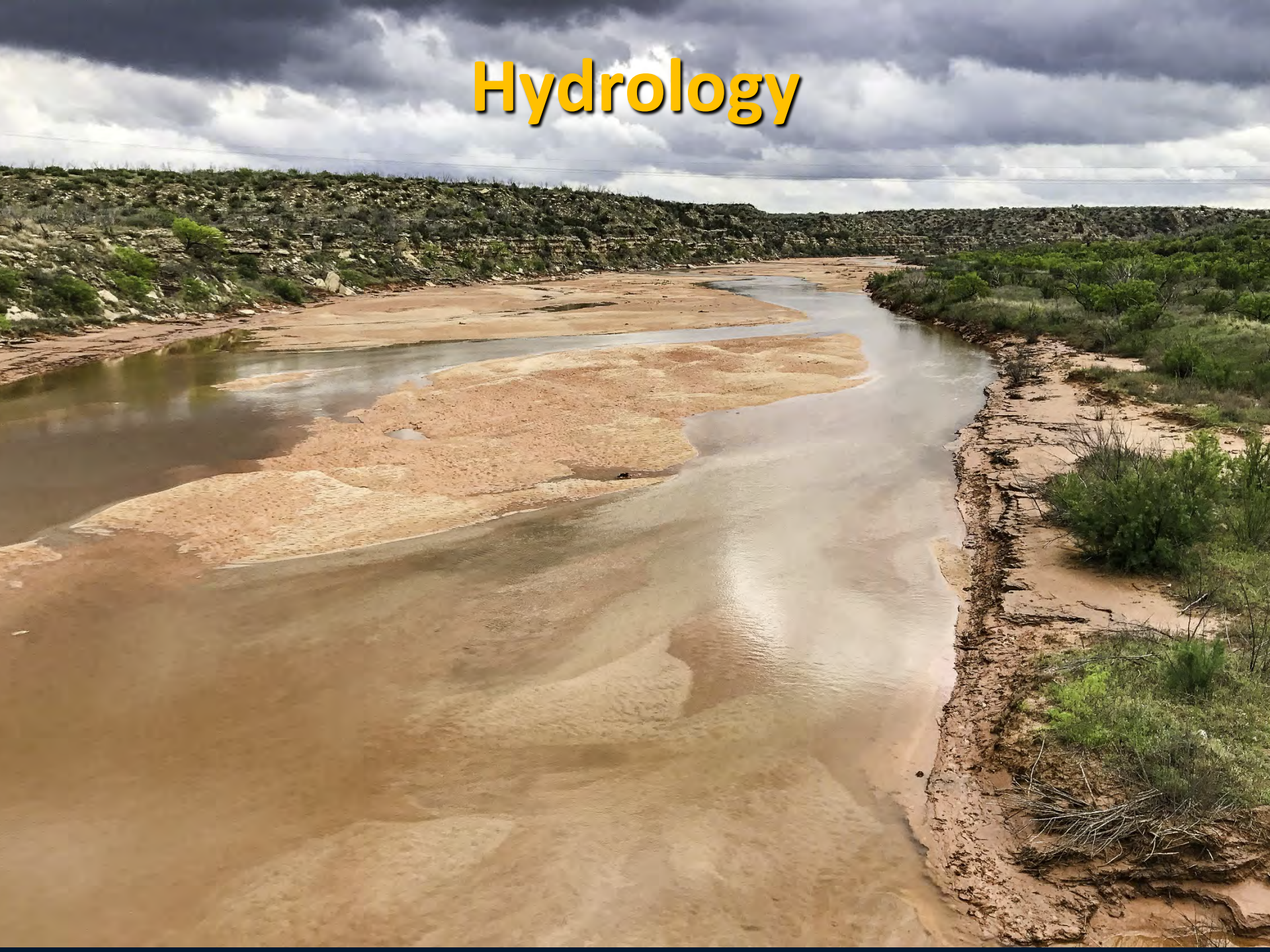


Figure 2. Probability of persistence of sharpnose shiner and smalleye shiner based on river fragment length in the Brazos and Wichita rivers. For three river reaches in which both species are either present or absent, symbols are jiggered vertically to facilitate visualization.

From: Wilde and Urbanczyk. 2013. Relationship between river fragment length and persistence of two imperiled great plains cyprinids, Journal of Freshwater Ecology, DOI:10.1080/02705060.2013.785984 [colors and ? Added]

Hydrology

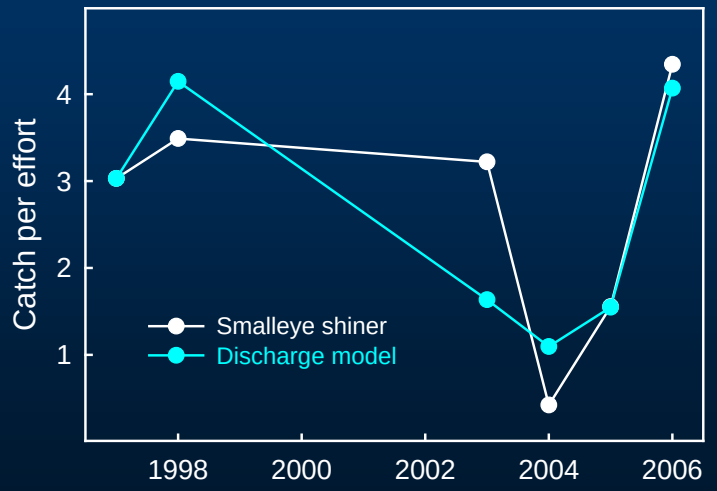


Flow-ecology

- **Mean summer (May-Sept) discharge of 227 cfs for Smalleye Shiner (Durham & Wilde 2009) and;**
- **Mean summer (May-Sept) discharge of 92 cfs for Sharpnose Shiner (Durham 2007) at Seymour gage**

TABLE 1.—Age-specific estimates and elasticities of survival and fecundity for smalleye shiners in the Brazos River.

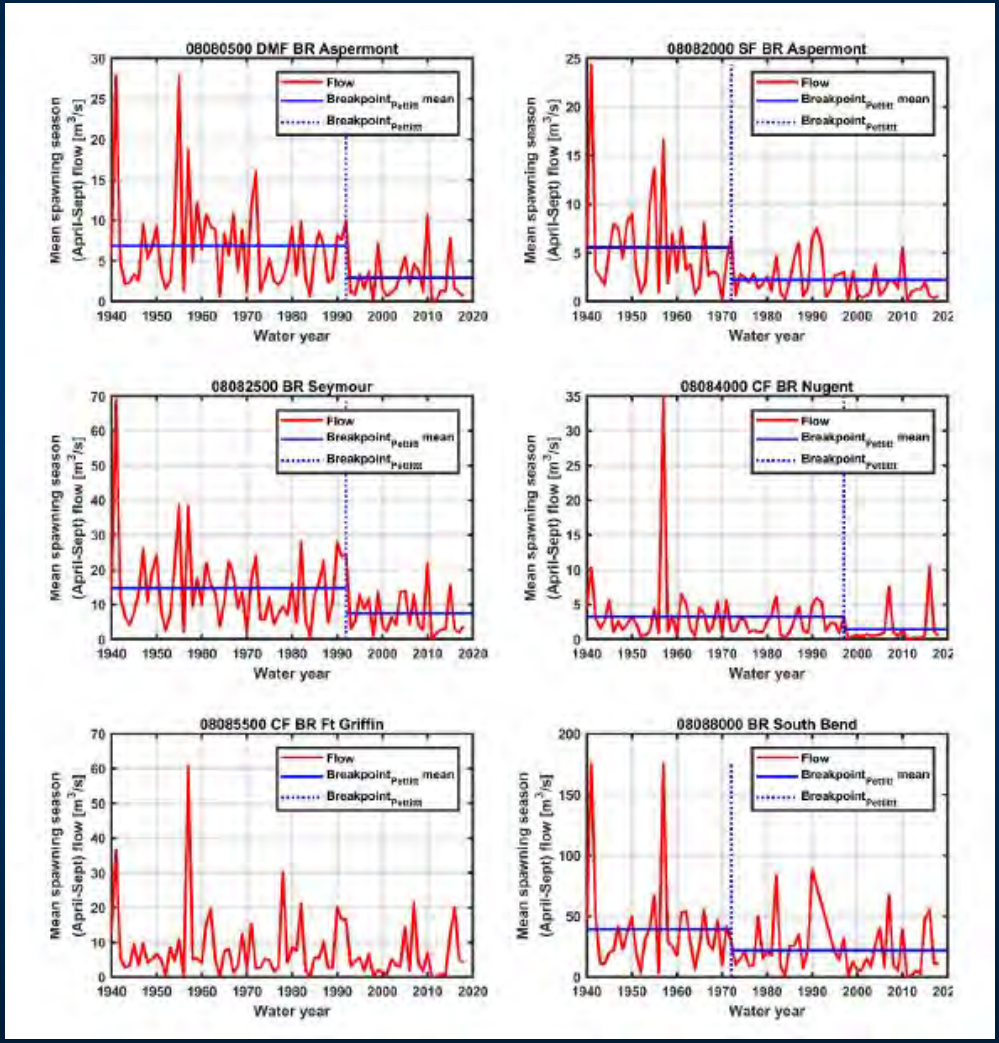
Variable	Age 0	Age 1	Age 2
Survival	0.001479	0.107	0.0
Fecundity	0.0	443.3	2,175.4
Survival elasticity	0.4265	0.1469	0.0
Fecundity elasticity	0.0	0.2797	0.1469



Flow-ecology

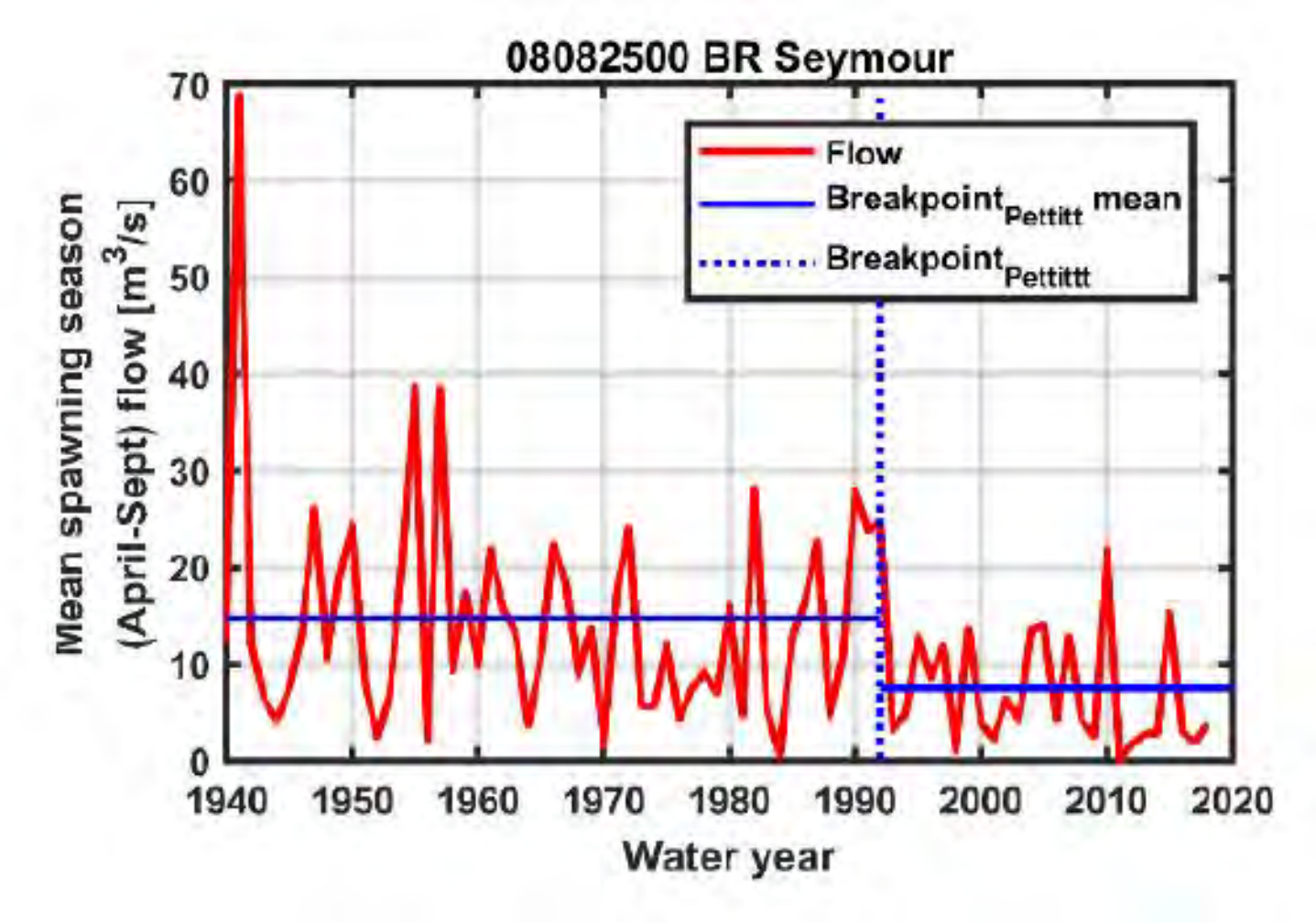
- During periods of drought, when the river ceased to flow, no young were successfully produced by SNS or SES (Durham and Wilde 2009)

Mean Summer Discharge



From: Wolaver. 2019. Surface water-groundwater interactions in the upper Brazos River basin of Texas and quantitative relationship to Smalleye and Sharpnose Shiner reproductive success

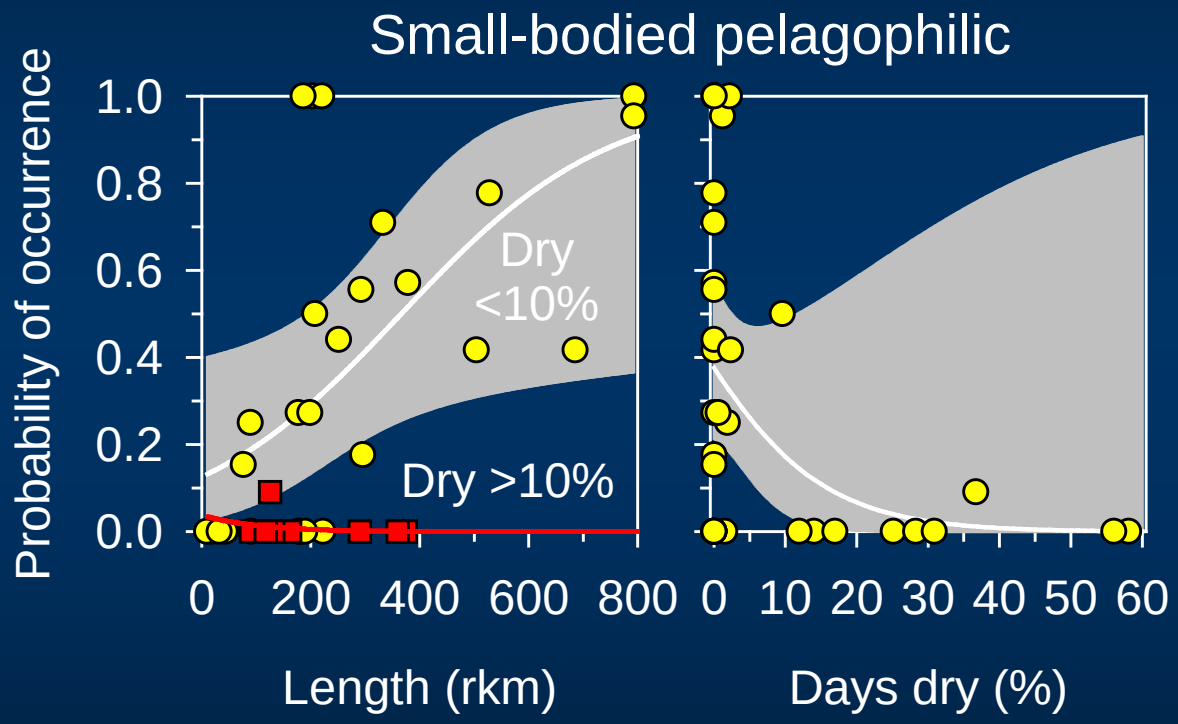
Mean Summer Discharge



From: Wolaver. 2019. Surface water-groundwater interactions in the upper Brazos River basin of Texas and quantitative relationship to Smalleye and Sharpnose Shiner reproductive success

Flow-ecology

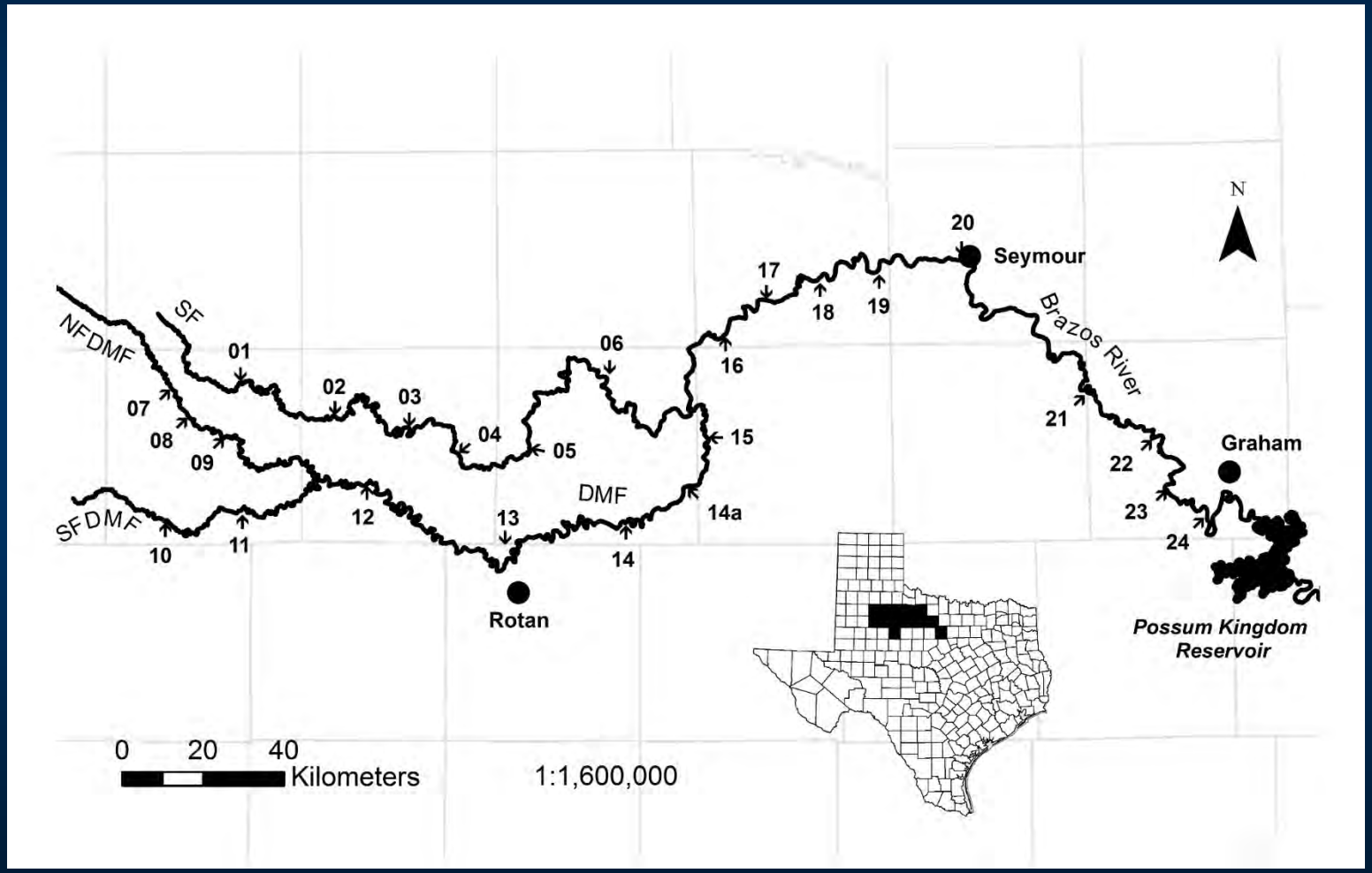
Fragmentation and Dewatering Reduce Fish Diversity



"… longer longitudinal lengths, greater discharge magnitudes, and lower frequencies of desiccation are likely to be most effective (as opposed to each feature individually) at conserving fish diversity in the central Great Plains…"

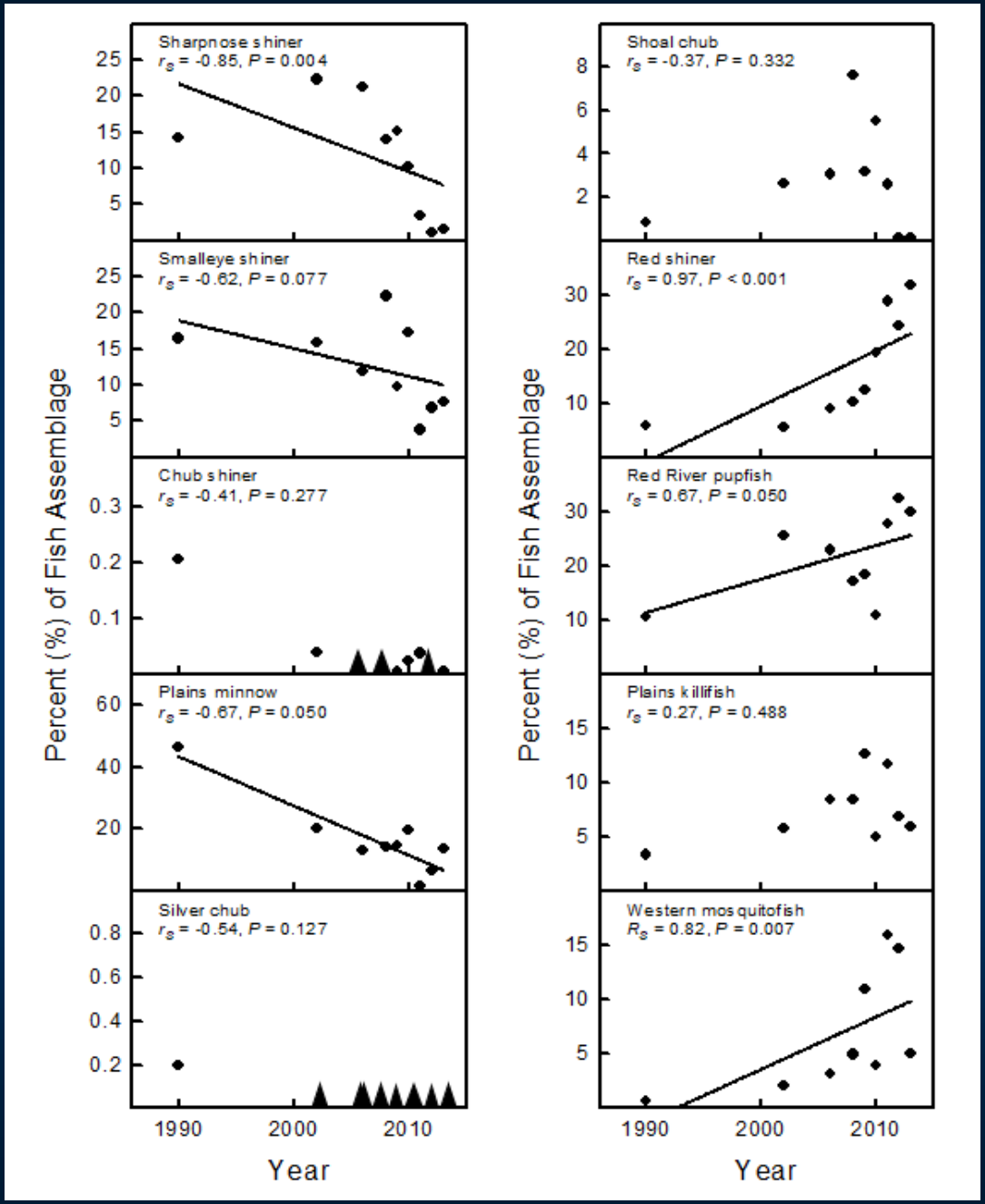
Source: Perkin et al. 2015. Fragmentation and dewatering transform Great Plains stream fish communities. Eco. Mono.

Fish community monitoring



Source: Wilde and Mayes 2015, upper Brazos R. Fish samples only

Pelagophils

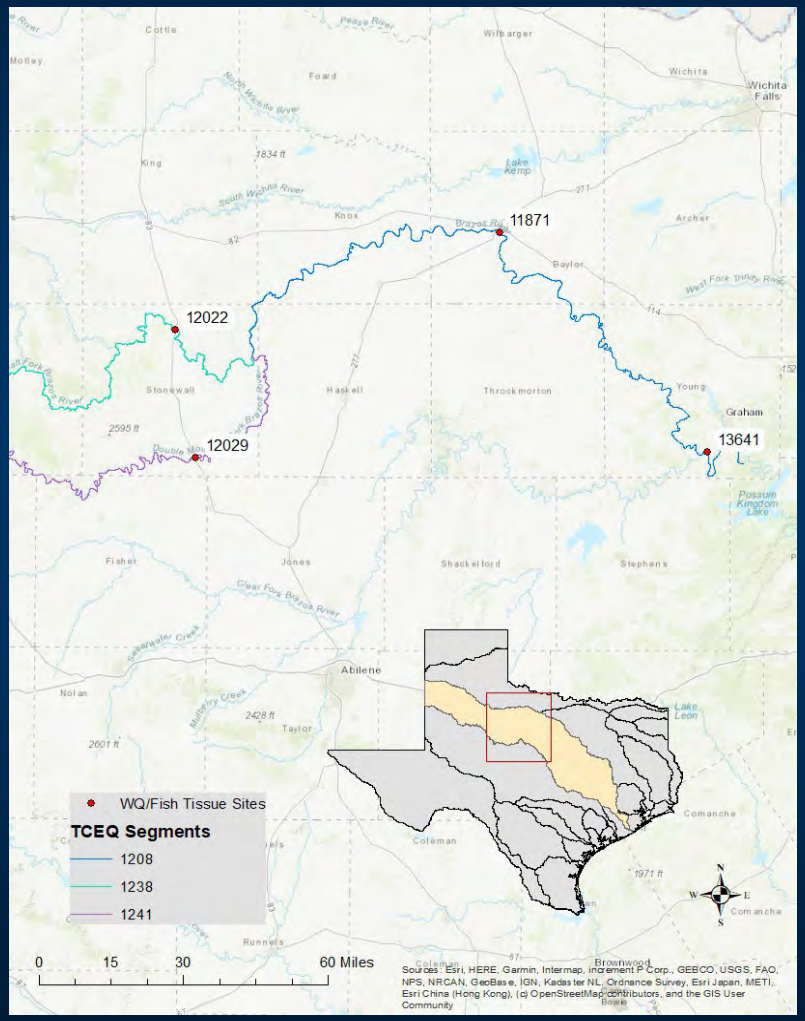


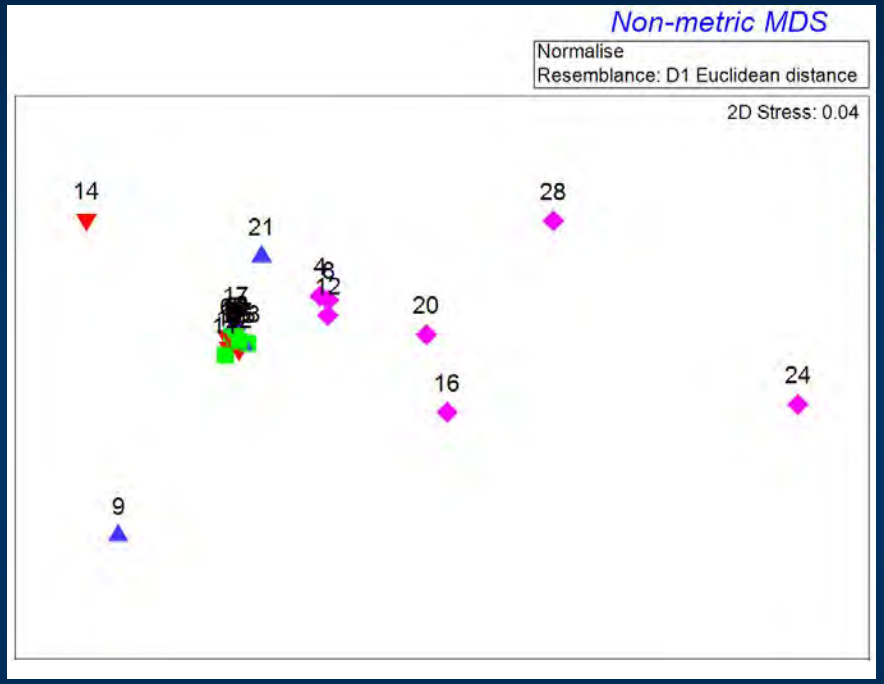
Nesting and live-bearers

Source: Wilde and Mayes 2015, upper Brazos R. Fish samples only

Water Quality

Water Quality in Upper Brazos





Source: Kelly and Wilde. 2019. Effects of Altered Water Quality on Populations of Smalleye Shiner and Sharpnose Shiner in the Upper Brazos River. TX E-184

Water Quality in Upper Brazos

Total Selenium in Water

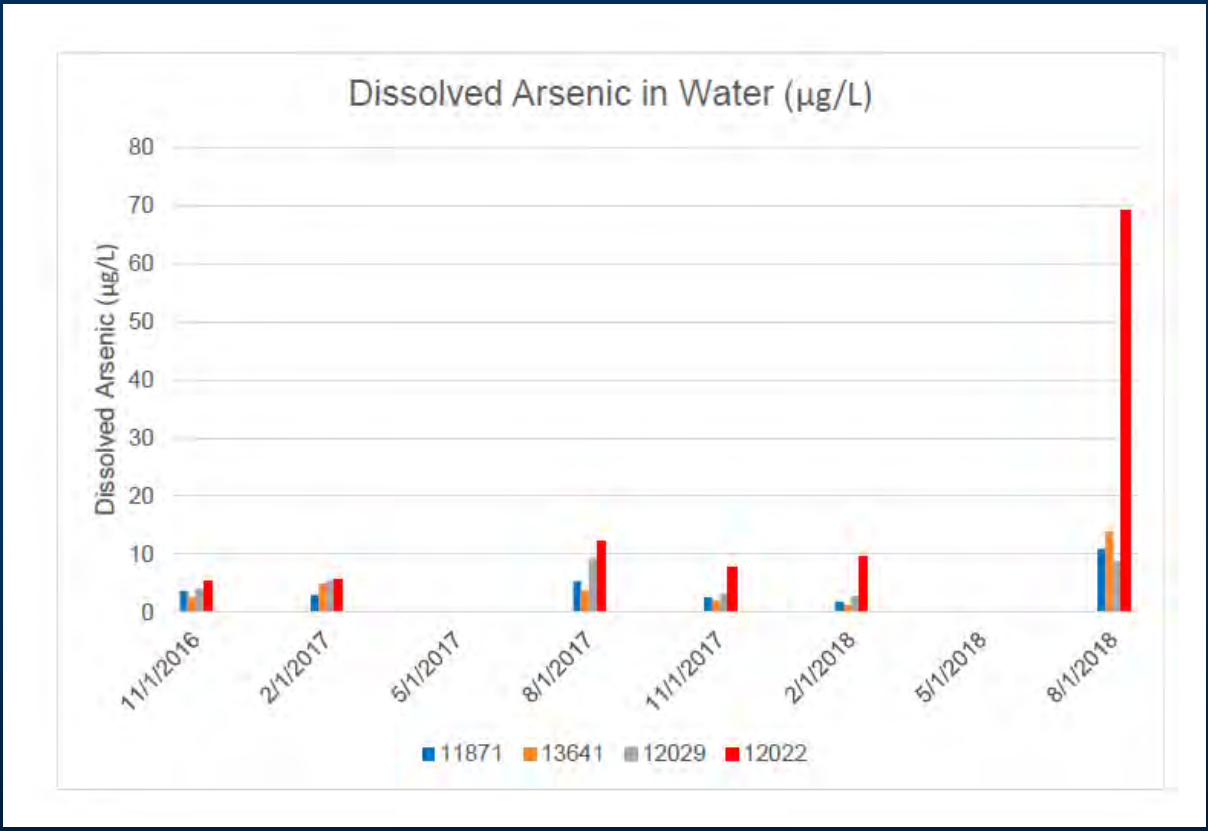
Table 12. Total selenium exceedances of acute and chronic criteria (TCEQ 2018) and EPA Criterion for lotic waters (EPA 2016b) to protect aquatic life in the Brazos River at US 183 (11871), Brazos River at SH 67 (13641), Double Mountain Fork Brazos River at US 183 (12029), and the Salt Fork Brazos River at US 183 (12022).

Site	Date	Total Selenium (µg/l)	TCEQ Acute Criteria (20 µ/L)	TCEQ Chronic Criteria (5 µg/L)	EPA Criterion (3.1 ug/L)
11871	11/30/2017	13.4	-	Exceeds	Exceeds
11871	8/29/2018	8.42	-	Exceeds	Exceeds
13641	11/30/2017	5.32	-	Exceeds	Exceeds
13641	8/29/2018	6.16	-	Exceeds	Exceeds
12029	11/30/2017	5.58	-	Exceeds	Exceeds
12022	11/30/2017	170	Exceeds	Exceeds	Exceeds
12022	8/29/2018	94.4	Exceeds	Exceeds	Exceeds

Source: Kelly and Wilde. 2019. Effects of Altered Water Quality on Populations of Smalleye Shiner and Sharpnose Shiner in the Upper Brazos River. TX E-184

Water Quality in Upper Brazos

Dissolved Arsenic in Water



Source: Kelly and Wilde. 2019. Effects of Altered Water Quality on Populations of Smalleye Shiner and Sharpnose Shiner in the Upper Brazos River. TX E-184

Water Quality in Upper Brazos

Metals in Fish Tissue

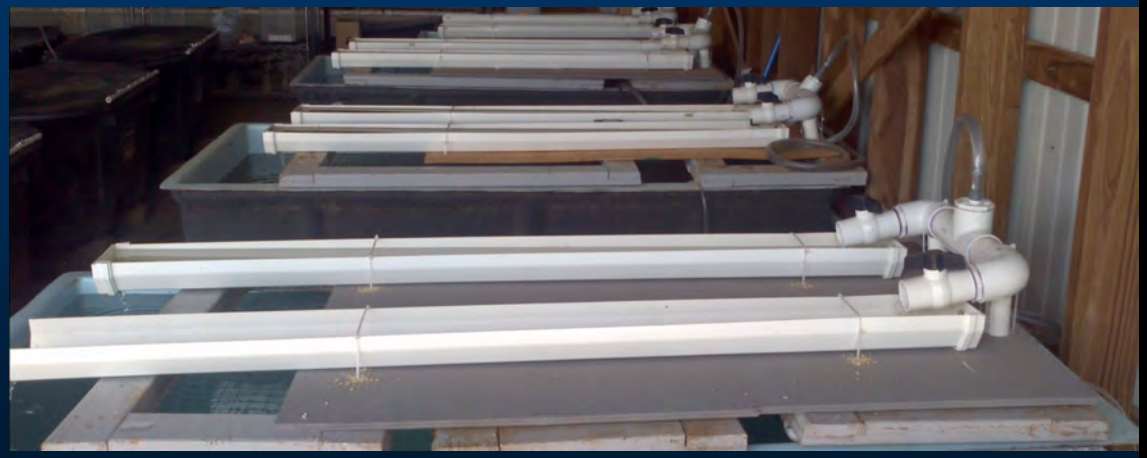
Source: Kelly and Wilde. 2019. Effects of Altered Water Quality on Populations of Smalleye Shiner and Sharpnose Shiner in the Upper Brazos River. TX E-184

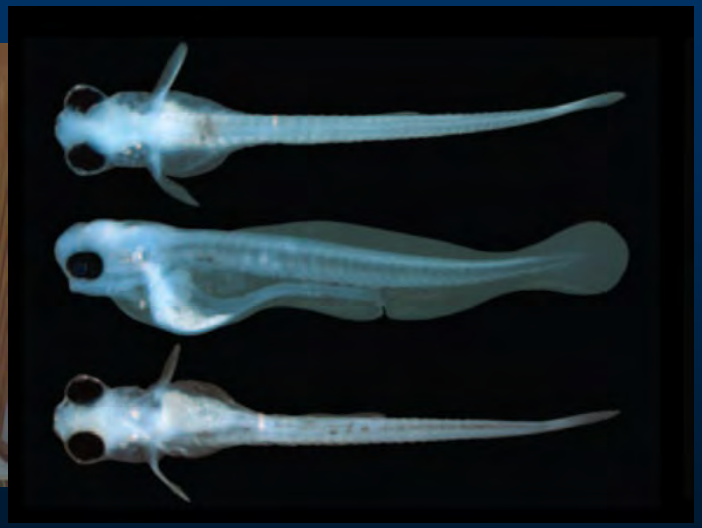
Captive Propagation & Repatriation

Prairie Stream Fish Conservation Research and Propagation Laboratory

Applications

- Captive spawning/propagation techniques
- Conservation Genetics
- VIE marking and tracking
- Larval and juvenile tolerances/preferences
- Repatriation experiments

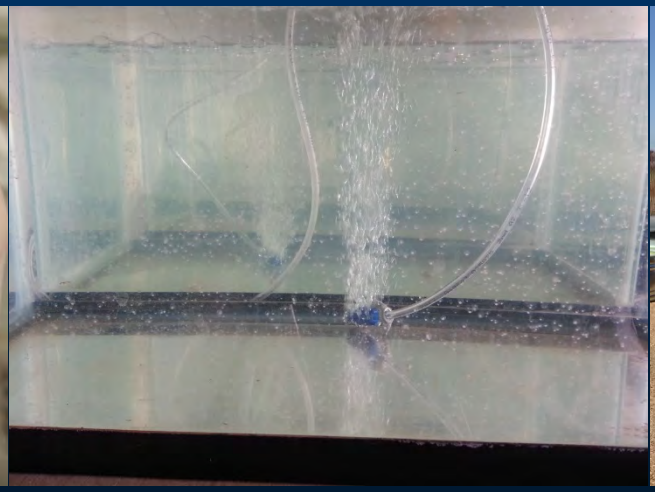




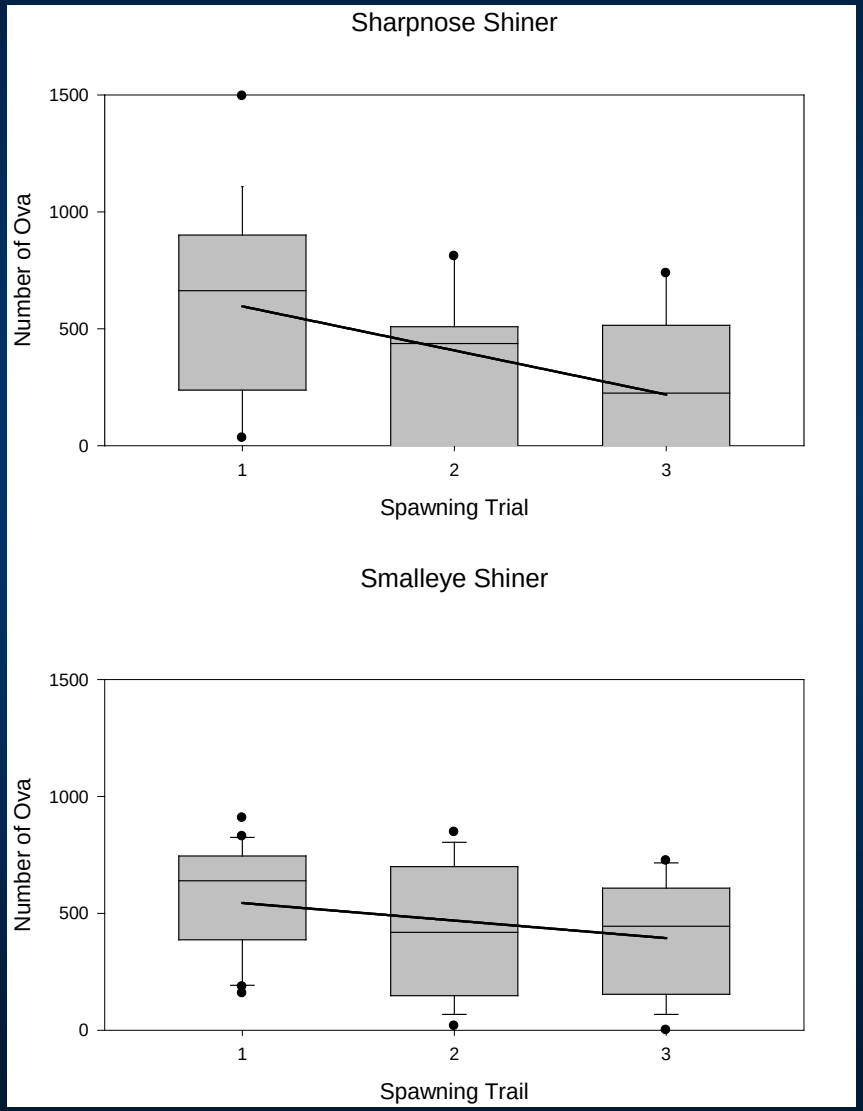
Strip Spawning: 5 Easy Steps








Multiple Strip Spawning



Prairie Stream Fish Conservation Research and Propagation Laboratory

Plains Minnow (*Hybognathus placitus*) - repatriation

Sharpnose Shiner (*Notropis oxyrhynchus*)

Smalleye Shiner (*Notropis buccula*)

Arkansas River Shiner (*Notropis girardi*)

Red River Shiner (*Notropis bairdi*)

Sand Shiner (*Notropis stramineus*)

Prairie Chub (*Macrhybopsis australis)*

Shoal Chub (*Macrhybopsis hyostoma*) - repatriation

Peppered Chub (*Macrhybopsis tetranema)*

Red Shiner (Cyprinella lutrensis)

Source: Urbanczyk et al. (2017)

Sharpnose Shiner Current and Historical Population Genetic Parameters

Sampling Year	Parameters	NTF43	Ns_A1	Nme 24B6.211	Nme 25C8.208
2003-2004	N	26	25	23	21
n=26	N_a	7[0]	5[0]	6[0]	7[1]
	H_o	0.8846	0.72	0.8696	0.619
	H_s	0.7315	0.7633	0.747	0.5619
	F_{is}	-0.2093	0.0568	-0.164	-0.1017
	Allele Size	84-102 bp	113-129 bp	208-218 bp	203-215 bp
2008	N	15	15	15	15
n=15	N_a	7[0]	4[0]	6[0]	4[0]
	H_o	0.9333	0.4667	0.8667	0.4
	H_s	0.7429	0.719	0.731	0.3548
	F_{is}	-0.2564	0.351	-0.1857	-0.1275
	Allele Size	84-102 bp	113-129 bp	202-216 bp	207-211 bp
2011	N	12	13	12	13
n=13	N_a	6[0]	4[0]	5[0]	3[0]
	H_o	0.75	0.9231	0.9167	0.6923
	H_s	0.7462	0.7083	0.6439	0.4872
	F_{is}	-0.0051	-0.3032	-0.4235	-0.4211
	Allele Size	84-104 bp	113-129 bp	202-216 bp	207-217 bp
2015-2016	N	205	214	217	219
n=221	N_a	11	6	13	7
	H_o	0.6118	0.6312	0.738	0.406
	H_s	0.7578	0.695	0.7378	0.389
	F_{is}	0.1927	0.0917	-0.0003	-0.0437
	Allele Size	84-104 bp	113-133 bp	202-244 bp	203-217 bp

Source: R. Vazquez, dissertation in prep

Captive Propagation Repatriation, and Refugia

Captive Propagation Repatriation, and Refugia

Ongoing Conservation Science

Measuring and predicting movement ecology for imperiled Great Plains fishes in Texas

J. Perkin, TAMU

1) Observe movements of marked individuals for six fish species at two sites within each of the Canadian, Red, and Brazos river basins.

2) Develop models for describing and predicting movement at all stream segments in the focal portions of each basin and for each species.

3) Relate movement models to species distribution modeling that is currently being conducted under an existing Section 6 grant.

Ongoing Conservation Science

Ecological forecasting and conservation contingency planning for imperiled Great Plains fishes in Texas

J. Perkin, TAMU

1) How have changes in habitat connectivity and water availability structured the distribution of imperiled Great Plains fishes in Texas riverscapes?

2) How will habitat features structuring occurrence of imperiled fishes change as habitat connectivity and water availability are affected in the future?

3) How will projected changes influence populations and where are current and future refugia located?

Ongoing Conservation Science

Assessing pathways of introduction of non-native fishes (Sheepshead Minnow and Gulf Killifish) in Texas streams

C. Montaña, SFA

1) Describe the status of the live bait industry Texas.
2) Identify the main fish species being sold in bait shops in Texas.
3) Evaluate the current status of *C. variegatus* and *F. grandis* in selected sites in the Brazos and Red River basins using direct surveys, dietary and stable isotope analysis, and functional species traits.
4) Model current and potential future locations of cyprinodontid introductions across multiple basins in the state of Texas using ecological niche modelling (ENM).

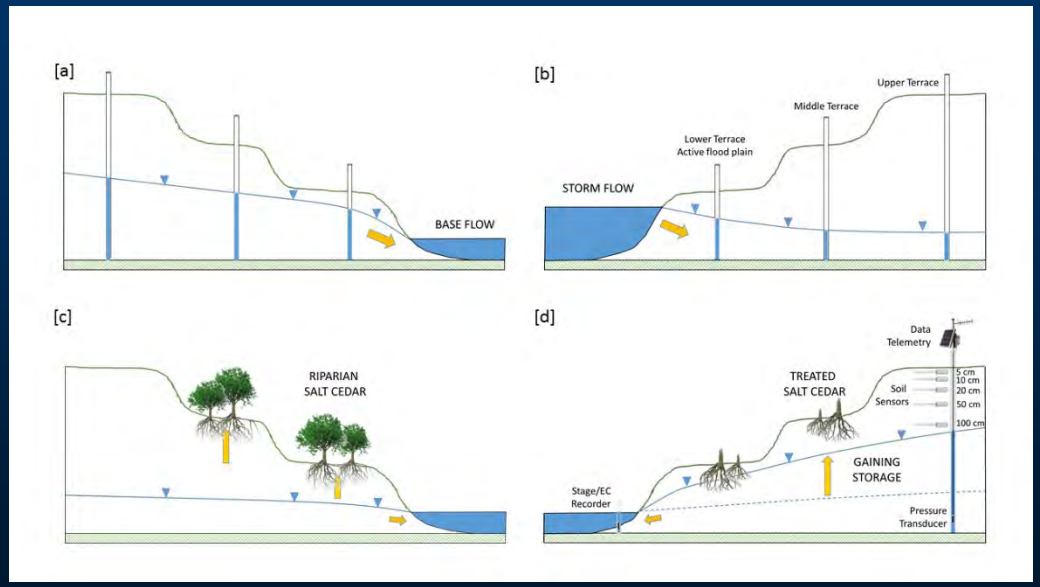
Ongoing Conservation Science

Saltcedar Management and Research

- Riparian Monitoring (T. Hayes, TCS)
- Hydrologic Monitoring (T. Bongiovanni, UTBEG)
- Hydraulic and Habitat Monitoring (TPWD)

Potential Benefits of Saltcedar Control

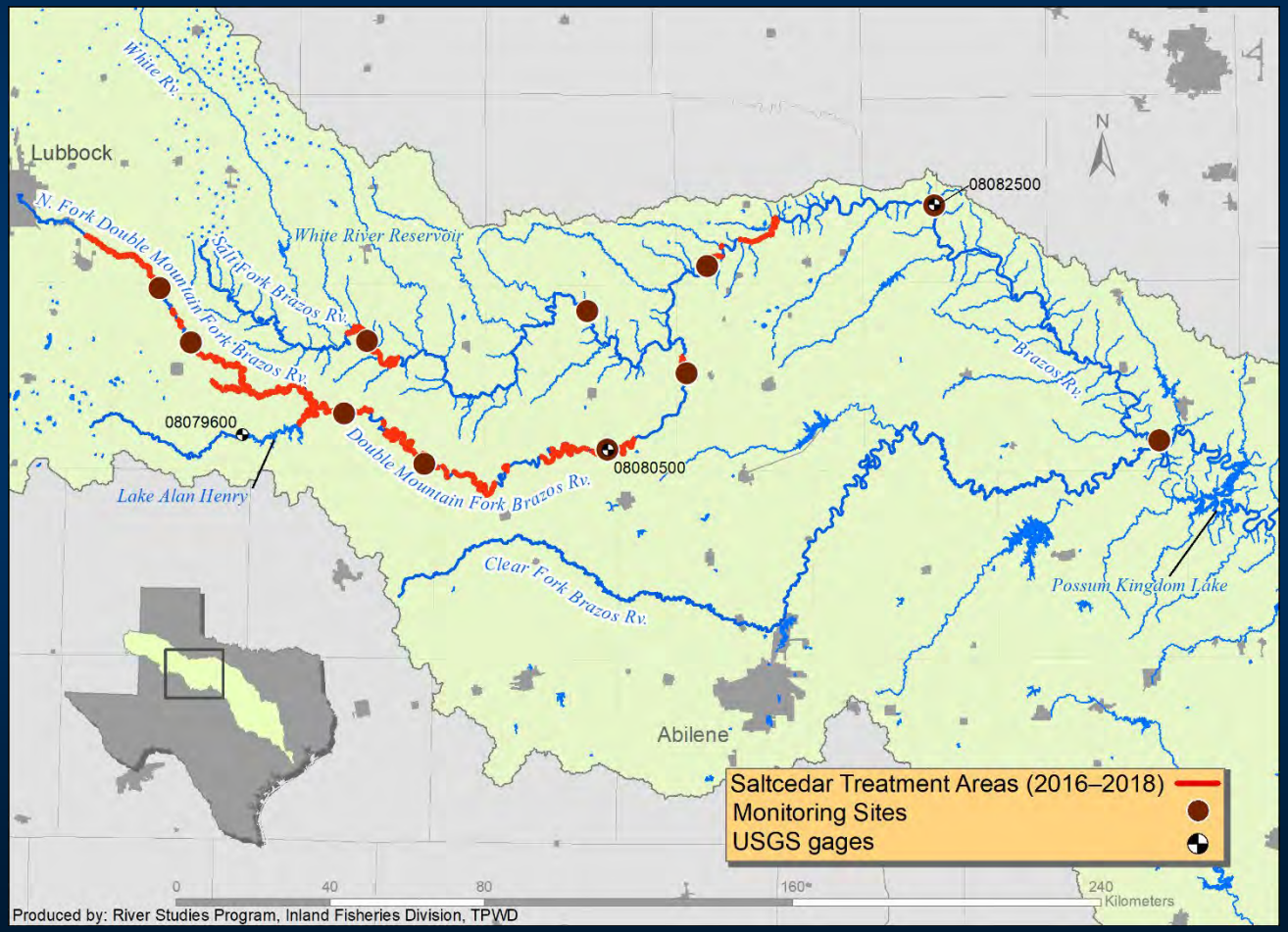
- Improve riparian habitat: plant diversity, wildlife, livestock, and people
- Improve river function: channel shape, hydraulics, geomorphology, fish habitat
- Improve base flows



Source: Mayes et al. (2019)

Ongoing Conservation Science

Saltcedar Management and Research

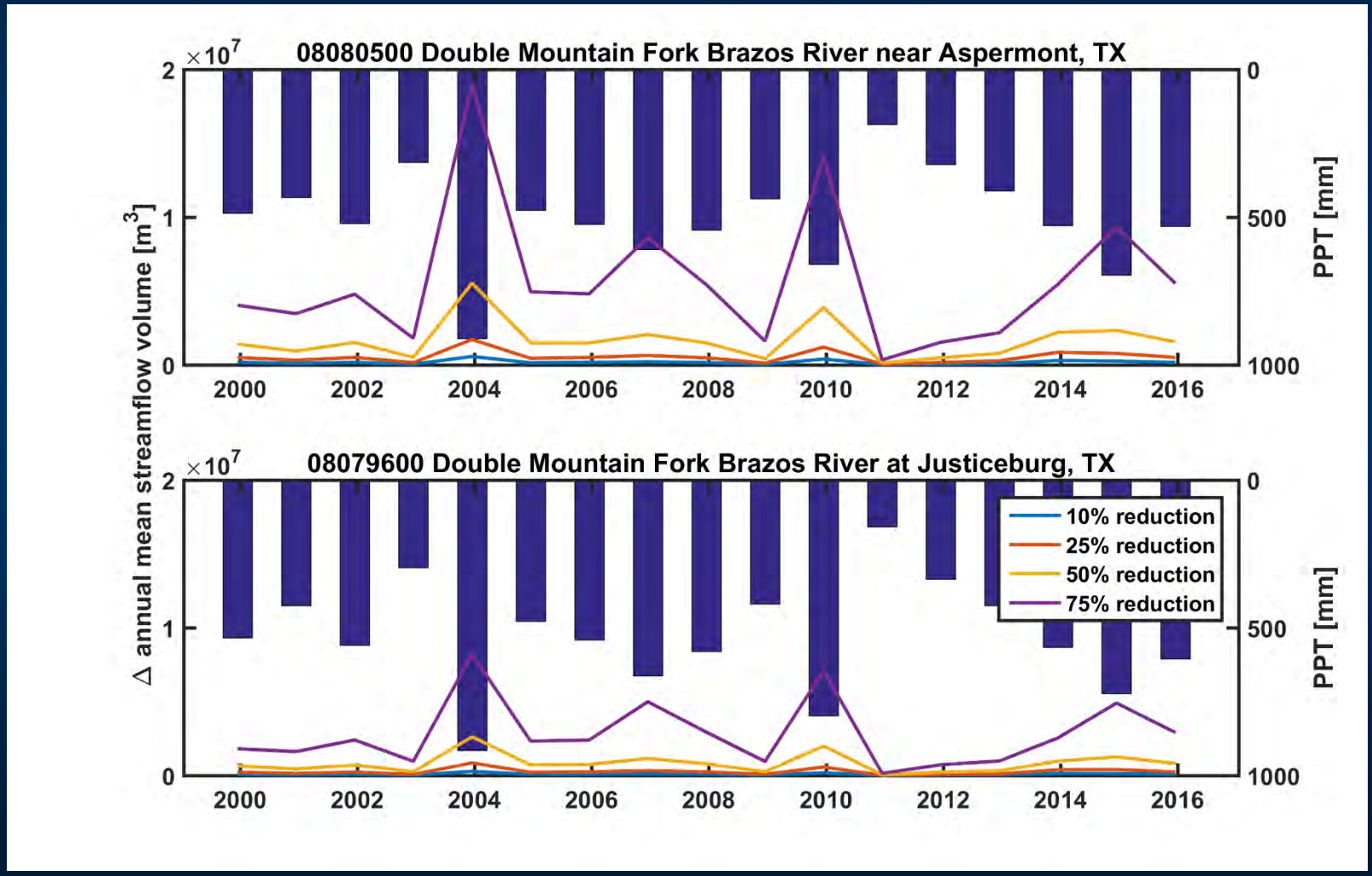


Source: Mayes et al. (2019) see https://tpwd.texas.gov/landwater/water/aquatic-invasives/saltcedar-upperbrazos.phtml

Hydrologic Monitoring and Modeling

- Three wells per site for water levels and chemistry
- Surface soil moisture and chemistry loggers
- Water budget developed to predict water availability

Hydrologic Monitoring and Modeling

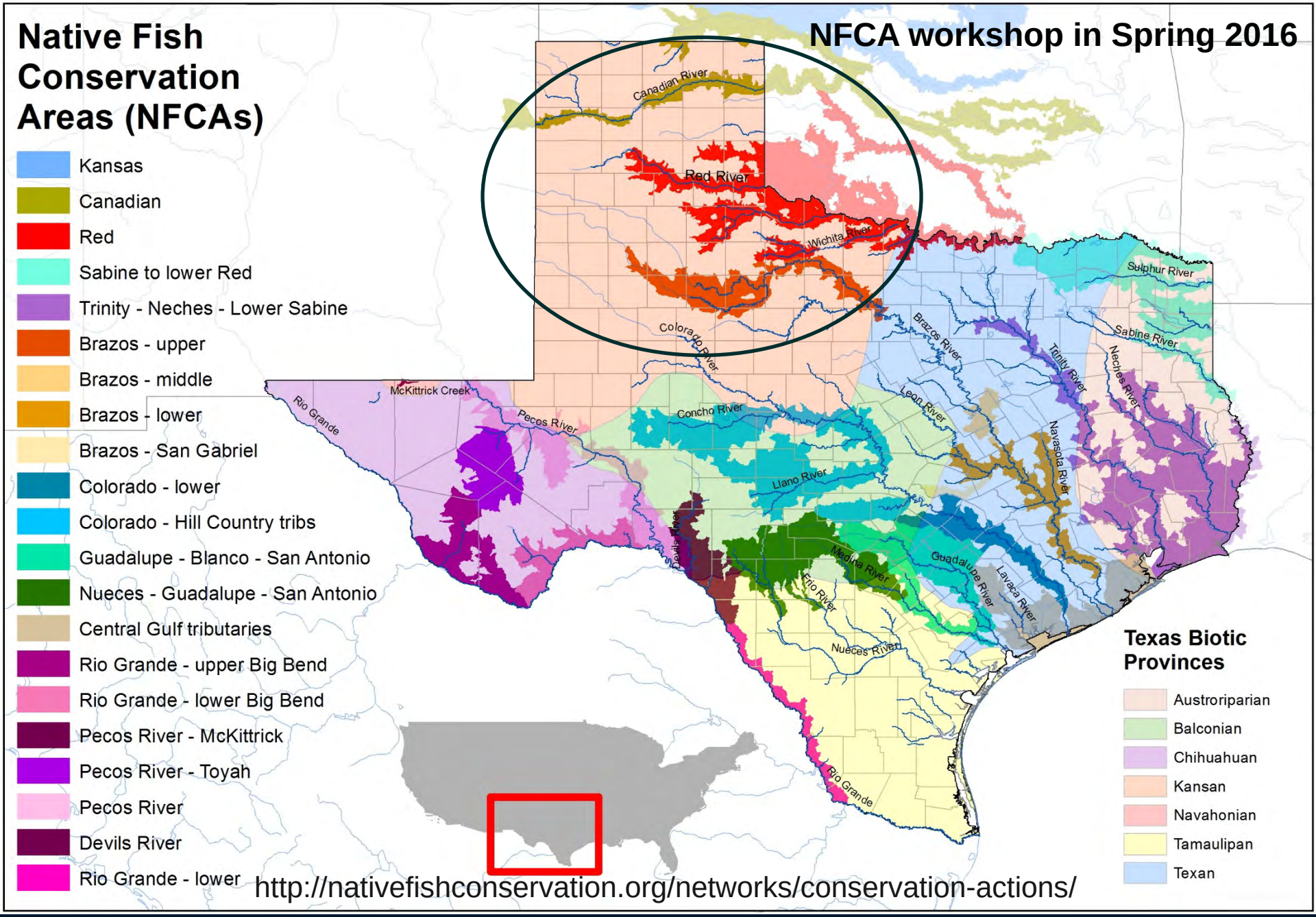


Source: Mayes et al. (2019)

Research Needs

Native Fish Conservation Areas (NFCAs)

NFCA workshop in Spring 2016



http://nativefishconservation.org/networks/conservation-actions/

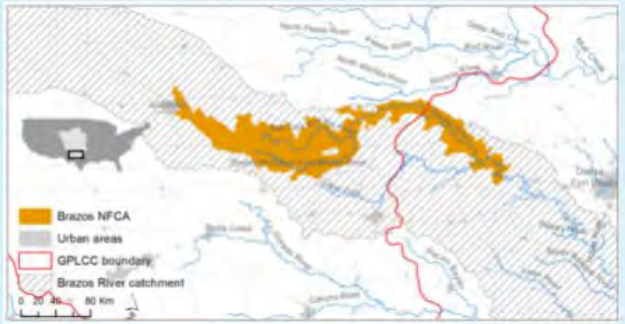
NATIVE FISH CONSERVATION NETWORK
Empowering Collaborative Stewardship

NETWORKS APPROACH DATA REPOSITORIES MAP ABOUT

UPPER BRAZOS RIVER

Conservation Plan

Conservation action plan and science agenda from stakeholder-led workshops



The Upper Brazos River NFCA planning was part of the Southern Great Plains Native Fish Conservation Area planning process - An interdisciplinary team of 45 fish and wildlife conservation professionals representing conservation non-profits, universities, state and federal agencies gathered for a series of conservation planning workshops in the early spring of 2016. Priority actions now provide the groundwork for a conservation action plan that will guide partner investments over the next 5-10 years in cooperative, watershed-scale conservation of native fishes and other aquatic resources in the Upper Brazos, Red, and Canadian rivers.

BRAZOS RIVER ACTION PLAN SUMMARY

Three priority projects were identified at the workshop to address the primary stressors within the Brazos River of flow regime alteration, and habitat loss, and invasive species control and management.

Set up monitoring sites across Great Plains major streams - Develop protocols and implement long-term monitoring sites across Great Plains basins.

SUBASIN PROFILE

Upper Brazos NFCA Profile

RELATED FILES

- Great Plains LCC Science Meeting Summary 2015

INTERACTIVE NFC PROJECT MAP

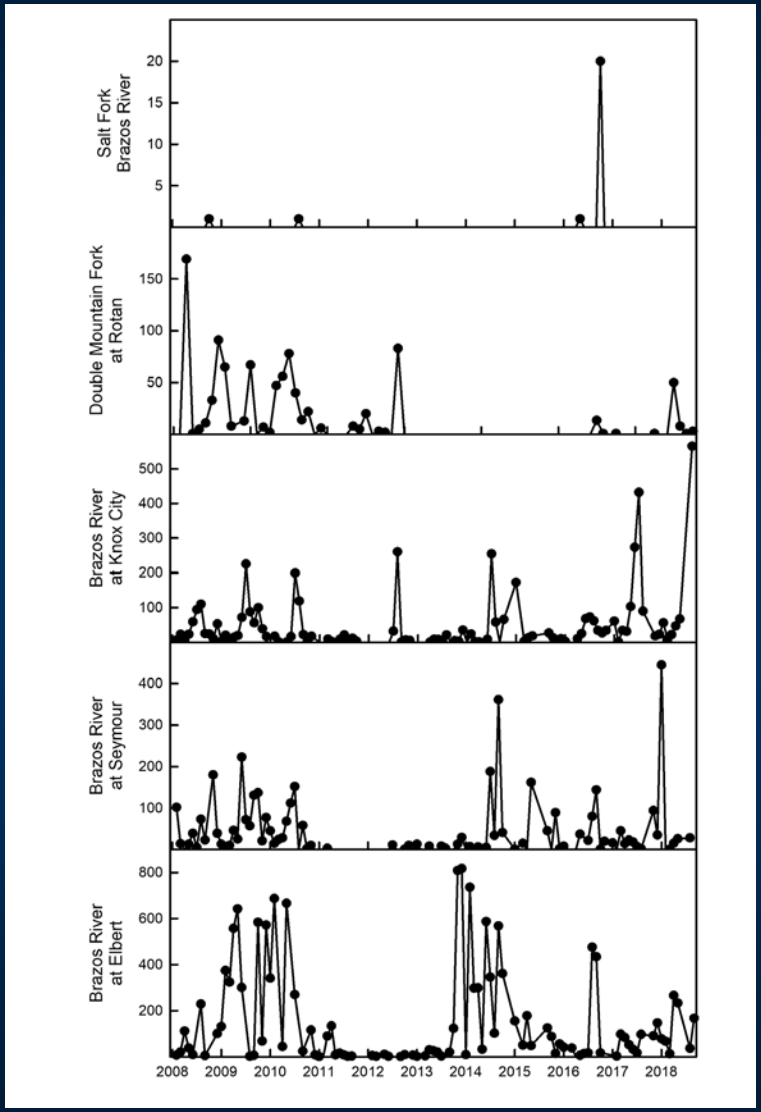
SUBMIT YOUR CONSERVATION PROJECT HERE

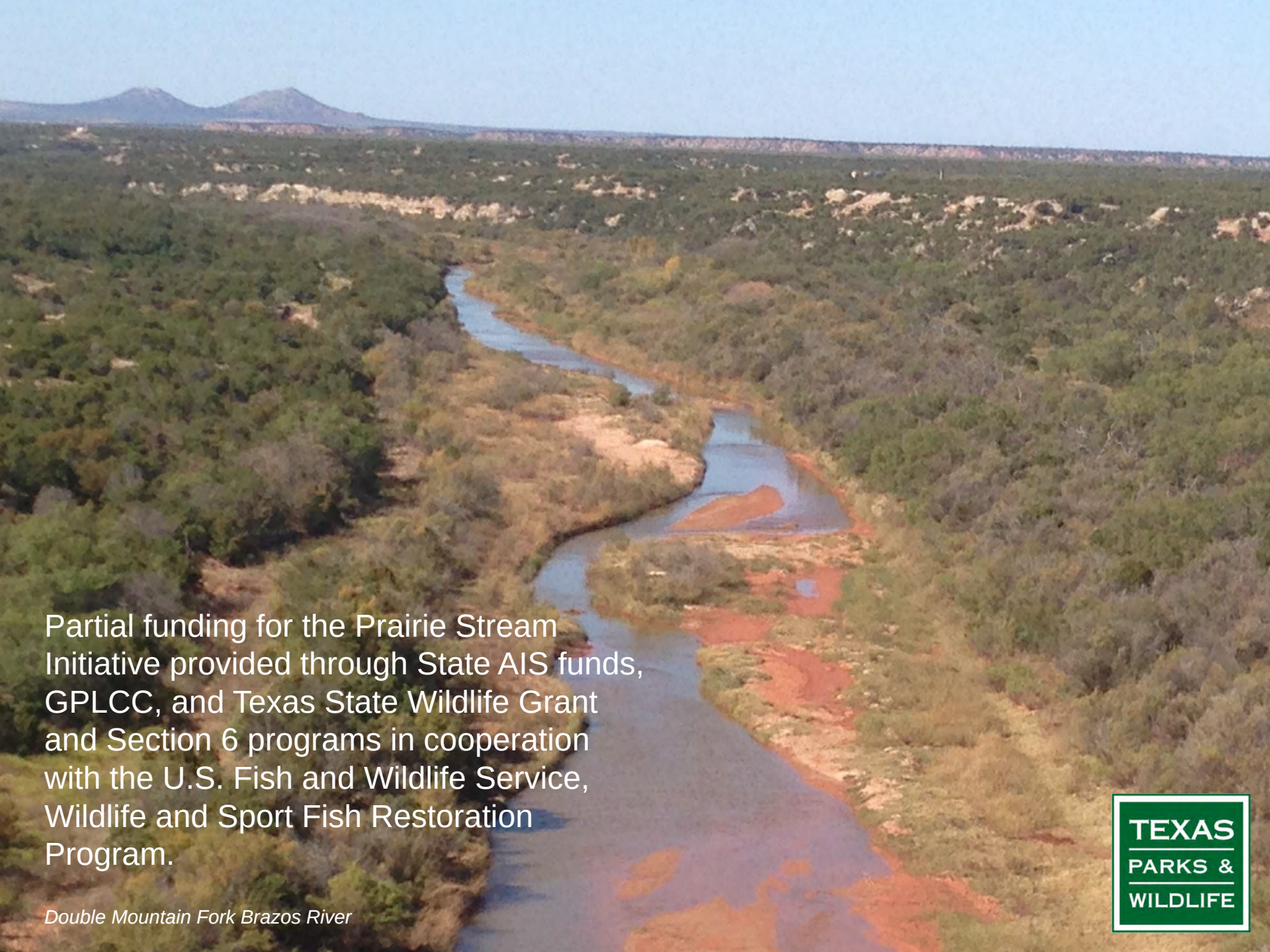
Source: https://nativefishconservation.org/plans/upper-brazos-river/

Workshop Science Priorities

- Establishing Long-term Ecological Monitoring Sites across Great Plains Streams
- Research on Saltcedar Management (ongoing)
- Assess Effects of Invasive Fishes (ongoing)
- Identifying Physical and Chemical Tolerances of Larval and Juvenile Fishes (More work needed)
- Quantifying Flow-Ecology Relationships and Fragmentation (ongoing but more work needed)
- Migration Dynamics & Habitat Use (ongoing)
- Captive Propagation and Repatriation (ongoing)

Long term ecological monitoring





Partial funding for the Prairie Stream Initiative provided through State AIS funds, GPLCC, and Texas State Wildlife Grant and Section 6 programs in cooperation with the U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program.

Double Mountain Fork Brazos River

TEXAS PARKS & WILDLIFE