New Tools for Environmental Flow Information

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Texas Waters Webinars
Poll #1

Environmental flows refer to:

A. Freshwater inflows to bays and estuaries
B. Instream flows in springs, rivers, streams, and bayous
C. Water levels in lakes, oxbows, aquifers
D. All of the above
Environmental Flows

- Instream Flows – water flowing in a stream
- Freshwater Inflows – river water that flows into a bay or estuary
- Water Levels – elevations to support fish and wildlife in reservoirs, aquifers, wetlands, estuaries, etc.
Instream Flow Regimes & Patterns
Inflows to Estuaries

Salinity Gradients

Nutrients

Wetlands

Flows which create and sustain estuaries
Water Needs Increasing

Texas Population and Water Demand Projections*

- Population increase of 20 million+ (2020-2070)
- Human water needs will nearly double between 2020 and 2070
- Municipal demands show four-fold increase

*2017 State Water Plan (TWDB 2016)
Figure ES.7 - Share of recommended water management strategies by strategy type in 2070
Regional Water Planning Groups
Poll #2

Which state agency regulates surface water permitting?

A. Texas Parks and Wildlife Department
B. Texas Commission on Environmental Quality
C. General Land Office
D. Texas Water Development Board
Surface Water Rights Primer

- Permitting regulated by TCEQ
- Surface water rights issued in perpetuity
- Prior appropriation and riparian doctrine
- Since 1985, special conditions added for environmental flow protection
- No new permits can be granted for environmental flows; only amendments
- Several basins fully or over-appropriated
Appropriated Surface Water Volumes

Texas Water Rights Timeline

- Black: water rights with no environmental conditions
- Red: water rights with environmental conditions

Millions of acre-feet

1900 - 2000
Senate Bill 3
Voluntary Strategies

• Senate Bill 3 (SB 3) environmental flows process: 80th Texas Legislature in 2007 established environmental flows standards.

• SB 3 also calls for voluntary strategies to meet environmental flow standards, especially in fully appropriated basins: “a variety of market approaches, both public and private, for filling the gap must be explored and pursued.”
TX E-flow Standards Adopted
Groundwater 101

- Groundwater pumped under “rule of capture” – no connection to surface water rights permitting
- Groundwater Conservation Districts (GCDs) set up by legislature in some areas of the state – not all parts of all aquifers
- Some aquifers over-drafted severely (e.g., Ogalalla)
GCDs
TNC’s Texas Water Explorer


Explore our interactive maps or read about our key findings across the state and in your area.

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Launch Interactive Maps

About the Explorer
Read about the Texas Water Explorer project

Water Explorer Category Summaries
Read summaries of our six water indicator categories

Your Local Water
See Explorer highlights from your local river basin and aquifer

Texas Water Basics
Learn about Texas water agencies and terminology
Texas Water Explorer Indicators

**Water Quantity**
- Flow depletion
- Water use by sector
- Reservoir storage
- Trends in 7-day minimum flows
- Trends in magnitude of small floods
- Trends in aquifer level
- Trends in springflow or river baseflow
- Groundwater use/Management restrictions

**Water Quality**
- Water quality violations
- Vulnerability to ecol. impacts from land uses
- Gw: Trends in water quality parameters
- Gw: Exceedence of drinking water standards

**Ecosystem Health**
- Native biological communities
- Invasive species
- Priority conservation areas
- River fragmentation
- Paddling trails

**Governance**
- Environmental flow protection
- Endangered species
- Watershed management (for water quality)
- Groundwater Management (GCDs)

**Water Conservation**
- Urban water use efficiency
- Water efficiency in electricity generation
- Irrigation demand

**Economic Productivity**
- Value of Water in the Economy
TPWDs Environmental Flow Information Toolkit (EFIT)

1. Decision Support Tool (DST)
   Enables a user to identify areas to align with flow management strategies for the restoration and protection of environmental flows

2. EFIT Strategies
   Identify and implement voluntary strategies to secure water for the environment, suitable for Texas policy and public dialogue
GP EFIT Hydrology Dashboard

Selection Index

Step 1: Review the percent change in pre and post attainment frequency by selecting a flow metric and mapping USGS gages by hydrologic alteration.

Step 2: Choose the river basin and USGS gage station location of interest.

Step 3: Use the water rights criteria selection to help identify potential voluntary strategies.

Select Flow Regime Component
Avg Summer Base Flows

Select River Basin
None

Select USGS Gage
None

Select Water Right Use Type(s)
None

Filter Water Right by Date
Set Priority Date Range
12/30/1900

8/6/2016

Priority Date
3/9/1975

HUC08 Name
Running Water Draw

Total Permitted
1,248 ac-ft

Storage Amount
4,427 ac-ft

Period Reliability Range
8.0%

Use Type
Irrigation

Diversion Type
Diversion Point

Monthly Pattern of Use (acre-ft)

Total Number of Water Rights
599

Total Amount Permitted (acre-ft)
737,908.2

Legend

USGS Discharge Locations:

Degree of Hydrologic Alteration

> 10% = Increased Attainment

> 10% - 10% = Negligible Alteration

> 25% - 10% = Moderate Alteration

< 25% = High Alteration

Texas Border

Click on the icon to add layers to the map. Use the scrollbar on the right-hand side to see all data layers selected within the extent.
Select USGS gage
### Hydrology-Based Target Flows: Avg. Summer Base Flows

**Qp: 18,600 cfs with Average Frequency 1 per 5 years**  
Regressed Volume is 51,123 to 132,276 (82,233)  
Regressed Duration is 5 to 15 (8)

**Qp: 13,000 cfs with Average Frequency 1 per 2 years**  
Regressed Volume is 35,243 to 91,076 (56,655)  
Regressed Duration is 4 to 13 (7)

**Qp: 9,100 cfs with Average Frequency 1 per year**  
Regressed Volume is 24,333 to 62,814 (39,096)  
Regressed Duration is 4 to 12 (7)

| High Flow Pulses | Qp: 205 cfs with Average Frequency 1 per season  
Regressed Volume is 499 to 2,006 (1,000)  
Regressed Duration is 1 to 6 (3)  
| Qp: 1,620 cfs with Average Frequency 1 per season  
Regressed Volume is 3,906 to 10,575 (6,427)  
Regressed Duration is 2 to 7 (4)  
| Qp: 6,390 cfs with Average Frequency 1 per season  
Regressed Volume is 17,930 to 40,088 (26,810)  
Regressed Duration is 3 to 9 (5)  
| Qp: 2,440 cfs with Average Frequency 1 per season  
Regressed Volume is 6,167 to 17,376 (10,518)  
Regressed Duration is 3 to 9 (5) |

| Base Flows (cfs) | Dec 40 (33.4%)  
Jan 16 (56.9%)  
Feb 11 (75.9%)  
| Mar 5.2 (95.2%)  
Apr 2.4 (95.2%)  
May 2.5 (95.1%)  
Jun 34 (39.0%)  
Jul 24 (37.8%)  
Aug 12 (56.5%)  
Sep 11 (75.9%)  
| Oct 7.8 (73.0%)  
Nov 2.4 (95.2%)  
| Winter 40 (33.4%)  
Spring 16 (56.9%)  
| Summer 11 (75.9%)  
| Fall 5.2 (95.2%) |

| Subsistence Flows (cfs) | Dec 2.4 (95.2%)  
Jan 2.5 (95.1%)  
Feb 1.6 (95.3%)  
| Mar 5.2 (95.2%)  
Apr 2.4 (95.2%)  
May 2.5 (95.1%)  
Jun 34 (39.0%)  
Jul 24 (37.8%)  
Aug 12 (56.5%)  
Sep 11 (75.9%)  
| Oct 7.8 (73.0%)  
Nov 2.4 (95.2%)  
| Winter 2.4 (95.2%)  
Spring 2.5 (95.1%)  
| Summer 1.6 (95.3%)  
| Fall 2.4 (95.2%) |

Base Flow Levels:  
- High (75th %ile)  
- Medium (50th %ile)  
- Low (25th %ile)

Pulse volumes are in units of acre-feet and durations are in days.  
Period of record used: 1/1/1939 to 12/31/1962.  
Q5 calculation used for subsistence flows. Annual Q5 value is 2.4 cfs. Water Q user did not input basinfill; all episodic events are labeled as high flow pulses.

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**Canadian_Amarillo**

**Canadian Rv nr Amarillo, TX**
Percent Change in Attainment Frequency

- **Summer**: -23.2%
- **Fall**: -15.7%
- **Winter**: 26.9%
- **Spring**: 16.5%

**Legend**:
- Increased Attainment
- Negligible Alteration
- Moderate Alteration

**Color Codes**:
- Green: Base Flow Alteration
- White: Subsistence Flow Alteration
Plains Minnow *Hybognathus pluchius* (image © Joseph R. Tomelleri)

**Status:** SGCN (proposed)

**Threats in Upper Brazos River, Upper Red Rivers, and Upper Canadian Native Fish Conservation Areas:** loss of natural flow regime; reduced stream flow; habitat fragmentation; habitat loss

**Description:** Mid-dorsal stripe broad and solid; first obvious dorsal fin ray a thin splint, closely attached to the following well developed but unbranched ray; distance from origin of anal fin to end of caudal peduncle contained two and one-half to four times in distance from tip of snout to origin of anal fin (Hubbs et al. 2008).

**Range:** Central Texas from the Colorado and Brazos basins to the Red River and northward to North Dakota and Montana (Hubbs et al. 2008).

**Habitat:** Commonly in turbid rivers having exposed, shallow, sand-filled channels (Cross et al. 1995) where sediments accumulate in shallow backwaters, gentle eddies, and along the deeper edges of sand “waves” that are formed on shifting substrates by actions of the current (Cross and Collins 1995).

**Biology:** Herbivore, primarily feeding on algae and other organic bottom material (Pflieger 1976; Goldstein and Simon 1999). Flood-pulse, broadcast spawner (Miller and Robison 2004; Lehtinen and Leyzer 1986; Cross and Collins 1995).

**Flow-Ecology Relationships and Flow Targets**

**Literature Review**


**Flow-Ecology Modeling**

**Influence Plots From Random Forest Models:**

- Canadian
- Red
- Brazos

**Partial Dependence Plots:**

- Canadian
- Red
- Brazos
Poll #3

Kevin’s favorite fish?

A. Bluefin Tuna
B. Bigmouth Buffalo
C. Blue Sucker
D. Flathead Catfish aka Yellow Cat
Blue Sucker *Cycleptus elongatus*
Native Fish Conservation Areas

Conservation Goals

1. Facilitate conservation partnership networks
2. Protect and maintain intact habitats
3. Restore altered habitats
4. Restore instream and floodplain connectivity
5. Mitigate effects of invasive species
6. Establish conservation demonstration areas
7. Conduct research to fill critical science needs
8. Monitor conservation outcomes and perform adaptive management
Native Fish Conservation Areas

Desired Outcomes

• Wild, naturally-produced, self-sustaining populations
• Functional watersheds
  ✓ Natural land cover
  ✓ Intact riparian buffers
  ✓ Natural river flow patterns
  ✓ Instream connectivity
• Local stewardship
• Sustained conservation investments
Occurrence Maps

Maps of Native Ranges

Trend Analyses

Species Distribution Models

Notropis potteri Chub Shiner

Herichthys cyanoguttatus Rio Grande Cichlid

Micropterus treculi Guadalupe Bass
Freshwater Mussels

Texas Fatmucket *Lampsilis bracteata*
Life cycle of a typical freshwater mussel.

1. Breeding
Males release sperm into the water. After being inhaled by females, sperm fertilizes eggs.

2. Spawning
Embryos develop into larvae called glochidia, which are released into the water and must encounter and attach to a host fish.

3. Transport
Glochidia lucky enough to find a suitable host will form a cyst and remain on a host for several weeks.

4. Settlement
Juvenile mussels release from the host fish and sink to the bottom. They burrow in the sediment and remain buried until they mature.
Mussels of Texas

WHY ARE MUSSELS IMPORTANT

Unionid freshwater mussels (hereafter mussels) are a fascinating group of aquatic animals that evolved from marine mollusks over 400 million years ago. Mussels are conspicuous, often difficult to find, due to their cryptic external morphology. Despite their lackluster appearance, these fascinating animals play a vital role in freshwater ecosystems by influencing nutrient cycling, providing and enhancing physical habitat, and as forage for animals such as fish and birds, to include humans.

Mussels possess a unique reproductive life history in which they require a fish to host their parasitic larvae (i.e., glochidia) to reproduce and for dispersal. Adult mussels don't move very much on their own and so their host-fish is the only means by which they can move long distances, particularly upstream. The nature of the mussel-host fish relationship can be very specific (i.e., a single host fish species for a mussel species) or general (multiple host fish species for a mussel species). Finally, mussels can be long-lived up to 100 years or more, although it's likely for species in Texas that longevity is less than this.

Of the approximately 297 mussel species known to occur in North America, nearly three-quarters are considered imperiled and at least 35 have already gone extinct making them one of the most imperiled organisms in North America. In Texas, similar declines have occurred such that of the 52 species known to reside within the state 15 are considered Imperiled.

WHY MUSSELS OF TEXAS (MOT)

So why Mussels of Texas? The reason is that accurate identification of freshwater mussels or any other species for that matter, and understanding their distribution is essential for not only enjoying them in nature but also for aiding in their conservation and management. For mussels, accurate identification is challenging due to similarities in shell morphology between species. Similarly, information on the distribution of mussels in Texas has been largely unavailable or based on small datasets that have not accurately portrayed the true distribution of a given species.

To that end, MOT includes species descriptions, photographs, range maps, and an interactive database of all the mussel species in Texas to assist the general public, resource managers, and scientists/conservationists, with appreciating, managing, and protecting this fascinating and important resource.

Get Started

View the Getting Started page to learn more about the Mussels of Texas website and how to use its tools.
**Plectomerus dombeyanus**

**Type locality**
Peru, type specimen existing and reported type locality is enimersus. Syntype from Lake St. Joseph, Mississippi and Bogueo from Lake Charles, Louisiana.

**Identification**
(Williams et al. 1998; Parmalee and Bogun 1998; Williams et al. 2000; Williams et al. 2014)

**Shape and size:** Black, moderately inflated, smaller individuals can be grouped; outline rectangular to trapezoidal, posterior ridge is high, sharp, and erect at the base of the shell; in a point posterior shive step, flat to slightly concave and often surrounded with pleats or ridges, which may be obscure or absent in smaller individuals.

**Shell color:** Greenish brown, brown, or black; shell but may be gray in smaller individuals.

**Habitat:** Pleurotomaria, corals, and coralline algae for 75% of shell; water column may show currents, ladies to moderate wave, rock walls, rock crevices may be less prominent on larger individuals.

**Behavior:** Low- to medium-temperature habitats, normally found in shallow, clear water.

**Reproductive behavior:** Terrestrial, terrestrial eggs, development in soil, or mud, hatching in the water, usually with a thin anterior venter and occasionally with a posterior venter. Larvae are free swimming, then sought in slightly shaded, 2- to 12-foot water, 8-14-foot water.

**Habitat:** Short to medium-long, riverine habitats.

**Distribution:** Usually purple or pink, can be white in small individuals, occasionally with brassy brownish or red highlights, distinct posteriorly.

**Other notes:** Sexually dimorphic, self-cleansing, creamy white to tan.

**General range:** East Texas to western Arkansas and north to southeastern Missouri and southern western Kentucky; P. Parmalee and Bogun 1998, Williams et al. 2000.

**Range in Texas:** Sabine River drainage to the Sabine River and north to the Red River drainage.

**Habitat:** Restricted to medium to large rivers, lakes, and reservoirs. In remaining habitat, it can occur in open habitats, such as along the shores or in backwater points or ridges. It is found in moderate currents in mud or sand and among rocks and boulders. In freshwater habitats, it may occur in moderate to well-oxygenated sand, gravel, or cobble substrates. Most often occurs in stable habitats where environmental impacts are not present, and potential for enhanced mobility is low (Parmalee and Bogun 1998; Williams et al. 2004; Williams et al. 2014; Kuehl and Gagliano 2011; Kietlak et al. 2019).

**Hosts:** Unknown. However, Williams et al. 2004 described eggs from wild-caught individuals from Cyprinids sp., Redfish (Cyprinidae) and Rockfish (Serranidae); Blackstripe Tuskfish (Gnathostoma) but transformation was not observed.

**Reproduction:** External fertilization, eggs are adhesive, and glaciolacustris held across the entire body, but there may be variability where glacial lobes are broadened, marsupium becomes pedunculated when gravid (Williams et al. 2009). Developing embryos are brooded from May to September (Kietlak 1994; Kietlak et al. 2000). Outside of Texas, females have been reported in St. Louis, Missouri (Haggard 1988). In Texas, eggs were found in females from mid-July through September, but mature glacial lobes were observed only in mid-July (Kietlak 1990; Gagliano et al. 2003). Glacial lobes are subterminal in shape, without styliodont hooks, 222-231 mm in length and 236-246 mm in height (Haggard 1998; Gagliano et al. 2003). Williams et al. (2011) reported maximum lifespan of 33 years, maturity at year 5, and mean fecundity of 55,000. No efforts have been made to confirm longevity, age of maturity, or fecundity for Texas populations.

**Remarks:** None.

**Similar species:** Plectomerus dombeyanus may be confused with A. ampla, but is more rectangular to trapezoidal in shape and has a well-developed posterior ridge and purple race. Marginal zone in minor outside, a poorly developed posterior ridge and its hue is white. Amblypelta atlantis is suboval to quadrangular, has a posterior ridge that is rounded and often obscure and its hue is white to brownish, occasionally with pink or purple tint.

**Legal listing status:** Threatened, Unique. USFWS: None.

**Photo caption:** Plectomerus dombeyanus – Sabine River (Sabine River drainage) length 80 mm.
Poll #4

How many species of freshwater mussels are native to Texas, over or under 50?

A. Over 50 species
B. Under 50 species

* 15 mussels listed as state threatened; one listed as federally endangered
Environmental Flow Resources

Texas

Instream Flows in Texas (TPWD)

Texas Instream Flow Program
Includes links to following documents and final reports of basin-specific instream flow studies (Lower San Antonio River and Middle and Lower Brazos River)
  - Texas Instream Flow Studies: Technical Overview

Freshwater Inflows to Texas Bays and Estuaries (TPWD)

Environmental Flow Information Toolkit (TPWD)

Surface Water Rights and Availability (TCEQ)
  - Environmental Flow Standards
  - TCEQ Water Rights Viewer

Water Data for Texas (TWDB)

Groundwater Management in Texas (TWDB)

Water Resources Planning (TWDB)

Texas Water Explorer

Fishes of Texas

Mussels of Texas

Washington
What can you do?

• Get involved in water issues!
  • Conservation
  • Permitting
  • Water Planning
• Participate!
  • Locally, regionally, statewide, nationally, globally…
Contact Information

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Acknowledgements
See you on the river...