

# From Drought to Flood: Benefits and Challenges to Aquatic Life in Texas

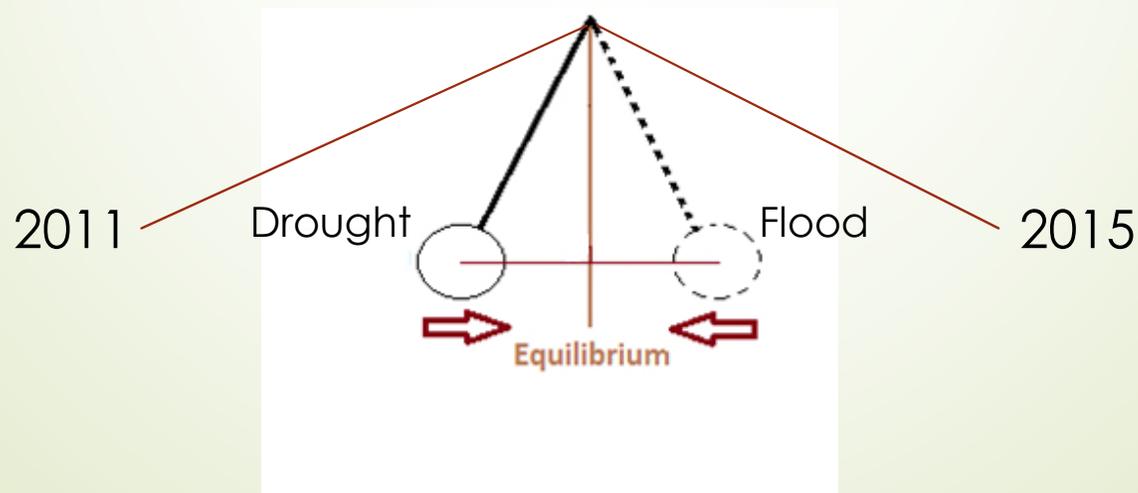
Anne Rogers  
Water Quality Program  
Texas Parks and Wildlife Department

National Monitoring Conference  
Tampa, FL  
May 4, 2016

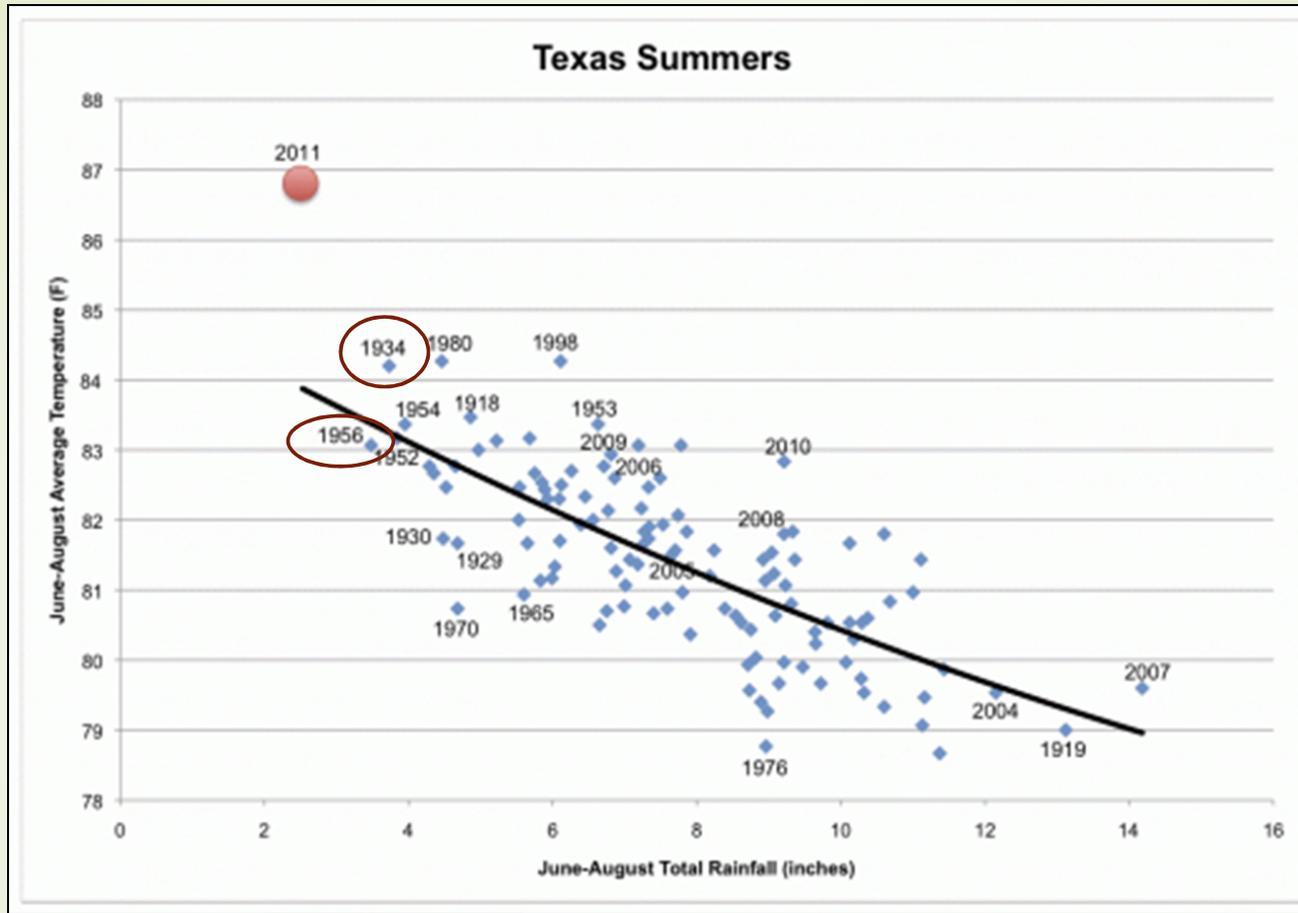
# Climatic Cycles in Texas

Extreme weather events are nothing new to Texas. Cycles of drought and flood have been the norm for decades if not centuries, however, recent droughts which peaked in 2011 and extreme floods culminating in 300-year events in 2015 seem to indicate the cycles are becoming more extreme.

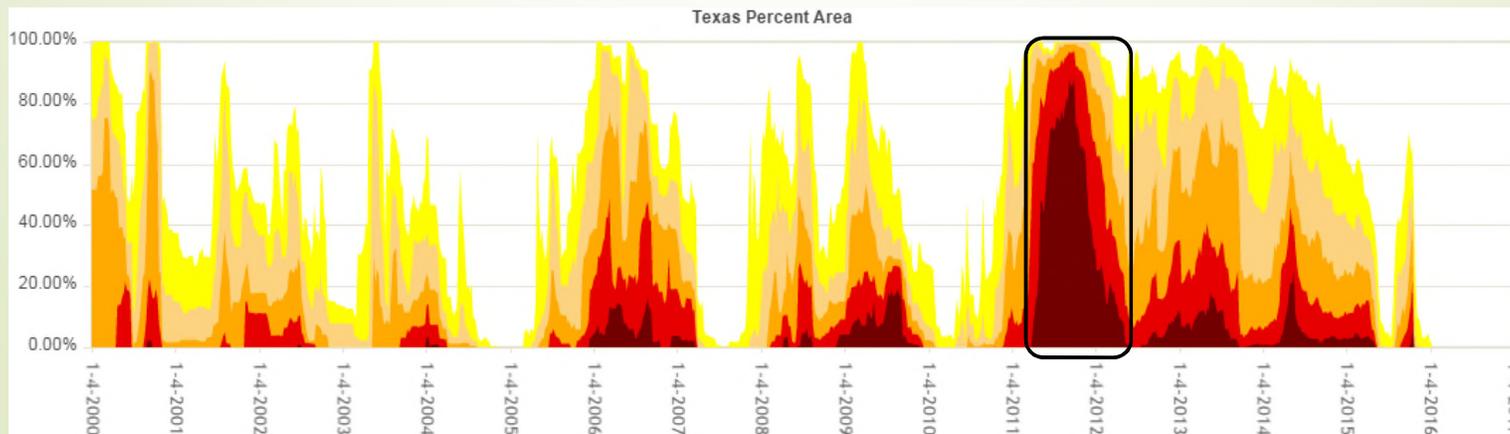
It is anticipated these extreme weather events will occur more often as global climate continues to change. A comparison of climatic events highlight the contrasts of the extremes with which aquatic life must contend.



# From Extreme Drought

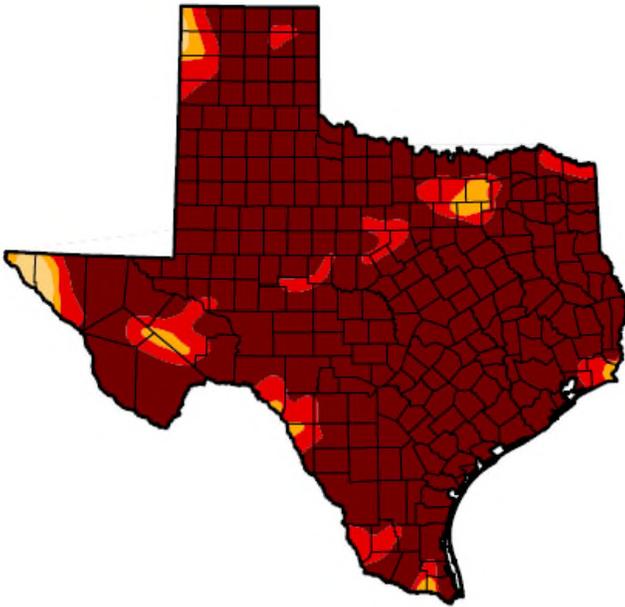


Source: US Drought Monitor



# U.S. Drought Monitor Texas

**October 4, 2011**  
(Released Thursday, Oct. 6, 2011)  
Valid 7 a.m. EST



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	99.16	96.99	87.99
Last Week 9/27/2011	0.00	100.00	100.00	99.16	96.65	85.75
3 Months Ago 7/6/2011	2.41	97.59	95.73	94.39	90.21	71.30
Start of Calendar Year 1/4/2011	13.55	86.45	66.68	36.30	13.04	0.00
Start of Water Year 9/27/2011	0.00	100.00	100.00	99.16	96.65	85.75
One Year Ago 10/6/2010	75.60	24.40	2.43	1.01	0.02	0.00

**Intensity:**

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

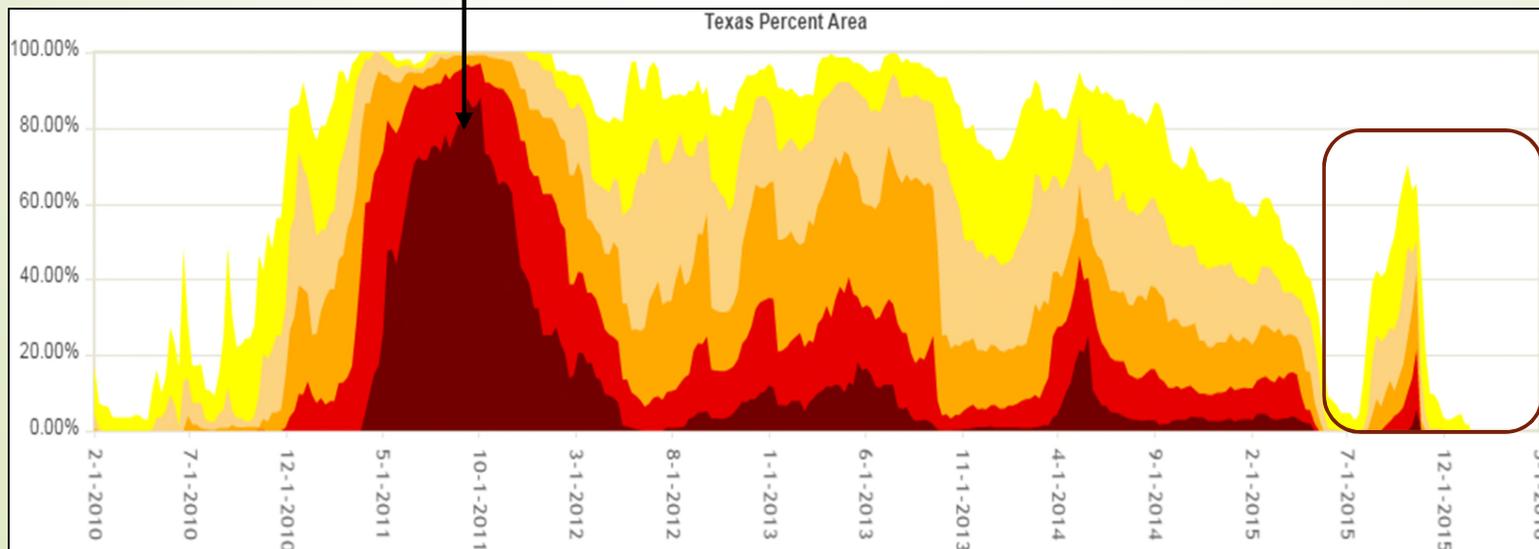
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

**Author:**  
Richard Tinker  
CPC/NOAA/NWS/NCEP

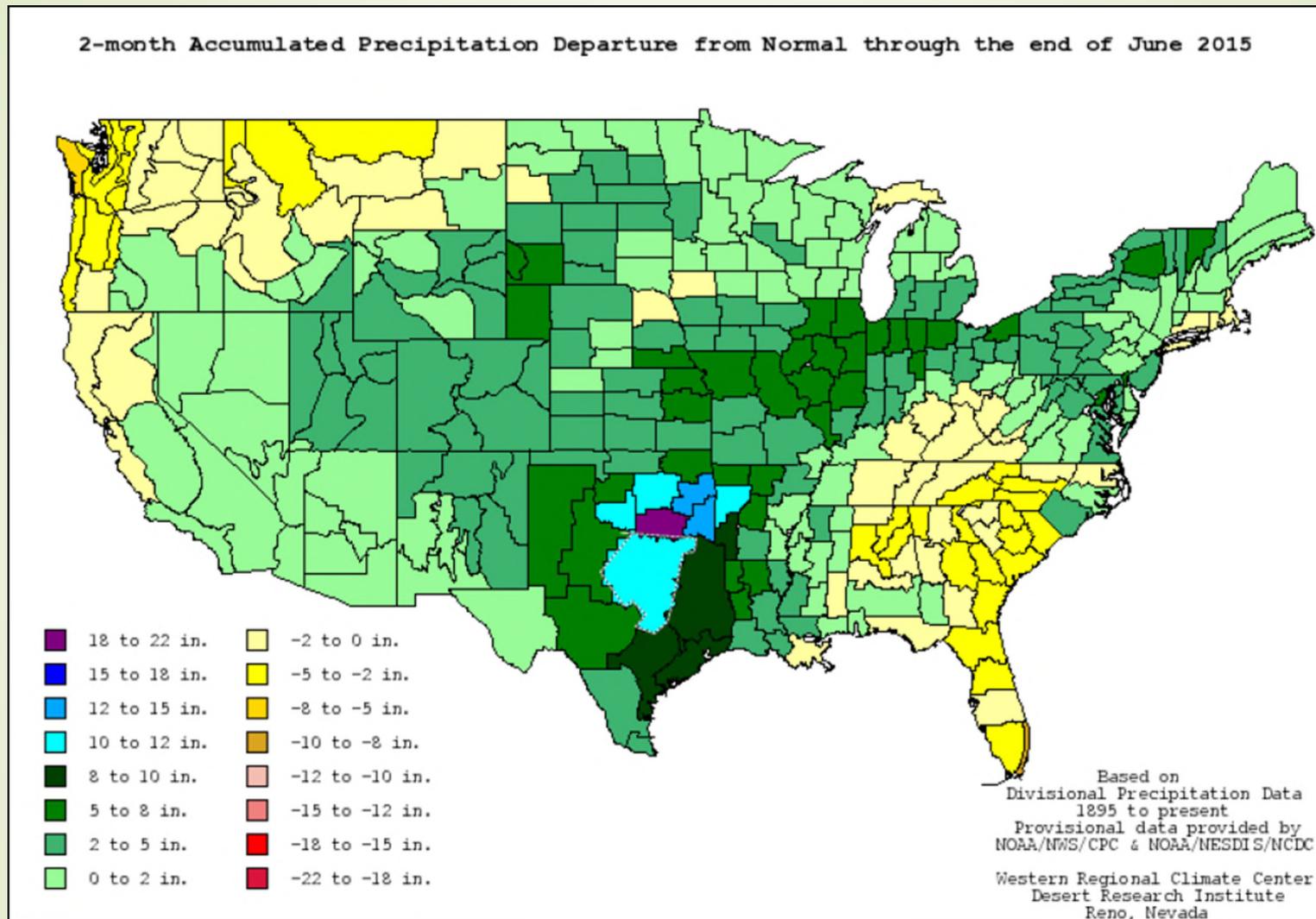


<http://droughtmonitor.unl.edu/>

Drought of this magnitude has not been seen in decades



# Extreme Flood



Departures from normal May-June 2015 from extremely heavy rains which resulted in massive flooding in north and central Texas.

Roadways in 167 of the state's 254 counties suffered some level of storm damage.



Austin flooding May, 2015



A swollen Trinity River southwest of downtown Dallas, May 29, 2015



Highway 288 corridor south of Houston transformed to a river channel, May 26, 2015

# Rainfall events are becoming more extreme



2010  
12" of rain over a 4 day period

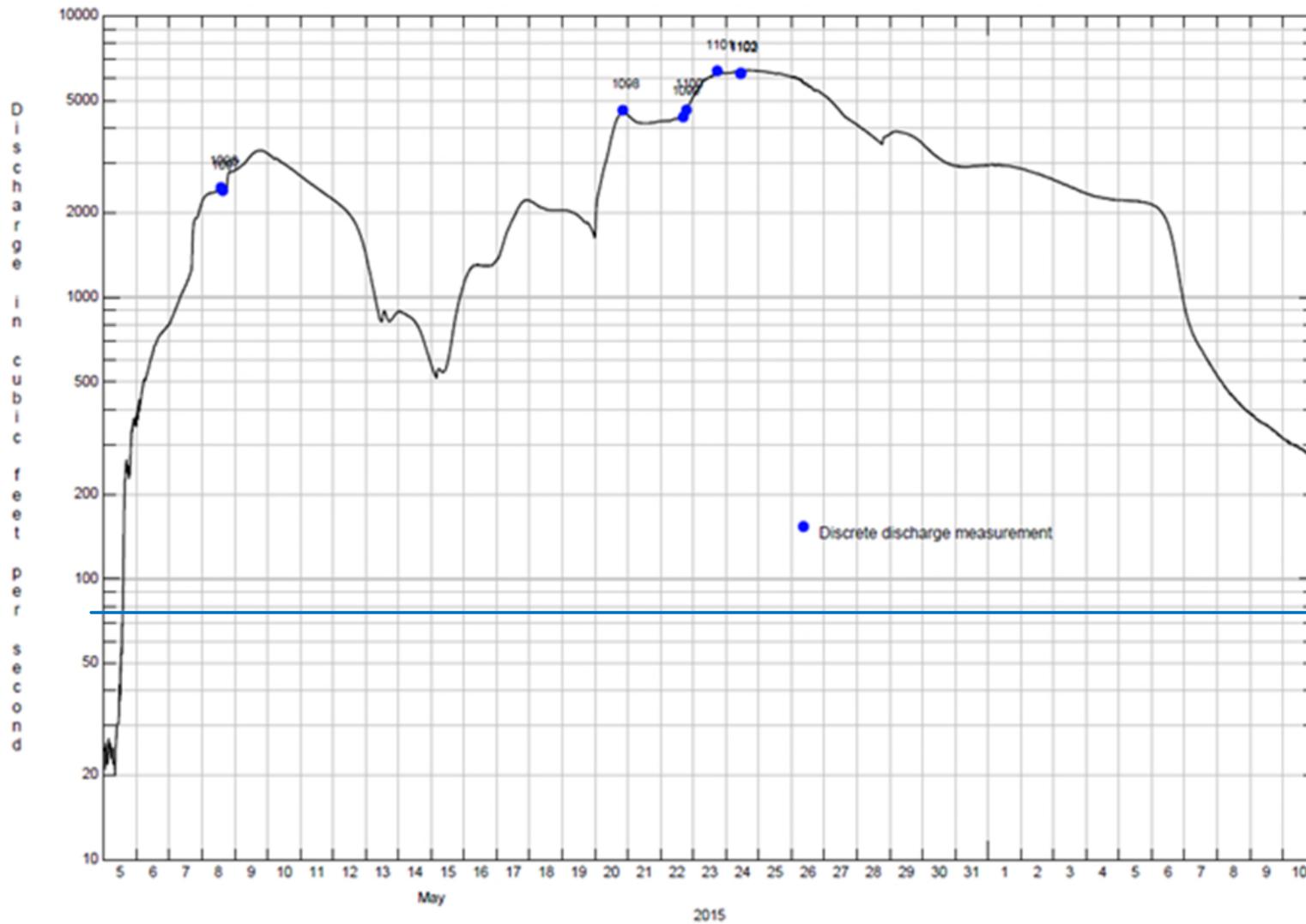


June, 2014  
11.6" of rain in less than 8 hours



Eagle Nest Canyon – tributary of the Rio Grande

# Wichita River at Wichita Falls, TX

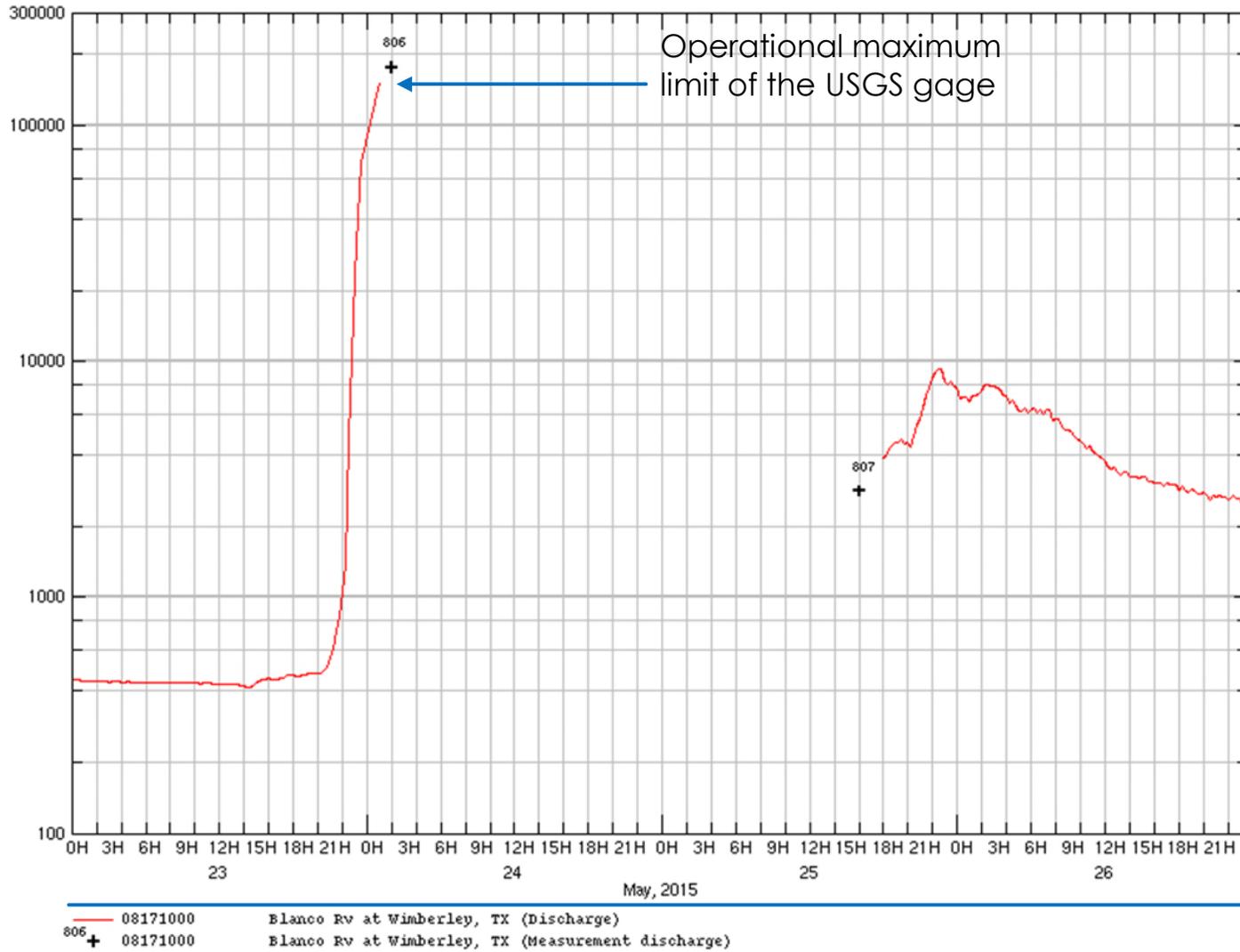


78 year median discharge = 74 cfs

May – June 2015



# Blanco River at Wimberley, TX



89 year median discharge = 82 cfs

Stage increased over 40 ft in 4 hours

Discharge increased from 300 cfs to 175,000 cfs in approximately 4 hours

# Reservoirs Have Been Impacted by Drought and Flood Events

2007 produced significant flooding across Texas



Lake Somerville, TX



2011 was peak of multi-year severe drought

# Effects to Freshwater Systems

# Drought Effects to Aquatic Life

## Benefits

- ▶ Drawdown allows for desiccation of invasive aquatic macrophytes and mussels along shoreline
- ▶ Allows for new terrestrial growth of trees and other woody vegetation out into water body
- ▶ In lakes, this results in “new reservoir effect” which greatly enhances littoral structure and renewed nutrient dynamics when lake refills much as it did when first built

## Challenges

- ▶ Results in exposure and loss of native vegetation and mussels
- ▶ Dissolved oxygen drops killing aquatic life
- ▶ As water body reduces to isolated pools, aquatic life is concentrated in remaining refugia leading to increased predation further reducing populations
- ▶ As drought period extends, recruitment of new populations can take time

# 2011 drought was most extreme in Texas history

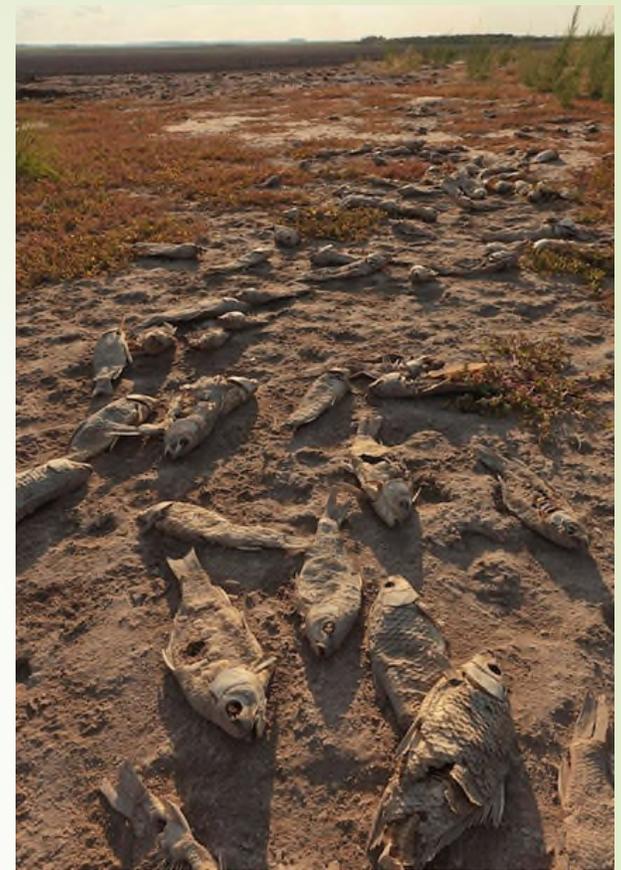


Pedernales River at Hwy 71 crossing, August 29, 2011

- Was prolonged over many years
- Note extensive terrestrial vegetation in former major river channel

Perennial systems now regularly experience drought where streams and lakes completely dry up resulting in:

- ▶ Decrease in survival, growth, and abundance of fish and insect populations
- ▶ Shifts in community composition toward more tolerant and invasive species
- ▶ Individual condition is negatively impacted making survival, even if flow returns, less likely



Drought exposes the bad, but...

Invasive hydrilla

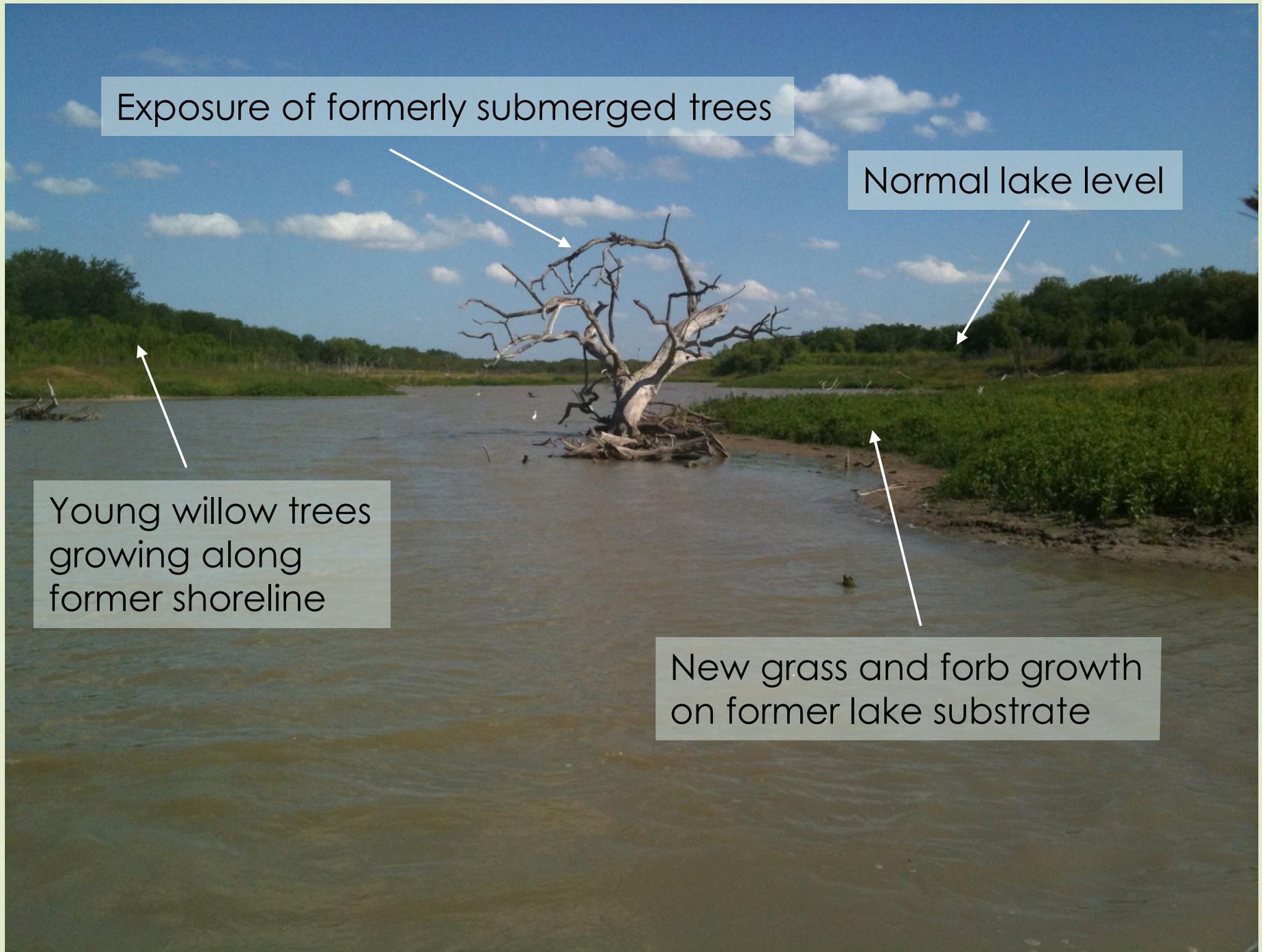


It also exposes the good!

Native American lotus



# Beginnings of “new reservoir effect”



Exposure of formerly submerged trees

Normal lake level

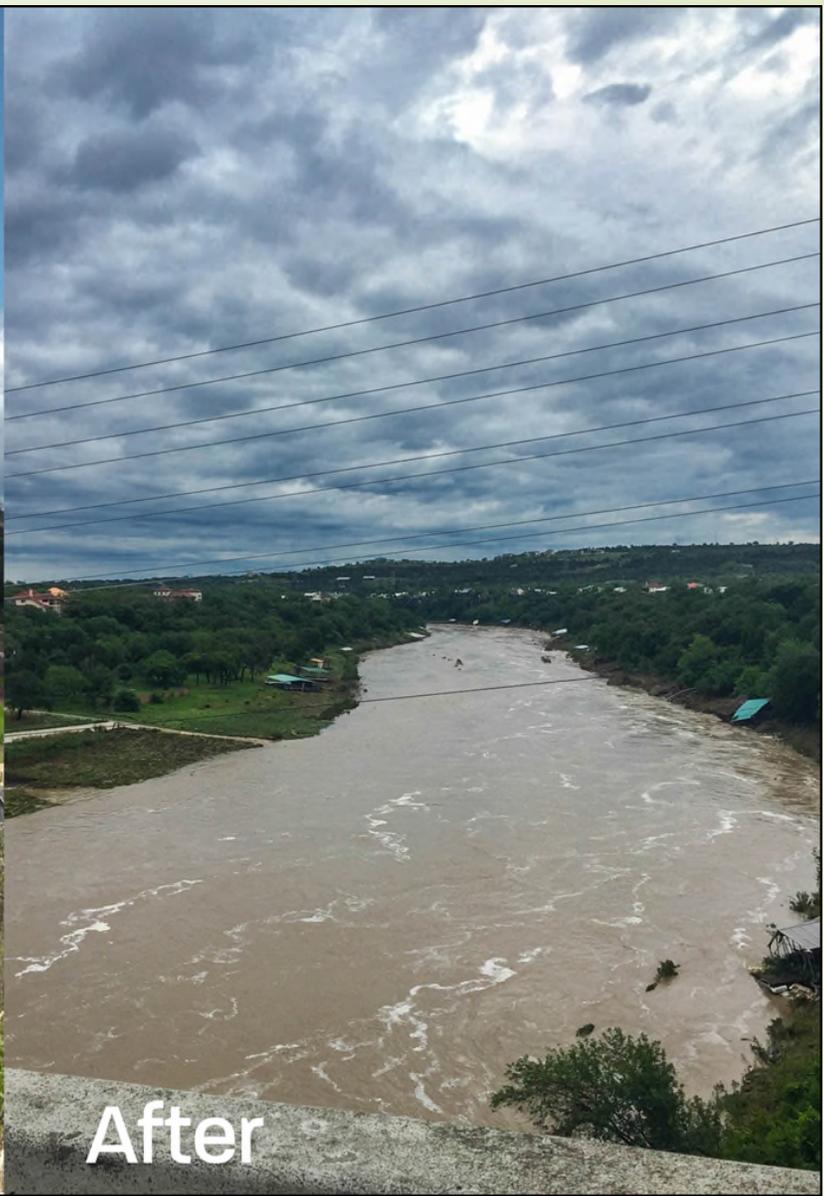
Young willow trees  
growing along  
former shoreline

New grass and forb growth  
on former lake substrate

# Clear Creek at FM 455



- When creek beds are dry for extended periods of time, the last remaining pools for refugia are lost
- This stream did not slowly recover, but rather was flooded within a few days
- Recruitment in such conditions is difficult and may take a significant toll on the ability for the aquatic community to rebound



Pedernales River at Highway 71 in 2014 during the drought and after the 2015 Memorial Day flood. (photos by Brooke LeMond and Jonathan Berry, DMTX)

# Flood Effects to Aquatic Life

## Benefits

- Reconnects water body with its floodplain depositing nutrient rich sediment which benefits riparian re-vegetation
- Enables the transfer of organic material and nutrients to system
- Stimulates spawning cues for several species of fish
- Performs important channel shaping functions: removing built up impediments to flow, creating oxbows, etc.
- Stimulates “New Reservoir Effect” essentially feeding the lake and increasing productivity for fishery

## Challenges

- Scoured channel results in loss of instream structure and cover
- Displaces native communities downstream
- Spreads invasive species downstream
- Frequent large floods can impact a weakened riparian zone by scouring remaining seedbank



Mountain Creek @ Hwy 287 near Dallas  
Small second order stream



## Extreme high flows events result in:

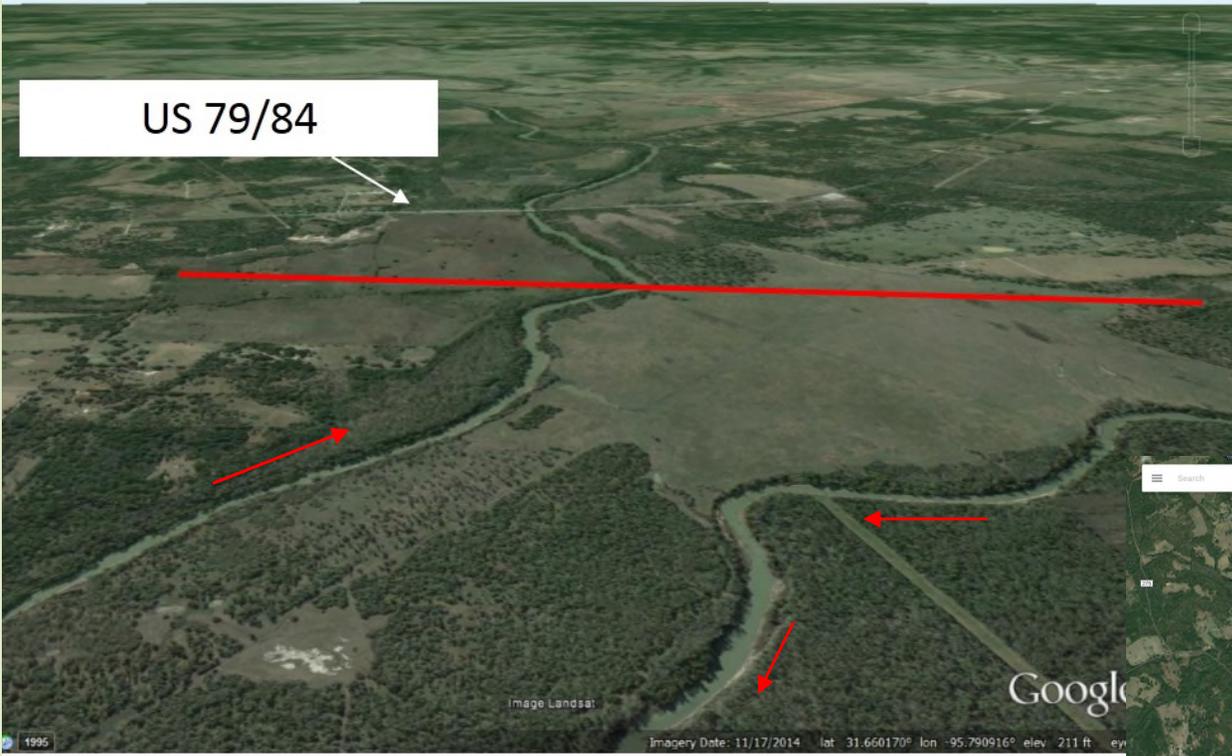
- Removal of significant portion of riparian community
- Reshaped channel and banks
- Sediment and nutrient deposition onto floodplain
- Displacement of fish communities downstream
- Significantly impacts benthic communities

# Significant Channel Alteration and Riparian Vegetation Removal After 2014 Eagle Nest Canyon Flood

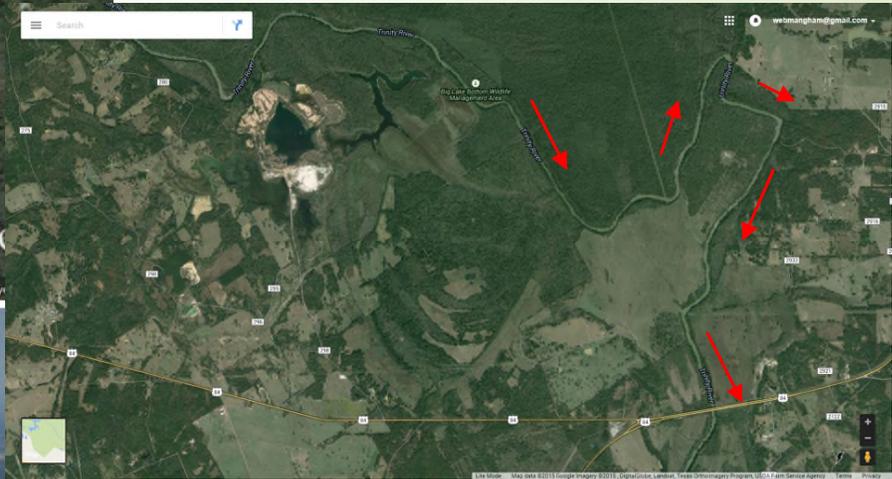


# Extensive Sediment Deposition Benefits Floodplain and Riparian Plant Communities





Extreme floods can reverse direction of flow in river channels



Trinity River at US 79 approx. 100 miles SE of Dallas, 6/4/15

Drainage = 12,833 mi<sup>2</sup>

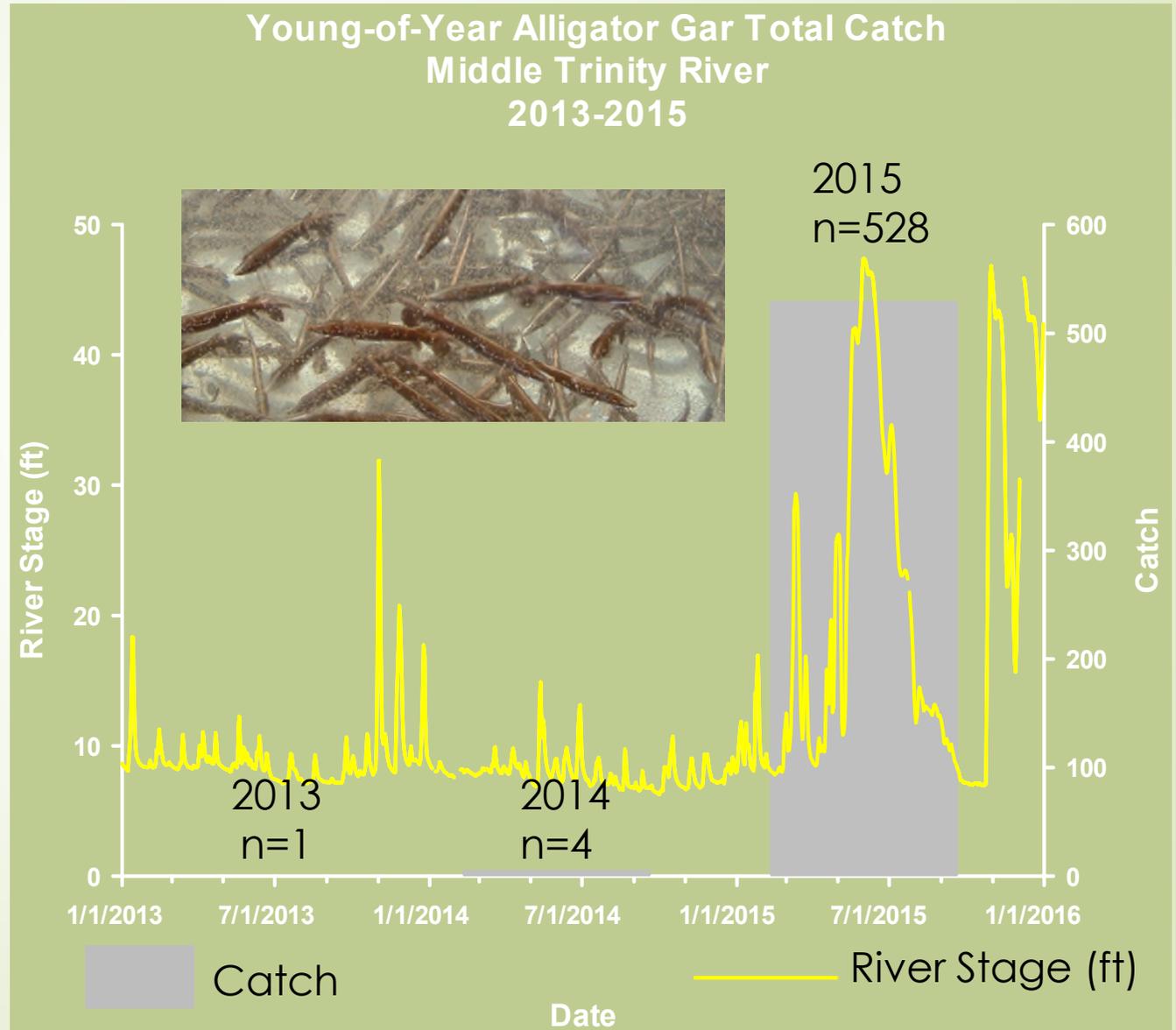


➤ In many large rivers, connectivity to floodplains is crucial for spawning cues for species such as the alligator gar

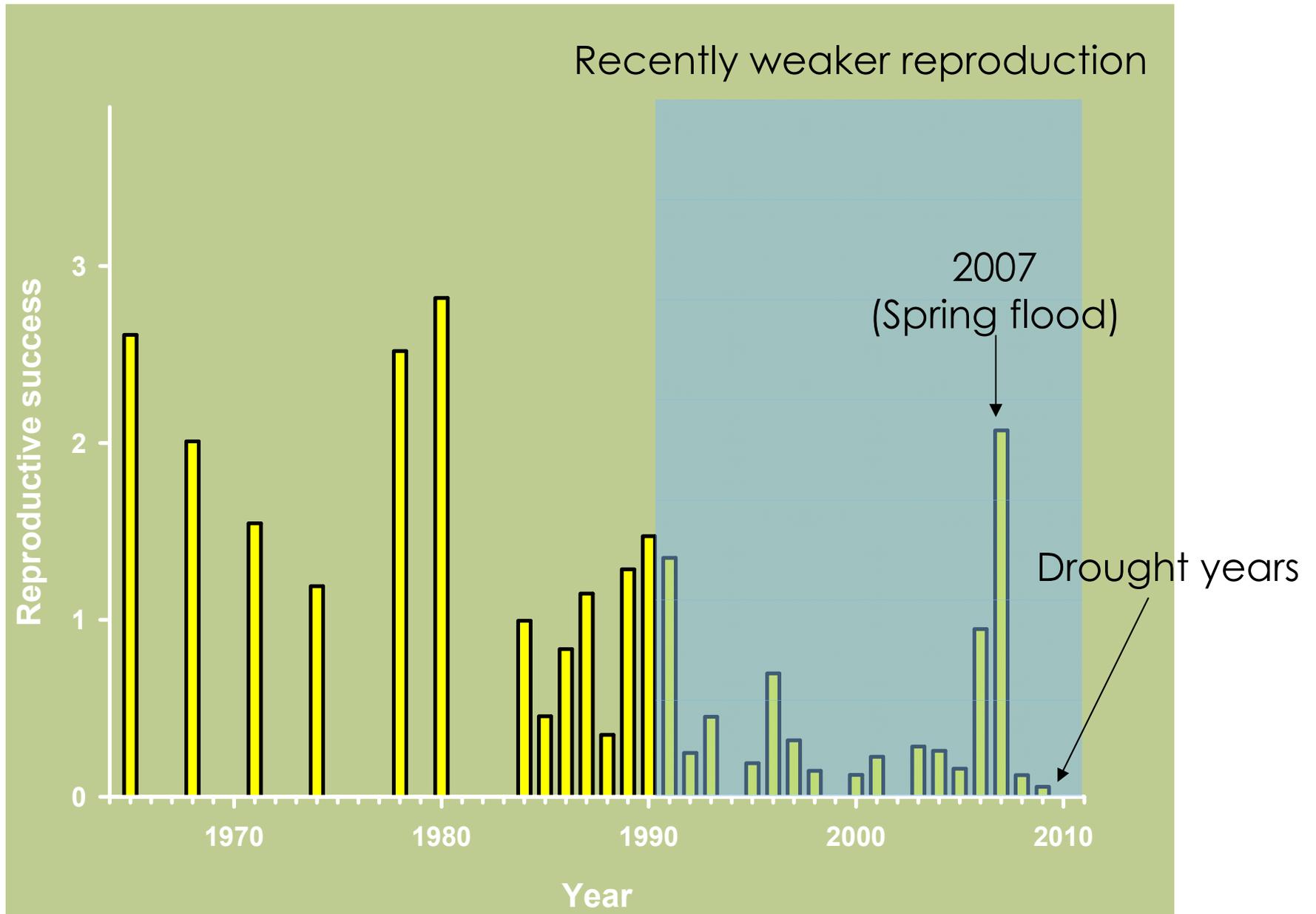
➤ Extreme floods in such large systems increases reproduction rates

➤ 2015 flood significantly increased number of total young caught

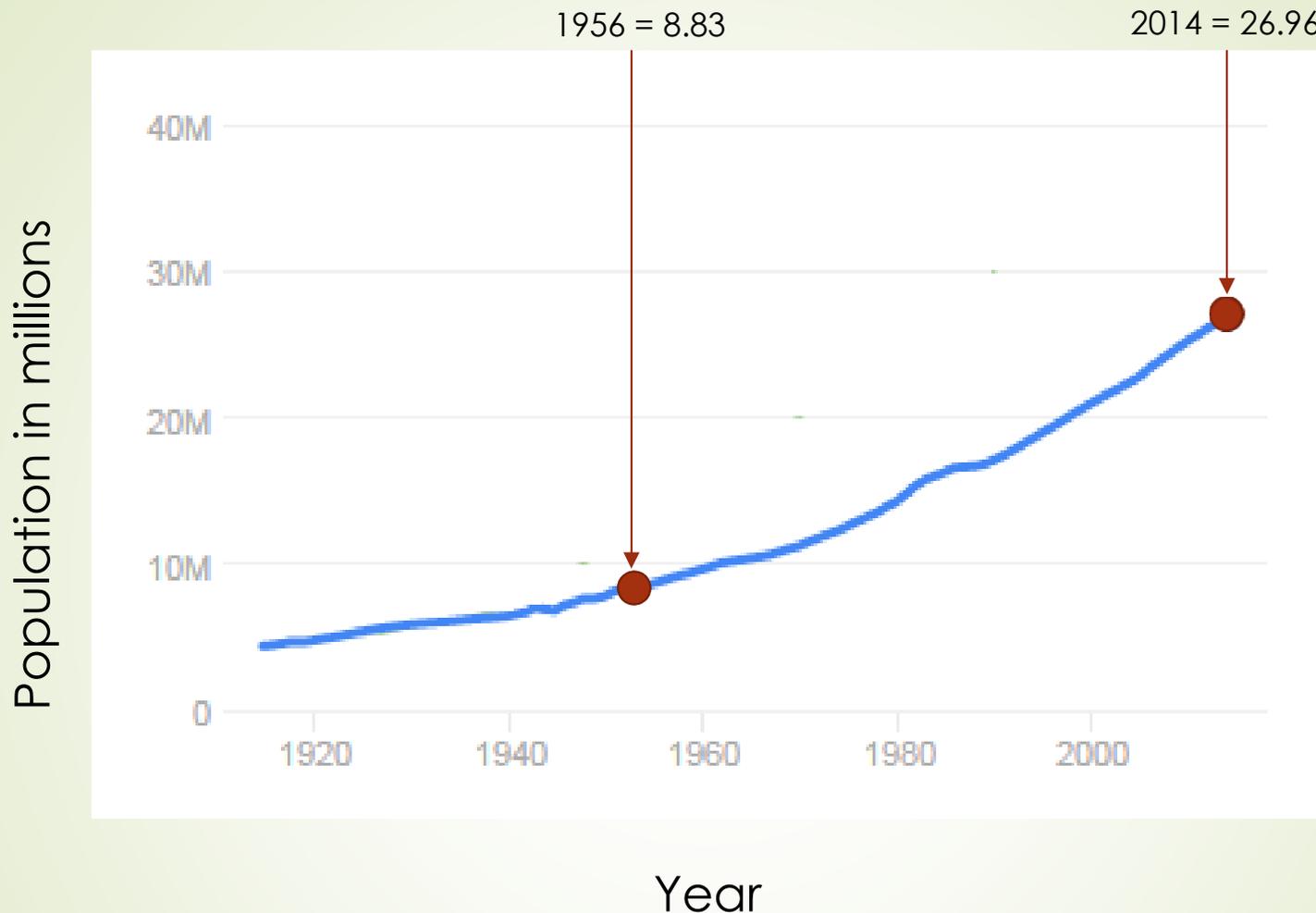
# Floods Trigger Spawning Cues



# Reproductive success of alligator gar in Trinity River over time



# Population Growth in Texas



- 1956 was the peak of the worst historical drought of record in Texas
- Three fold increase in population since 1956. Could there be a corresponding three fold increase in effects from extreme events?
- Effects of extreme climatic events will likely be compounded with population growth

# Implications for Continued Extreme Climatic Events



The extremes in climatic events that Texas has experienced in the last decade contribute pressures to aquatic systems in addition to the threats they already face from human activities such as increased development, de-watering, and habitat alteration.

While aquatic communities in Texas have become adapted to the normal flashiness that exists in the arid west, these new extremes may push the limits of species adaptability.



# Acknowledgements

- Leslie Hartman, Texas Parks & Wildlife Division - Coastal Fisheries Division
- Dan Daugherty, Texas Parks & Wildlife Division – Inland Fisheries Division
- Bill Harrison, Texas Commission on Environmental Quality, Surface Water Quality Monitoring Program
- Kelly McKnight, Trinity River Authority

## Questions?

Contact: Anne Rogers, Water Quality Program, Texas Parks & Wildlife Department, (512) 389-8687  
[anne.rogers@tpwd.texas.gov](mailto:anne.rogers@tpwd.texas.gov)

# Effects to Estuarine Systems

# Alligator on Bryan Beach near Houston , 7/21/15

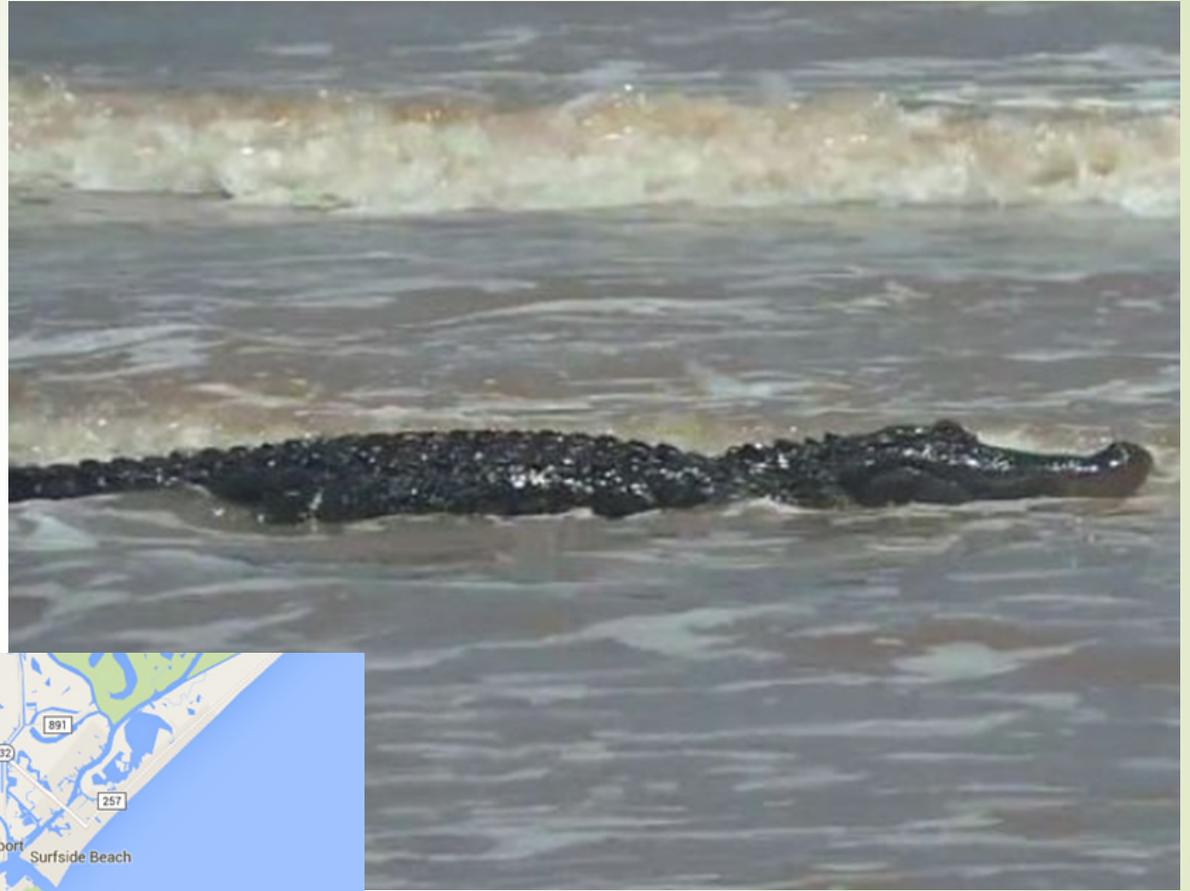
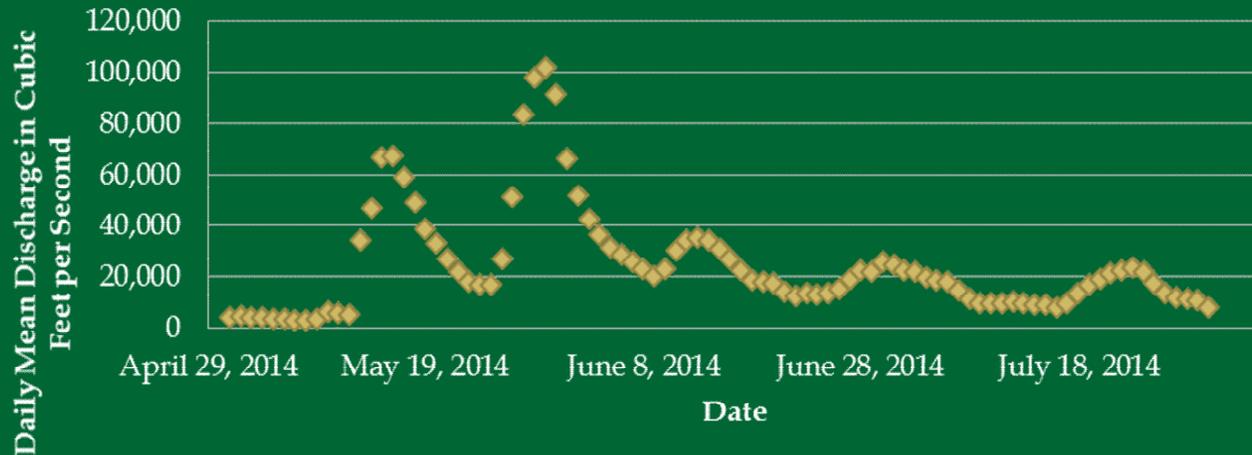


Photo: Ray McGee



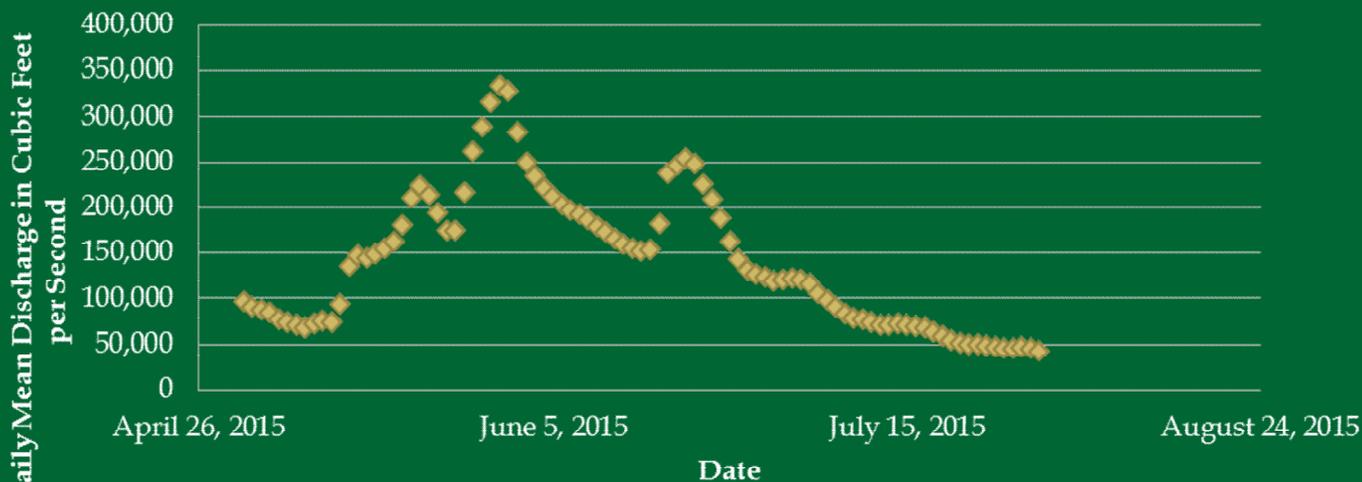
# Total Discharge to Gulf of Mexico from May–July 2015 Flood compared to May–July, 2014

## May 1 - July 31, 2014

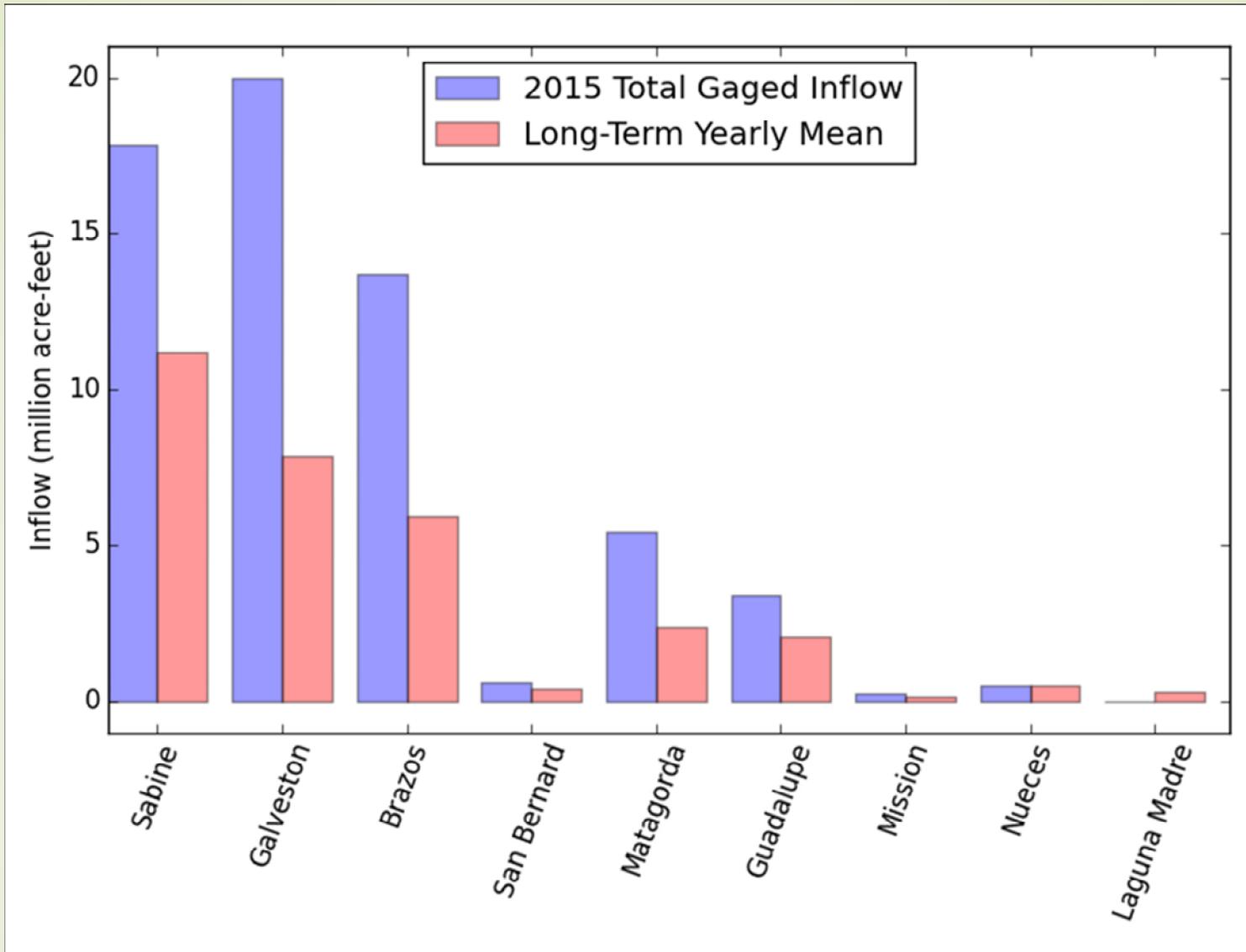


4.5 million acre-ft

## May 1 - July 31, 2015



25.6 million acre-ft

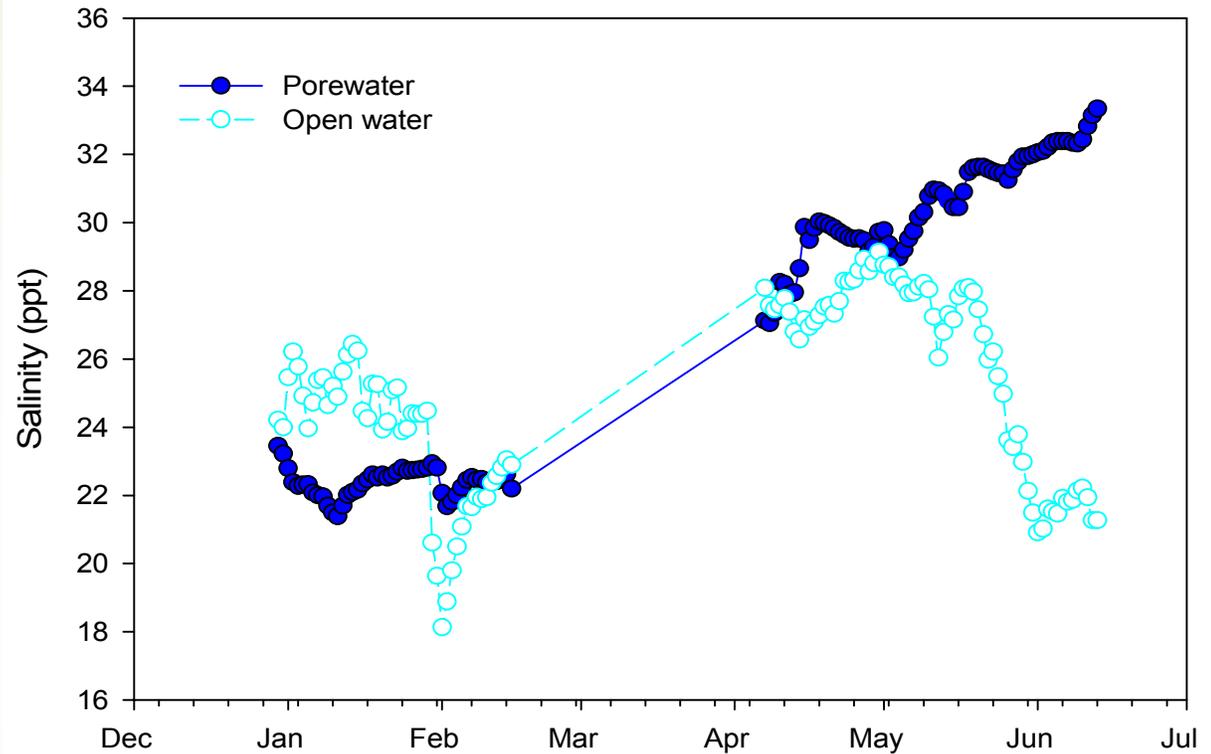


Inflow comparisons show the upper coast of Texas had inflows that more than doubled historic mean inflows.



Visible Red Tide near the Perry R. Bass Marine Fisheries Research Center in Palacios, October 28, 2011 (photo courtesy Winston Denton, TPWD)

# Porewater and open water salinities in Tres Palacios Bay



Porewater in marsh along Tres Palacios Bay and open water salinity (ppt) during 2010 and 2011 showing the long-term effects of the drought on marsh health. While open water salinities began to decline in May, marsh salinities continued to increase to differences greater than 13ppt. Plant composition and abundance remained affected