RESEARCH RELATED TO THE BRAZOS RIVER AND ASSOCIATED BAY AND ESTUARY SYSTEM

JANUARY 29, 2015

BRAZOS BBASC

BIO-WEST

BAYLOR UNIVERSITY ENVIRONMENTAL SCIENCE

THE TEXAS A&M UNIVERSITY SYSTEM 1876

TEXAS STATE UNIVERSITY SAN MARCOS Department of Biology

Environmental Institute of Houston University of Houston Clear Lake

OVERVIEW

- Funded - Texas Water Development Board
- Project Team:
  - Baylor University
  - Texas State University
  - Texas A&M University
  - University of Houston – Clear Lake
  - BIO-WEST, Inc.
- Coordination with Guadalupe – San Antonio Project

OVERVIEW

- Project goals are:
  - to enhance the understanding of flow-ecology relationships in the Brazos River basin
  - to better describe baseline ecological conditions in the Brazos estuary
  - to develop a methodology for testing established flow standards
- A key focus is how pulse flows affects biology in the rivers and estuary

OVERVIEW

- **Project development Science Workshops**
  - July and October 2014
  - Hypothesis development and Indicator selection
  - Site selection and methodologies
- **Preliminary field work and observations**
  - July through September 2014
- **Environmental Flows Validation Project Study Methodologies Interim Report**
  - submitted to TWDB in November 2014

ENVIRONMENTAL FLOWS VALIDATION PROJECT STUDY METHODOLOGIES INTERIM REPORT

November, 2014

ECOLOGICAL COMPONENTS

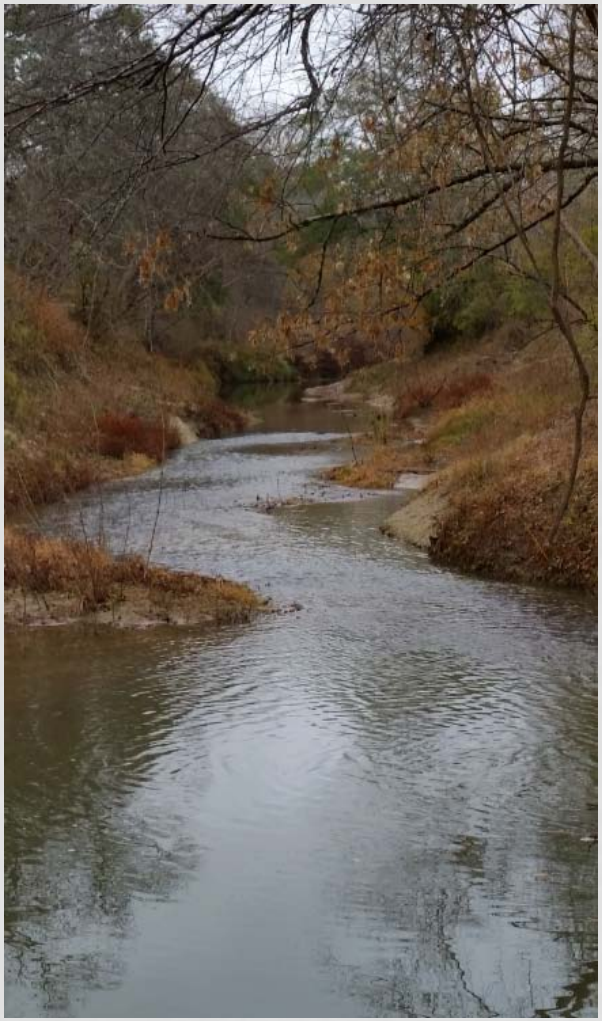
- Aquatic
- Riparian
- Fish Recruitment
  - (Otoliths)
- Brazos Estuary

ECOLOGICAL COMPONENTS

- Aquatic
  - Sampling Components
    - Riffle Habitats
      - Fish
      - Benthic macroinvertebrates
      - Embeddedness
      - Habitat
    - Run Habitats
      - Fish
      - Habitat
    - Seasonal baseline sampling
    - Pulse event sampling

ECOLOGICAL COMPONENTS

- Aquatic
  - Sites
    - Leon River near Gatesville
    - Lampasas River near Kempner
    - Little River near Little River
    - Navasota River near Easterly
    - Brazos River near Hempstead
    - Brazos River near Rosharon

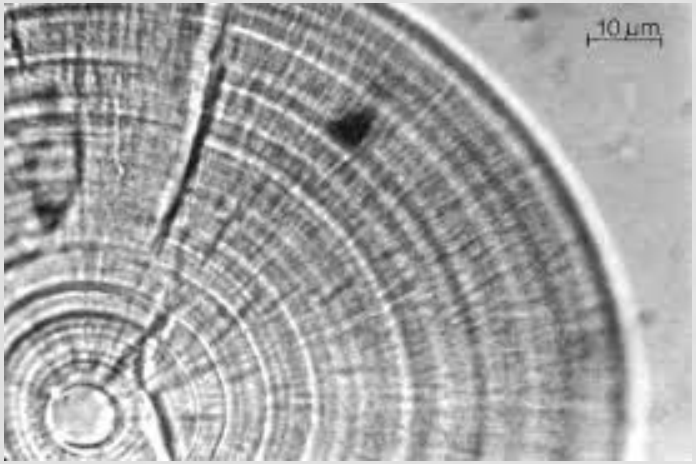


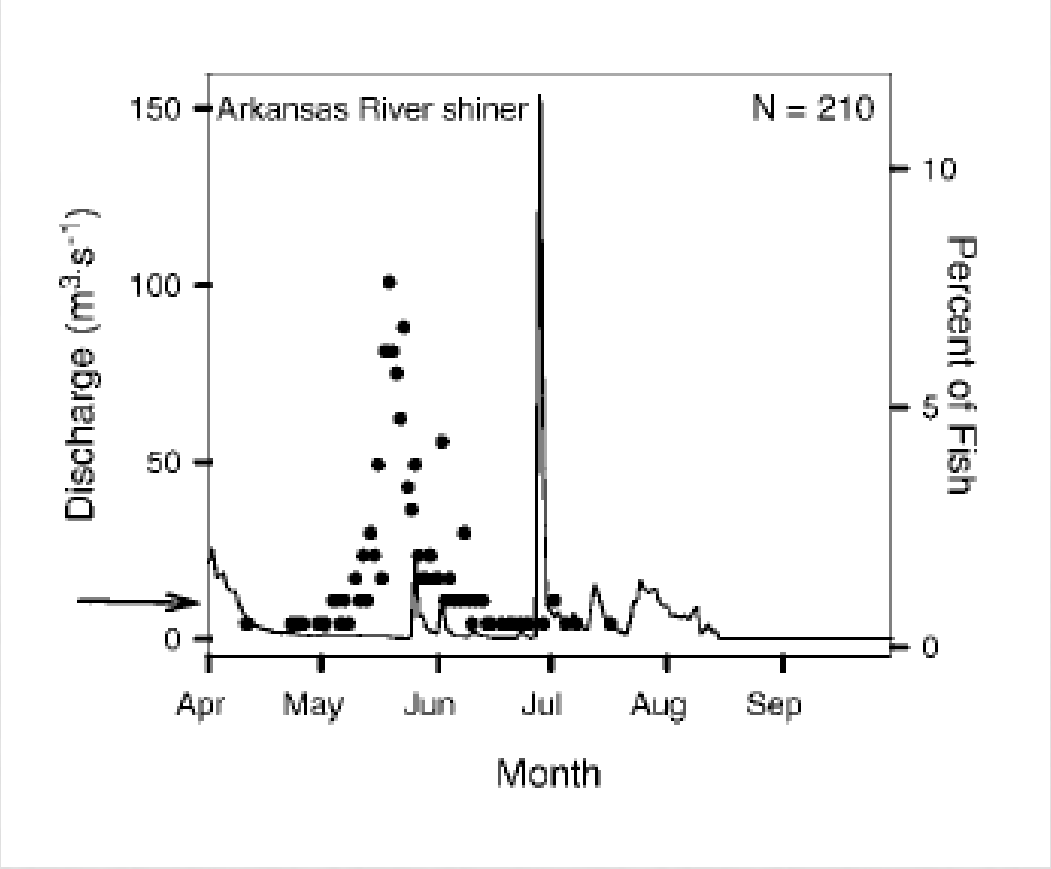
ECOLOGICAL COMPONENTS

- Riparian
  - Sampling Components
    - Seedlings
    - Saplings
    - Mature Trees
    - Riparian Communities
  - Riparian Responses to Flow

ECOLOGICAL COMPONENTS

- Fish Recruitment (Otoliths)





ECOLOGICAL COMPONENTS

- Brazos Estuary
  - Sampling Components
    - Water Quality and Discharge
    - Fish
      - Electrofishing
      - Otter trawls
      - Beam trawls
    - Benthic macroinvertebrates
    - Plankton
    - Stable isotopes

ECOLOGICAL COMPONENTS

- Brazos Estuary

ECOLOGICAL COMPONENTS

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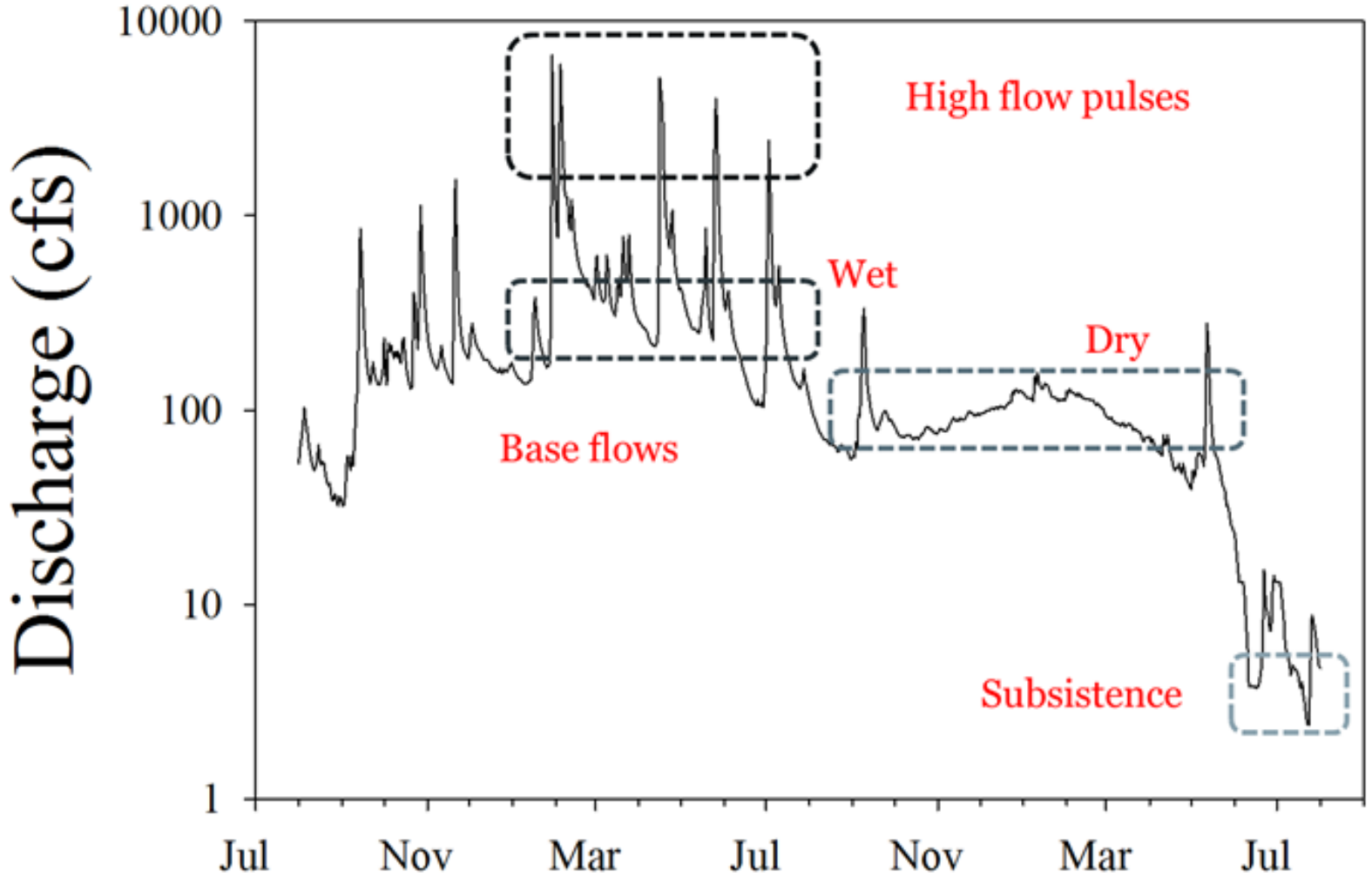
ECOLOGICAL COMPONENTS

- Brazos Estuary

ANALYSIS


Discharge (cfs)
10000
1000
100
10
1
Jul
Nov
Mar
Jul
Nov
Mar
Jul
High flow pulses
Wet
Dry
Base flows
Subsistence

UPDATE ON PRELIMINARY SAMPLING ACTIVITIES

RIPARIAN

- Jacquelyn Duke

STUDY QUESTIONS

Riparian responses to flow:

- **Seedling** establishment and survival require multiple high flow pulses throughout the growing season.
- **Sapling** survival requires multiple high flow pulses throughout the growing season.
- **Mature trees** depend on groundwater; falling water tables result in loss of plant vigor, increased mortality rates, and stand loss. The recommended flow rates are adequate for maintaining current mature riparian tree distributions.
- **Riparian communities** rely on high flow pulses, which both recharge groundwater availability to mature trees and scour/remove invasive / non-riparian species along the active channel and riparian zone.

RIPARIAN INDICATOR SPECIES

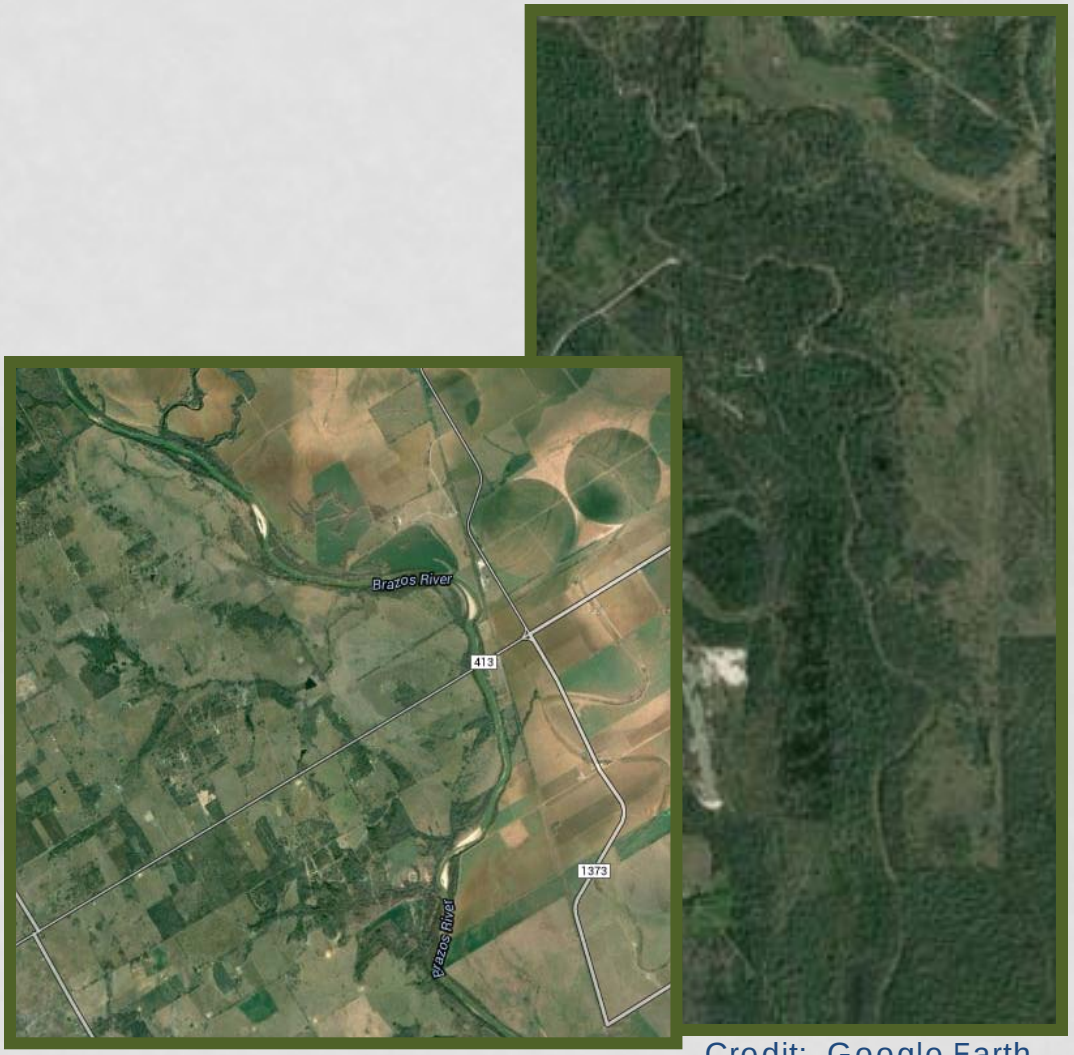
- Black Willow (*Salix nigra*)
  - Seed deposition early spring through summer
- Box Elder (*Acer negundo*)
  - Fall/overwinter
- Green Ash (*Fraxinus pennsylvanica*)
  - Spring and Fall/overwinter

Credti: ncwildlife.org

RIPARIAN SITE SELECTION

Scouting

- Established riparian
- At least one indicator
  - Presence of seedling to mature
- Prop owner permission

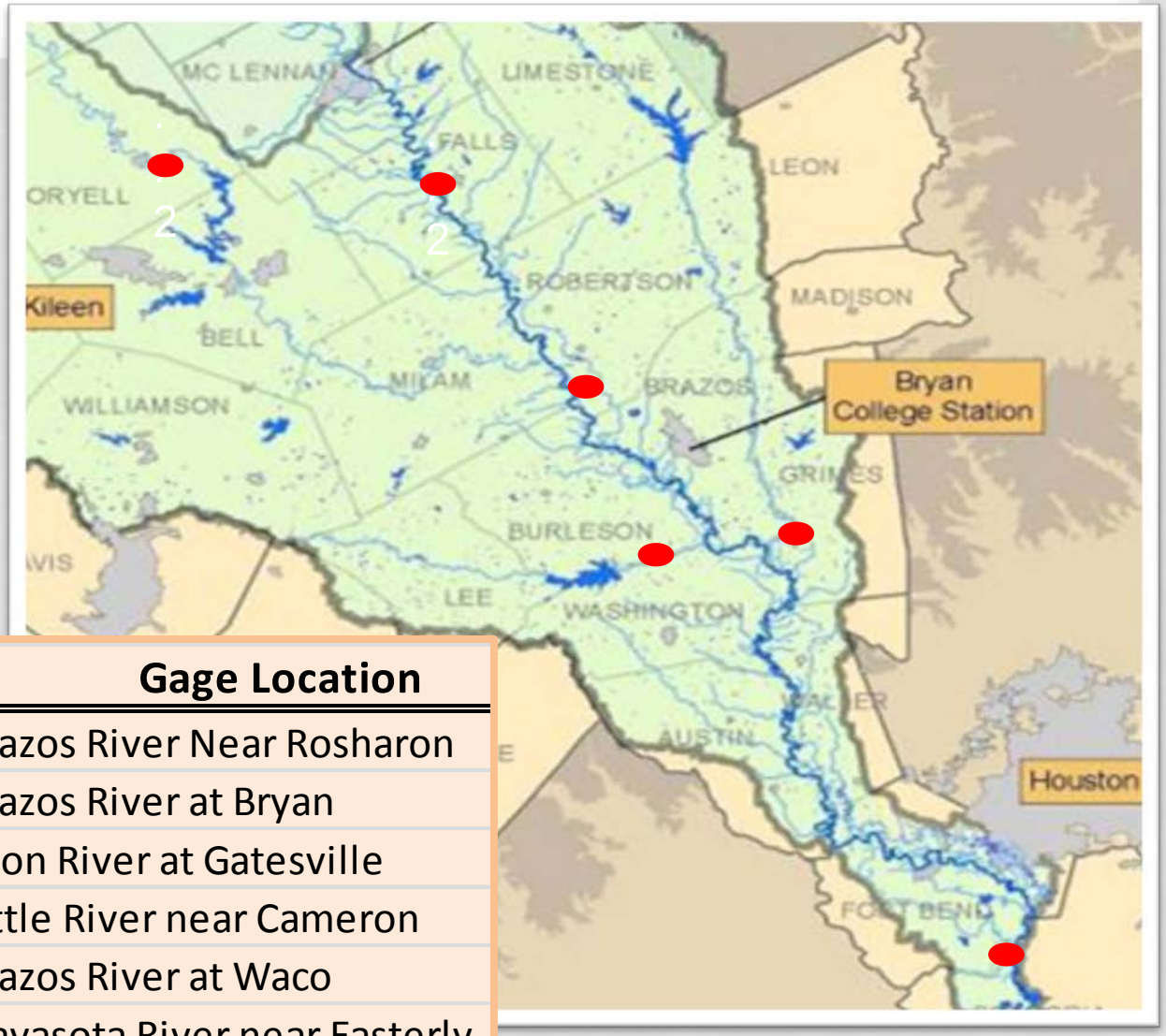


Credit: Google Earth

RIPARIAN SITE SELECTION

6 sites

- 3 Brazos River
- 3 Tribs



Gauge #	Site Name	Gage Location
8116650	Brazos Bend	Brazos River Near Rosharon
8108700	Hearne	Brazos River at Bryan
8100500	Leon	Leon River at Gatesville
8106500	Little River	Little River near Cameron
8096500	Marlin	Brazos River at Waco
8110500	Navasota	Navasota River near Easterly

Photo Credit: TWDB (modified)

NAVASOTA SITE

- What's left of it…

SAMPLING PROTOCOLS

- Seedling distribution, establishment, survival
- Sapling distribution, recruitment, survival
- Mature tree distribution, maintenance
- Riparian indicator age classes
- Community Characterization
- Streamflow inundation (with USGS stream gauge)
- Rainfall

SAMPLING PROCEDURES

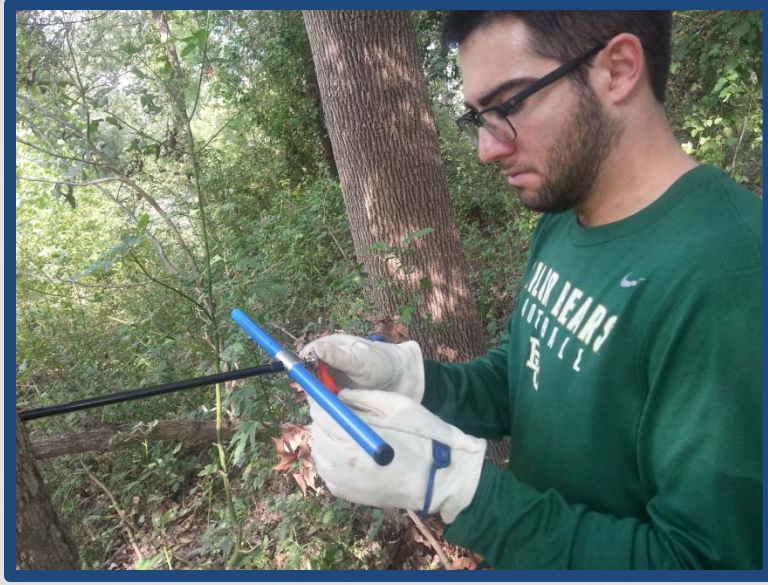
- 3 transects
- 2X2 m plots – count all seedlings, saplings, mature
- Coring of 9 trees per site, use of 200+ previous cores
- Saplings – 5-20 per site
- USGS flows
- Stream flow levels
  - 30-min intervals
- Rainfall events

Credit: Nick Castillo

SAMPLING EVENTS

- Summer 2014
- Fall 2014
- (Winter 2014)
- Spring 2015
- Summer 2015

Credit: Casey Williams

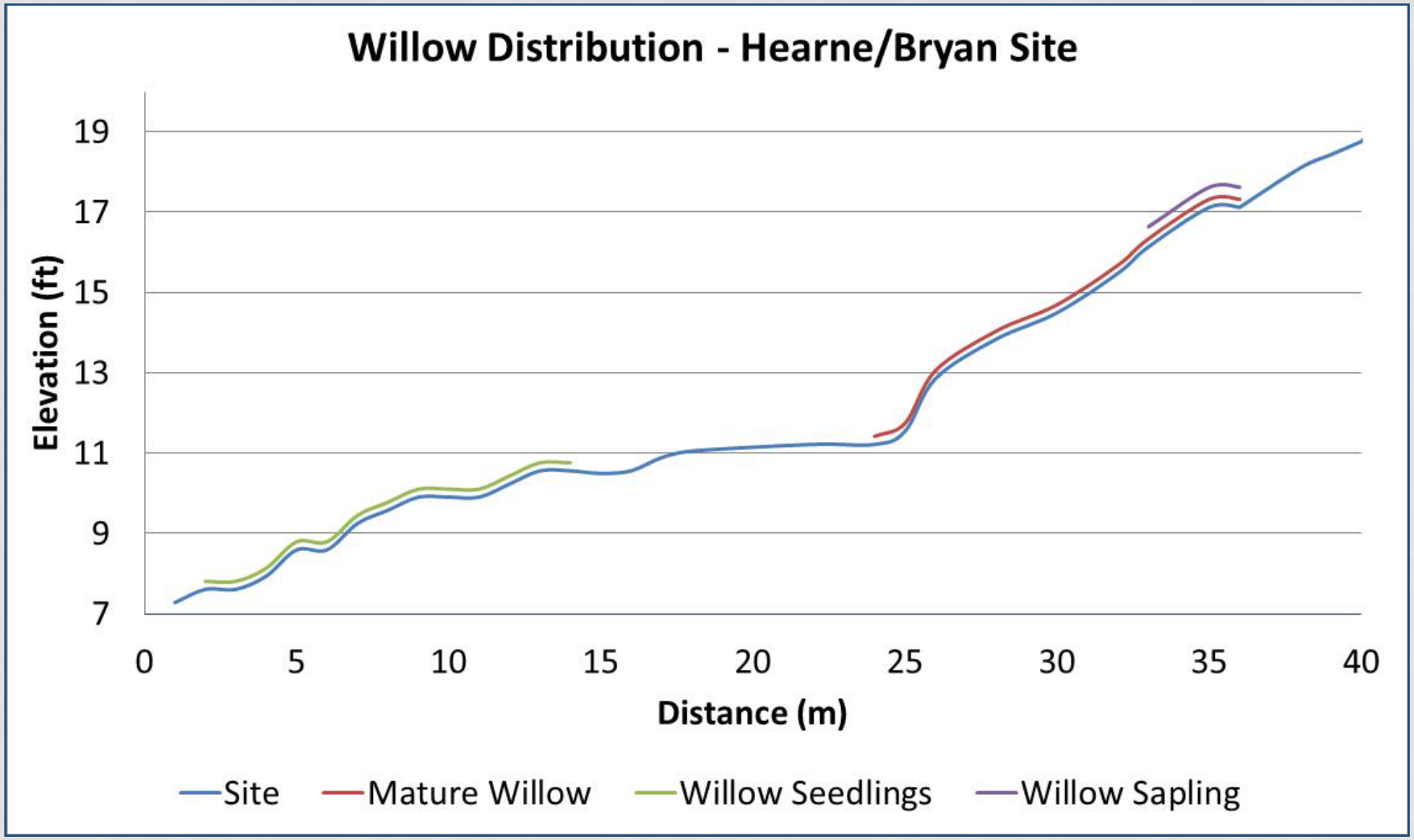


Credit: Casey Williams

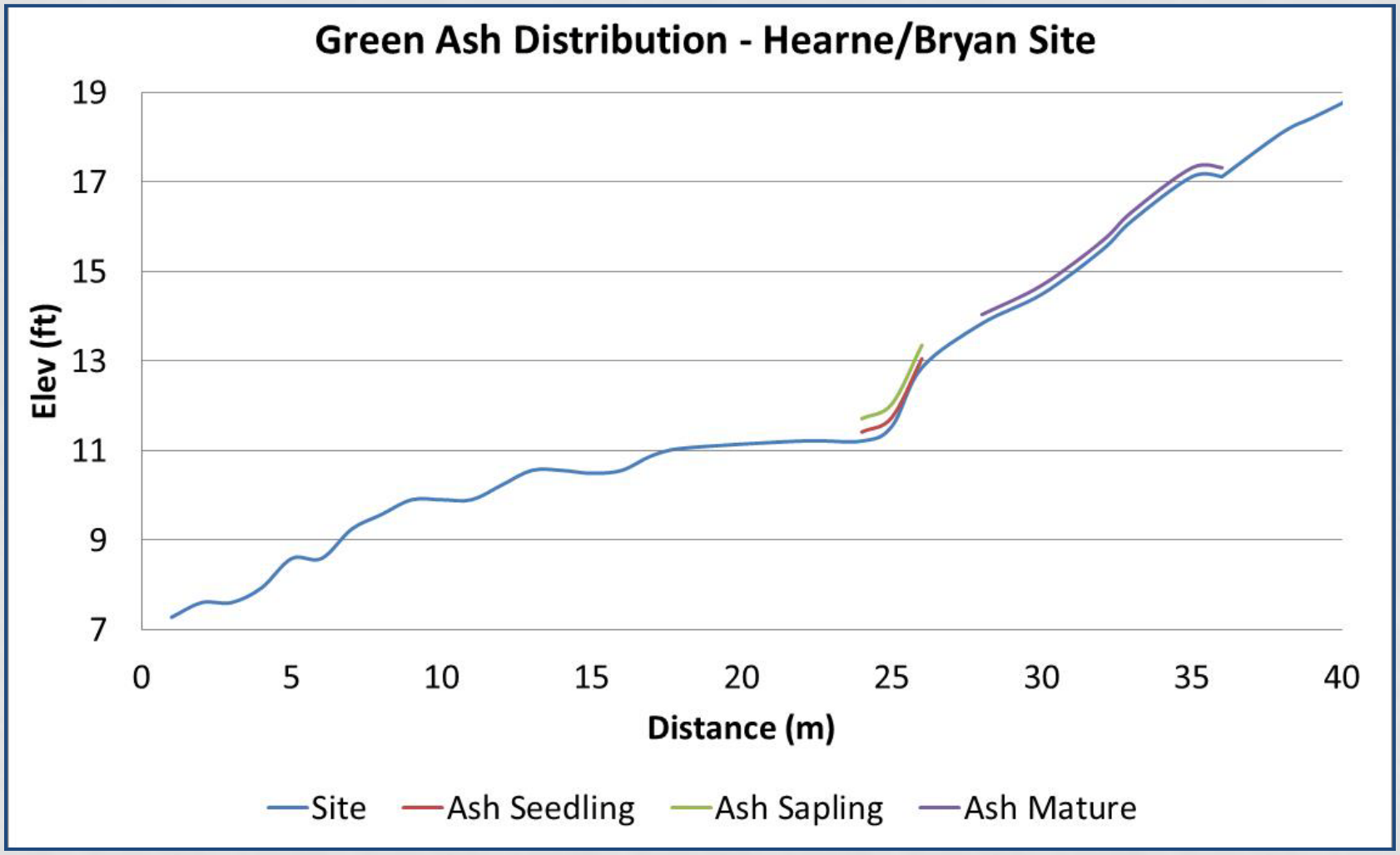
SAMPLING EVENTS

- Summer 2014
  - Scouting, establishment, equipment installation, first counts taken, sapling collections, community characterization
- Fall 2014
  - Counts, download data, sapling collections, tree coring
- (Winter 2014)
  - Download data, map elevations
- Spring 2015
  - Counts, download data, tree coring, sapling collections
- Summer 2015
  - Counts, download data, community characterization, equipment removal

PRELIMINARY RESULTS

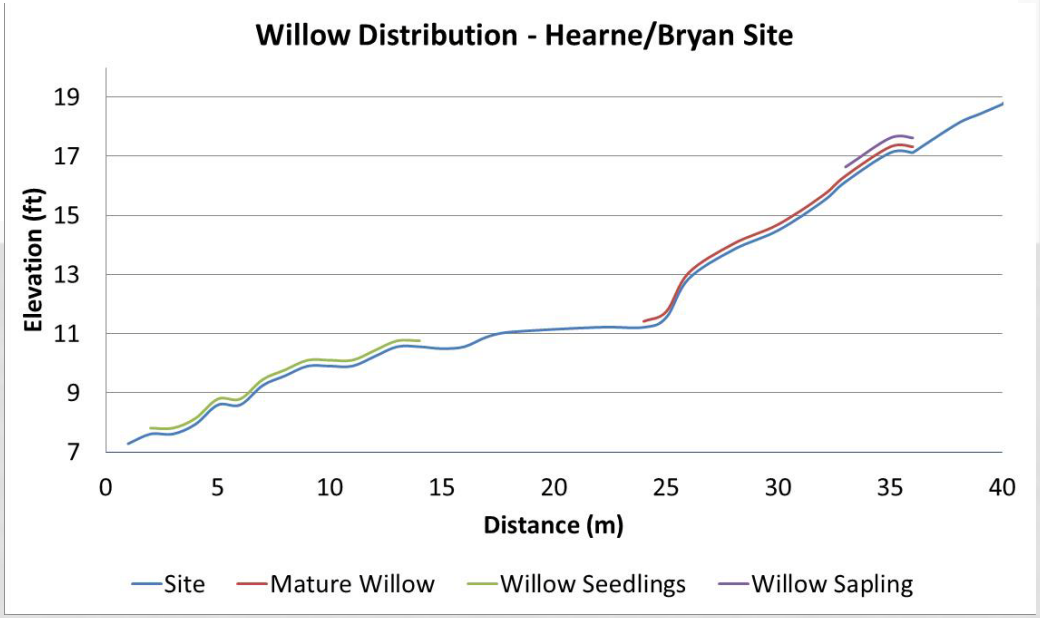


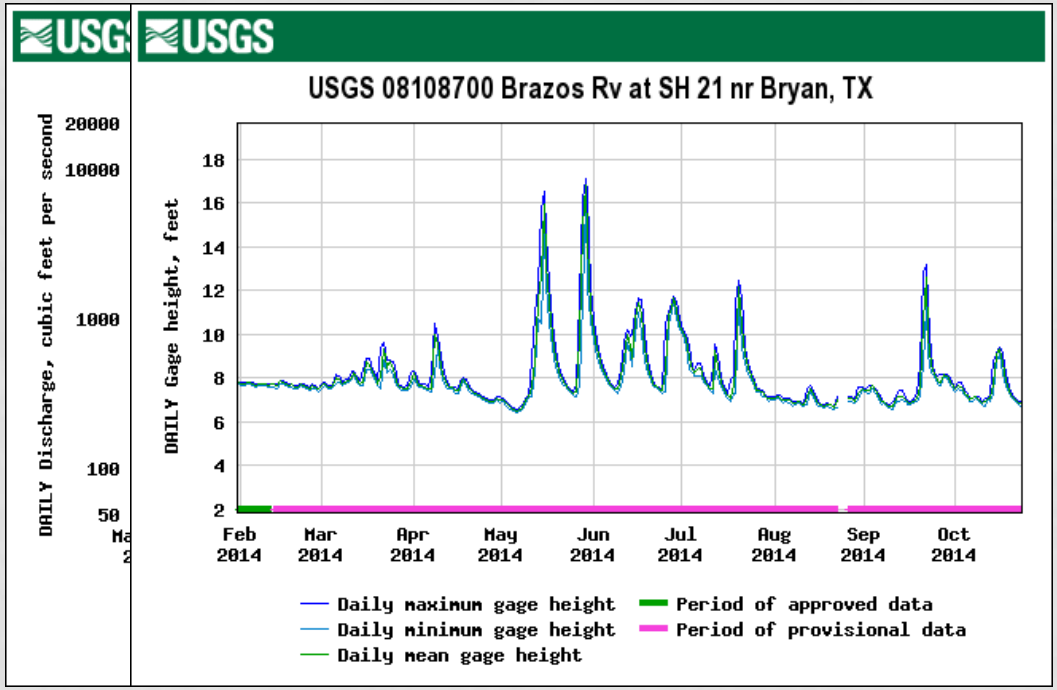
PRELIMINARY RESULTS



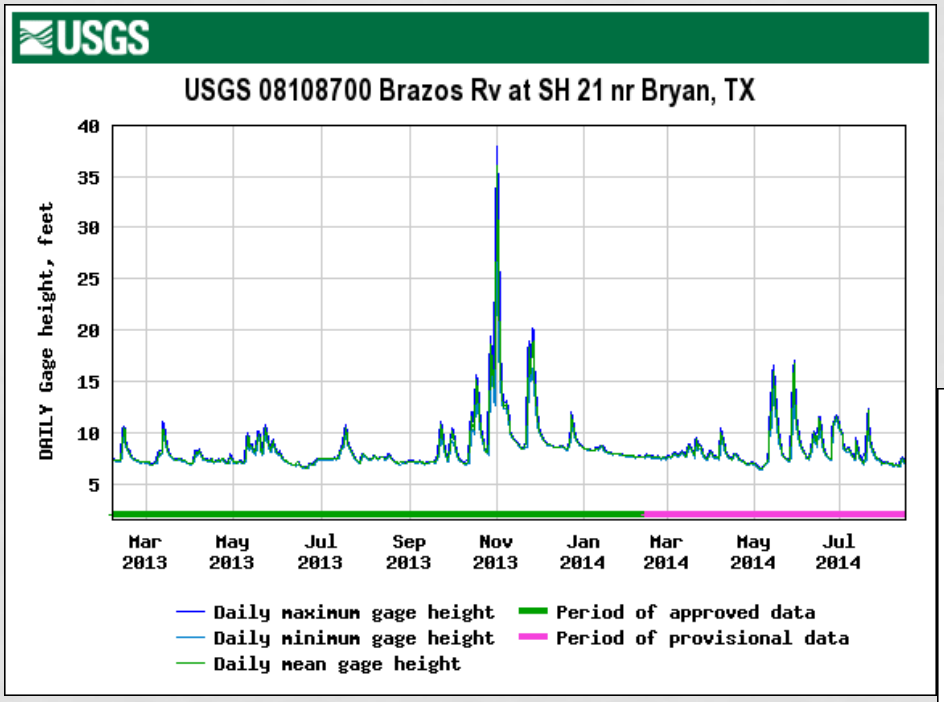
PRELIMINARY RESULTS

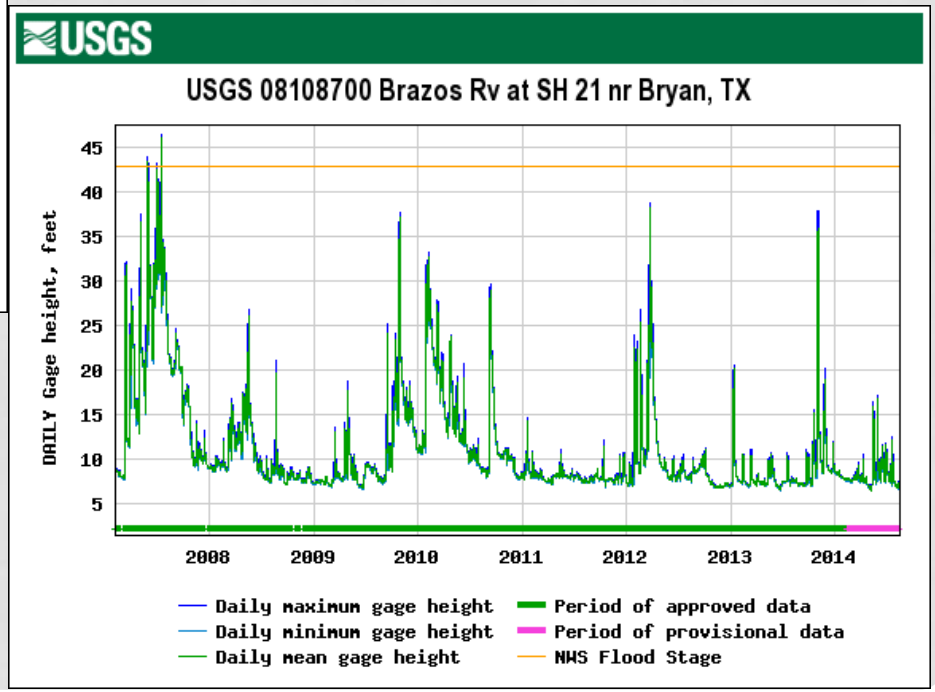
Black Willow	Events
March-May	3
June - Aug	2
Sept - Nov	2





PRELIMINARY RESULTS





LESSONS LEARNED

- Tree cores don't provide a "tight" year-to year signal
- But they do act as sentinels
- Saplings vs. seedlings
- Feral hogs
- Don't let your site be bulldozed!

Credit: Casey Williams

Credit: Tom Hayes

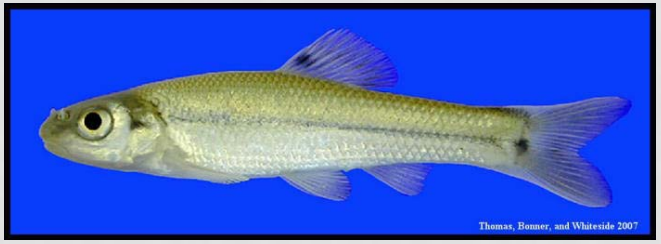
ANALYSIS EXAMPLES

- Riffle and Run habitats
  - Fish community structure
    - Richness, relative abundances, densities
    - Native vs. non-native
    - Swift water specialists vs. slackwater specialists
    - Food consumption, Energy into reproduction, Condition
- Riffle habitats
  - Aquatic insect community structure
    - Richness, relative abundances, densities
    - Swift water specialists vs. slackwater specialists
  - Habitat responses
    - Riffle embeddedness
    - Substrate changes
    - Depth and velocity changes

ANALYSIS EXAMPLE

- Reductions in flow (base and/or pulses):

↑ slackwater organisms

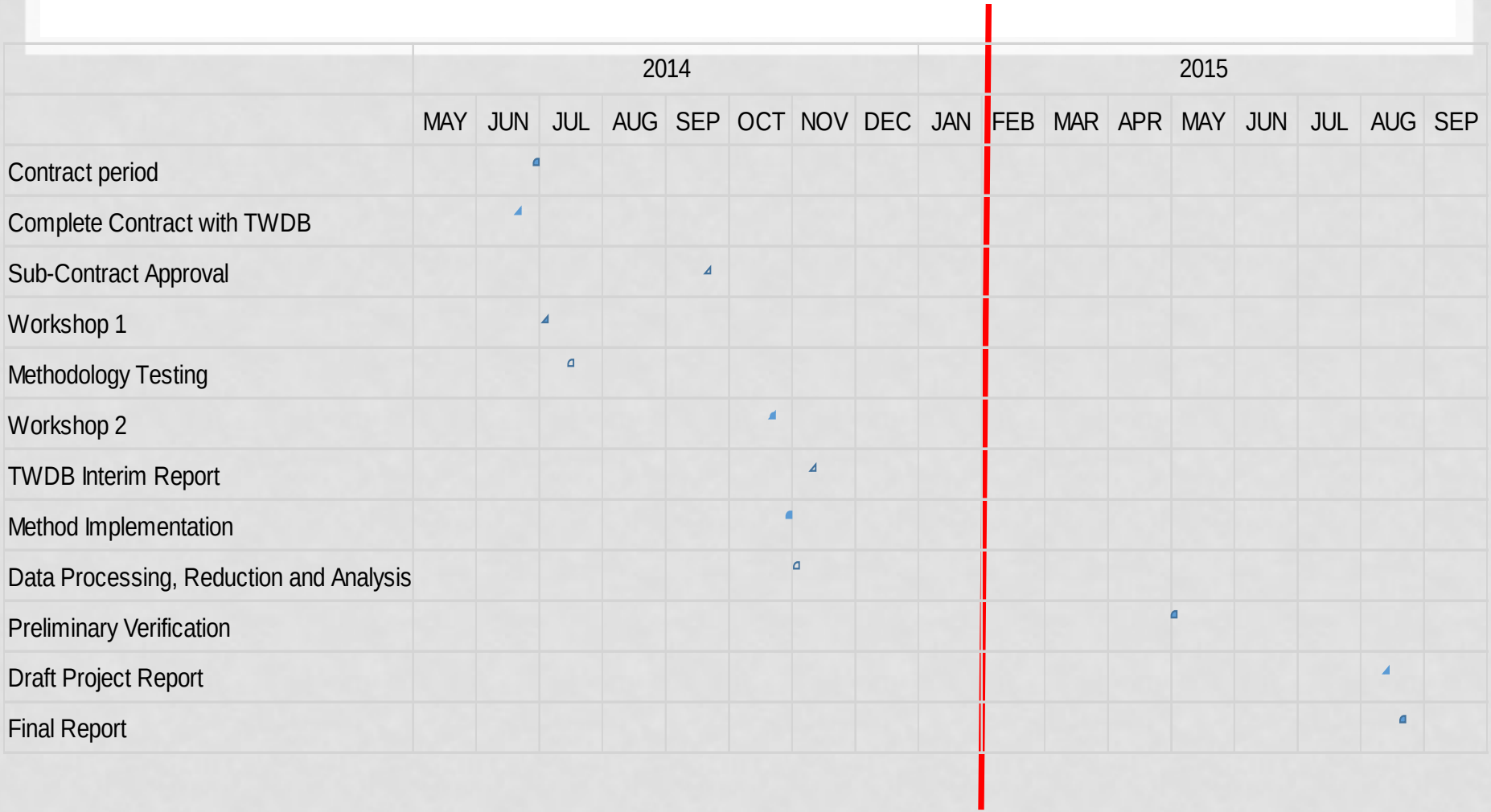


↓ swift water organisms

ENVIRONMENTAL FLOWS VALIDATION ASSESSMENT

- Two main objectives
  - To inform and refine validation methodologies with the goal of having a scientifically defensible approach for testing TCEQ environmental flow standards.
  - To provide the Brazos BBASC with information on how application of these methodologies either validated or suggested refinement for existing TCEQ flow standards at select Brazos basin sites.

TIMELINE


2014
2015
MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
Contract period
Complete Contract with TWDB
Sub-Contract Approval
Workshop 1
Methodology Testing
Workshop 2
TWDB Interim Report
Method Implementation
Data Processing, Reduction and Analysis
Preliminary Verification
Draft Project Report
Final Report


QUESTIONS / COMMENTS?