OVERVIEW

- Funded - Texas Water Development Board
- Project Team:

SAN ANTONIO RIVER AUTHORITY

TEXAS STATE UNIVERSITY SAN MARCOS Department of Biology

BAYLOR UNIVERSITY ENVIRONMENTAL SCIENCE

BIO-WEST

- Coordination with SB3 Brazos River Project

OVERVIEW

- Project goals:
  - To enhance the understanding of flow-ecology relationships in the GSA basin
  - To initiate the process for developing a methodology for testing established flow standards
- A key focus was how pulse flows affect the ecology of the river systems

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

Prepared for:

Texas Water Development Board
1700 North Congress Avenue
Austin, Texas 78711

Prepared by:

BIO-WEST, Inc.
Baylor University
San Antonio River Authority
Texas A&M University
Texas State University
University of Houston – Clear Lake

ECOLOGICAL COMPONENTS

- Aquatic
- Riparian
- Fish Recruitment
  - (Otoliths)
- Oxbow Connectivity

ENVIRONMENTAL FLOWS VALIDATION METHODOLOGY

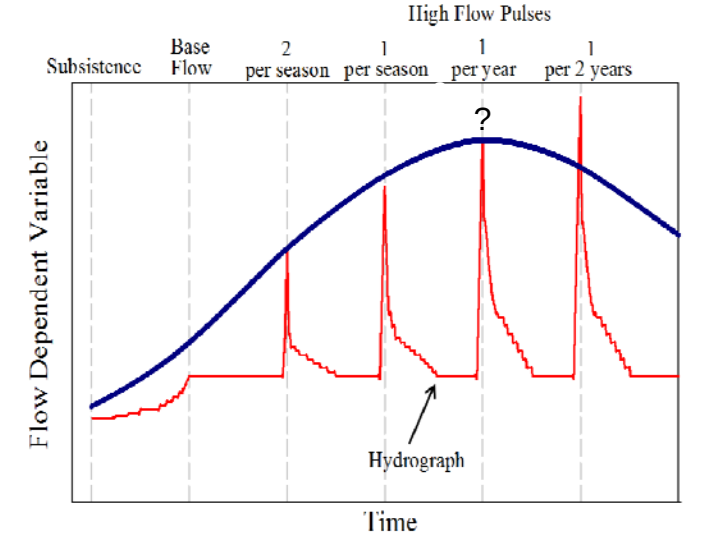
- Two main objectives
  - To inform and refine validation methodologies with the goal of having a scientifically defensible approach for testing TCEQ environmental flow standards.
  - To provide the GSA BBASC with information on how application of these methodologies might validate or suggest refinement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

SAMPLING ACTIVITIES AND RESULTS

AQUATICS

- Timothy Bonner

PREDICTIONS



BASE

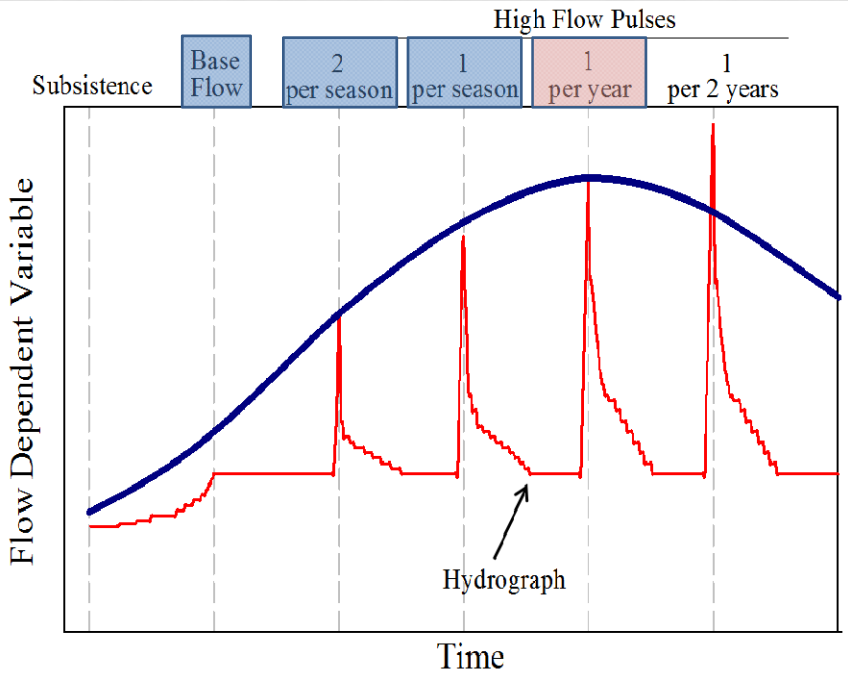
PULSE

Basin	Season	Flow Tier	Science	Stakeholder	TCEQ
Brazos	Summer	S	X	X	X
	Winter	B	X	X	X
	Spring	4/S	X	X*	X**
		3/S	X	X	X
		2/S	X		
		1/S	X		
		1/Y	X		
		1/2Y	X		
		1/5Y	X		
Guadalupe	Summer	S	X	X	X
	Fall	B	X	X	X
	Winter	2/S	X	X	X
	Spring	1/S	X	X	X
		1/Y	X	X	
		1/2Y	X	X	
		1/5Y	X	X	
San Antonio	Summer	S	X	X	X
	Fall	B	X	X	X
	Winter	2/S	X	X*	X**
	Spring	1/S	X	X*	X**
		1/Y	X	X*	**
		1/2Y	X	X	
		1/5Y	X	X	

SUMMARY STATS

- 63 riffle habitats, 74 run habitats
- 51,000 macroinvertebrates
- 21,000 fishes

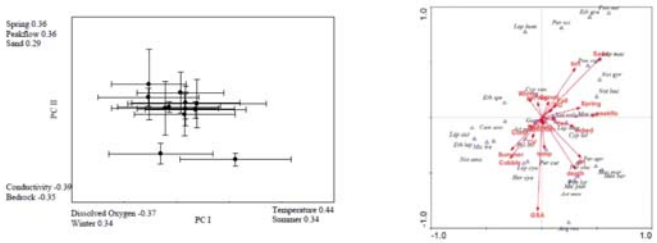
Tier	N
Subsistence	3
Base	30
4 / season	2
3 / season	2
2 / season	9
1 / season	12
1 / year	5



STATISTICAL METHODS

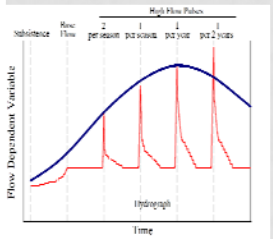
- Multivariate analyses (assess trends)
- Tested responses with a 3-factor ANOVA
  - Tier, Seasons, and Drainage

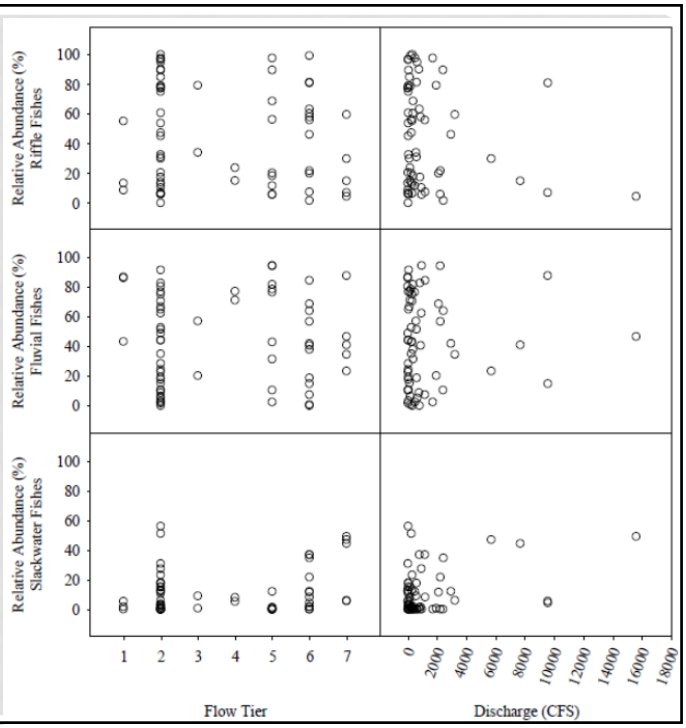
Site, habitat, species characterizations



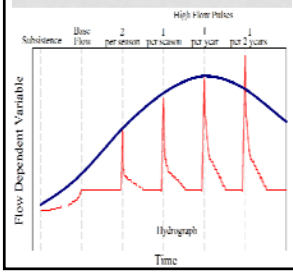
Multivariate assessments (CCA) of macroinvertebrates and fishes

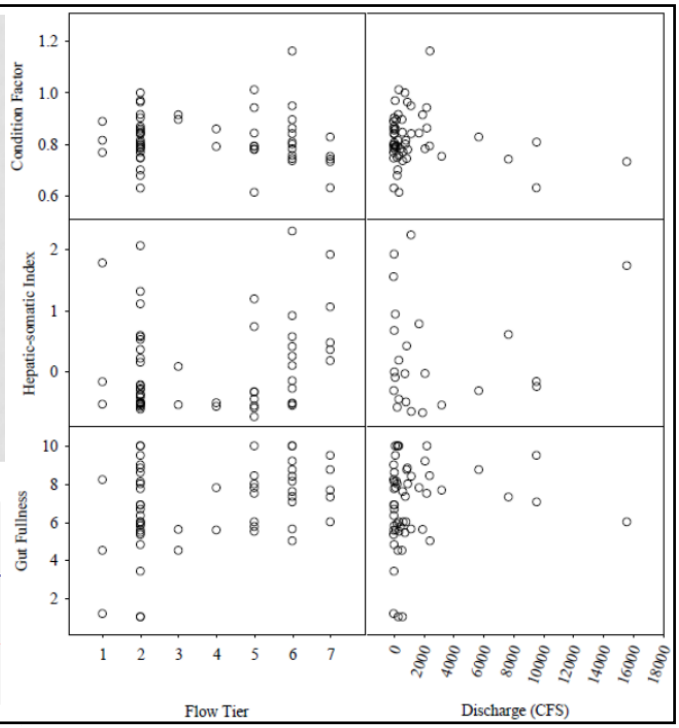
Parameter vs. Flow Tier And Discharge





Parameter
vs.
Flow Tier
And
Discharge





CONCLUSIONS SO FAR…

- Among base, 2/season, 1/season, and 1/year events…
- Among 58 abiotic and biotic predictions tested…
  - ↑ Flow tiers ↑slackwater fishes
    - Opposite of predicted, but not too surprising
  - ↑ Flow tiers ↓ N of darters
    - Opposite of predicted, surprising
- "Failure to detect a difference doesn't mean a difference doesn't exist" - MORE LATER

SAMPLING ACTIVITIES AND RESULTS

RIPARIAN

- Jacquelyn Duke

RIPARIAN STUDY HYPOTHESES

Riparian responses to flow:

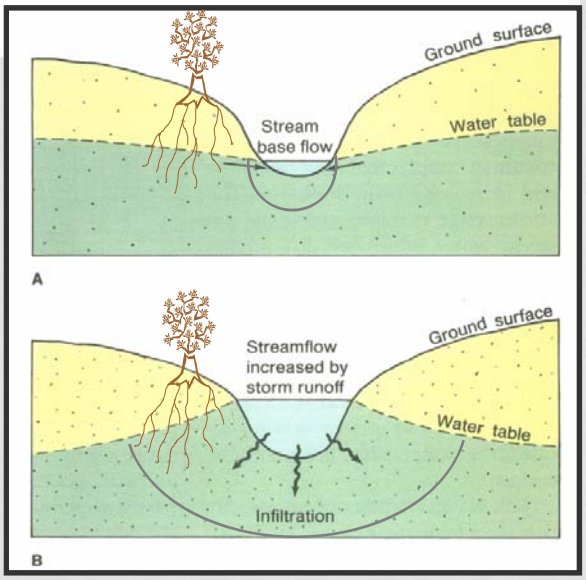
- **Seedlings**
  - Distributions correlate with TCEQ /BBEST flows
  - Distributions correlate with *actual* flows
  - Survival correlates with flows
- **Saplings**
  - Distributions correlate with TCEQ /BBEST flows
  - Distributions correlate with *actual* flows
  - Survival correlates with flows

- **Mature trees**
  - Distributions reflect TCEQ/BBEST flow coverage (80% or more)
- **Community**
  - Relative abundance reflects riparian dominance
  - Age distributions detect the effect of major anomalies in flow

HYPORHEIC ZONE

- A – Low-flow conditions, little discharge to hyporheic zone
- B – Increased flow, expansion of hyporheic zone

Water stress is limiting factor to tree growth (Spurr and Barnes, 1980)



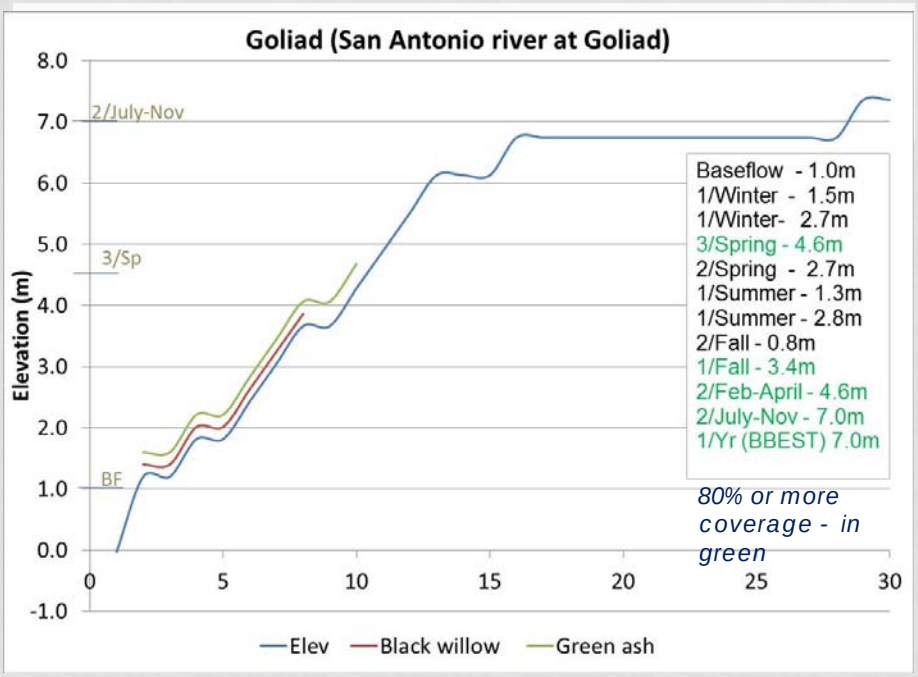
INDICATOR SPECIES

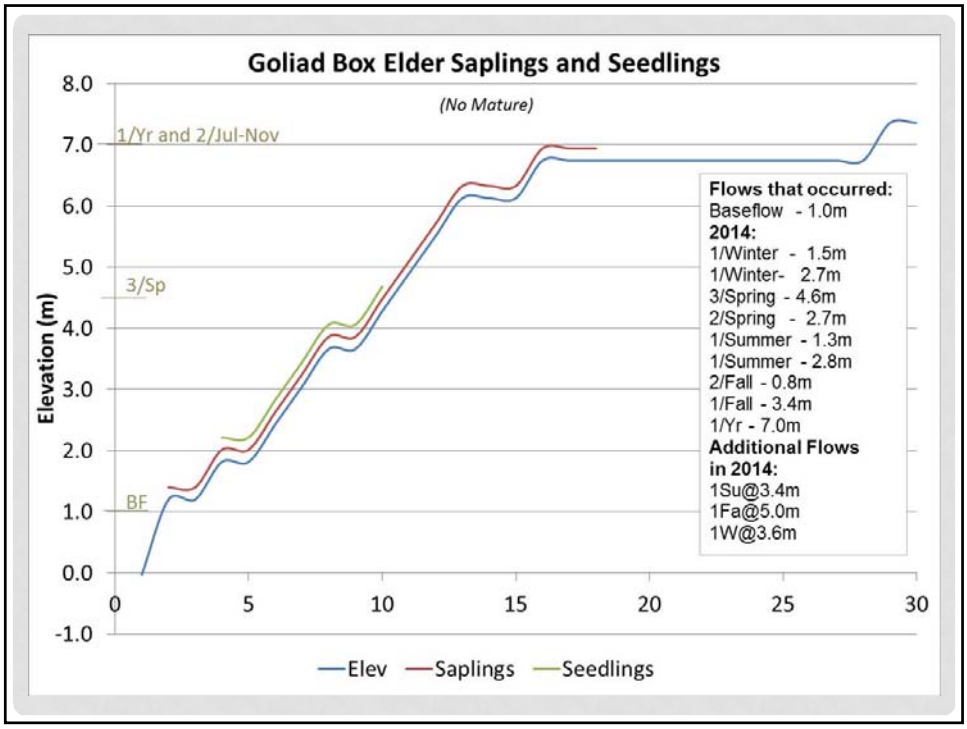
- Black Willow (*Salix nigra*)
  - Seed deposition early spring through summer
- Box Elder (*Acer negundo*)
  - Fall/overwinter
- Green Ash (*Fraxinus pennsylvanica*)
  - Spring and Fall/overwinter

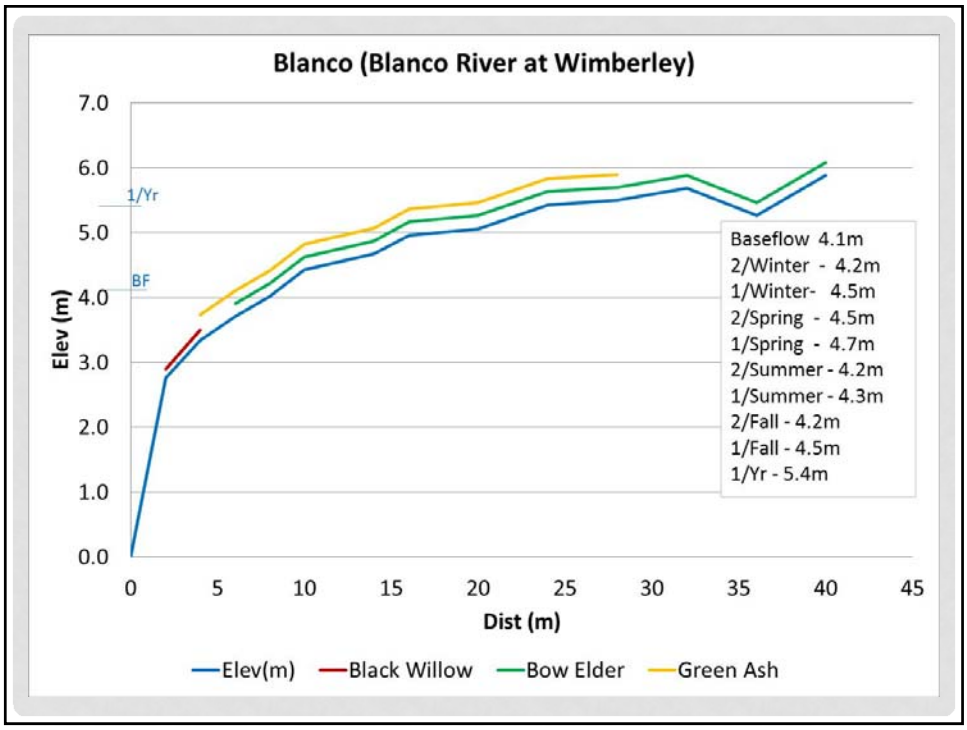
Credti: ncwildlife.org

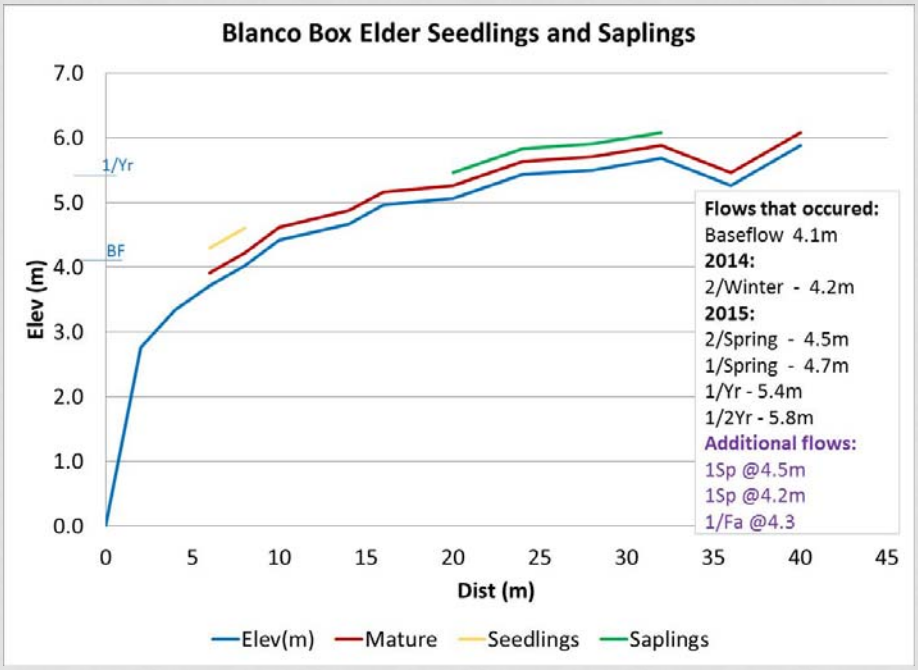
SAMPLING EVENTS

- 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




Goliad Box Elder Saplings and Seedlings
(No Mature)
1/Yr and 2/Jul-Nov
3/Sp
BF
Elevation (m)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0
5
10
15
20
25
30
Flows that occurred:
Baseflow - 1.0m
2014:
1/Winter - 1.5m
1/Winter- 2.7m
3/Spring - 4.6m
2/Spring - 2.7m
1/Summer - 1.3m
1/Summer - 2.8m
2/Fall - 0.8m
1/Fall - 3.4m
1/Yr - 7.0m
Additional Flows in 2014:
1Su@3.4m
1Fa@5.0m
1W@3.6m
Elev
Saplings
Seedlings


Blanco (Blanco River at Wimberley)
1/Yr
BF
Elev (m)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
5
10
15
20
25
30
35
40
45
Dist (m)
Baseflow 4.1m
2/Winter - 4.2m
1/Winter- 4.5m
2/Spring - 4.5m
1/Spring - 4.7m
2/Summer - 4.2m
1/Summer - 4.3m
2/Fall - 4.2m
1/Fall - 4.5m
1/Yr - 5.4m
Elev(m)
Black Willow
Bow Elder
Green Ash



SUMMARY OF RESULTS

Flow Tiers	Number of All Species Covered* by	Number of Species at the Highest Elev Covered* by	Number That Occurred in 2014
BF	1/14	0/6	6/6
2/W	1/14	0/6	5/6
1/W	1/14	0/6	4/6
3/Sp**	2/2	1/1	1/1
2/Sp	0/14	0/6	2/6
1/Sp	3/12	1/5	3/6
2/Su	1/14	0/6	3/6
1/Su	1/14	0/6	0/6
2/Fa	1/14	0/6	2/6
1/Fa	3/14	0/6	2/6
2/Feb-Apr**	2/2	1/1	0/1
2/Jul-Nov**	2/2	1/1	0/1
1/Yr	12/14	4/6	2/6

* Inundation of 80% or more of the species' distribution

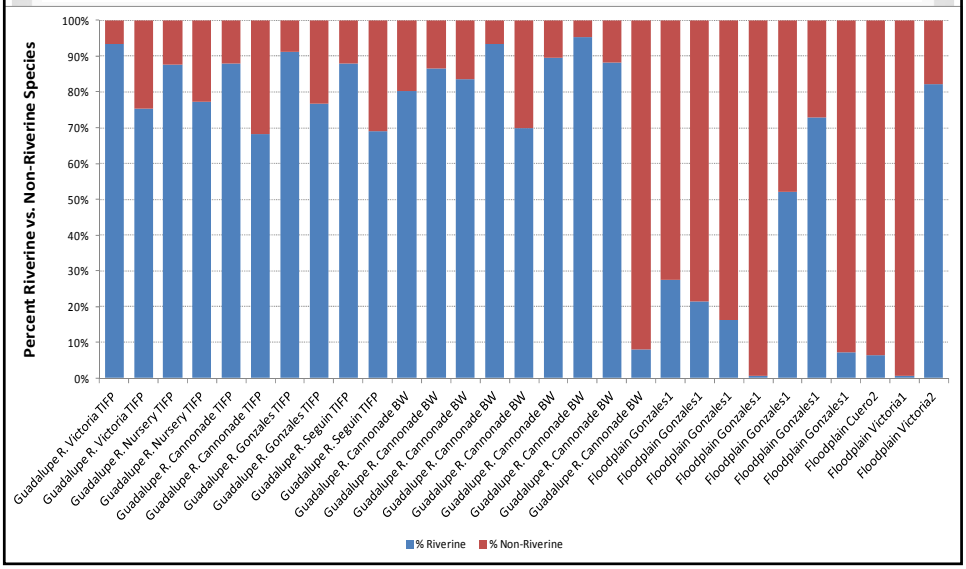
** Goliad large flow pulses

SAMPLING ACTIVITIES AND RESULTS

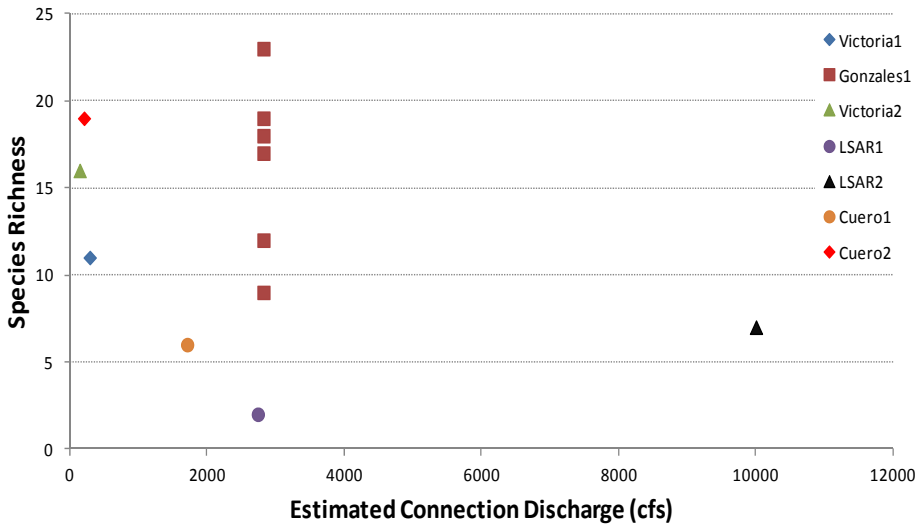
OXBOW CONNECTIVITY

- Brad Littrell

FISH ASSEMBLAGES



OXBOW CONNECTIVITY



PRELIMINARY CONCLUSIONS

- Aquatics
  - Most aquatic hypotheses were "largely unsupported"
  - "Failure to detect a difference doesn't mean a difference doesn't exist"
  - More data needed
- Riparian
  - Excepting LSAR sites, larger pulses are generally needed to support the existing riparian communities
  - Timing also important
- Oxbow Connectivity
  - 6 of 7 sites tested were connected with existing TCEQ flow standards

ENVIRONMENTAL FLOWS
PROPOSED VALIDATION METHODOLOGY

- Standardized approach
- Incorporates multiple ecological components
- Agreed upon upfront – BBASC and TCEQ
- Simplified field and desktop activities
- Tiered approach
  - Tier I – Floodplain Connectivity
  - Tier II – Riparian Assessment
  - Tier III – Aquatic Assessment
  - Tier IV - ???

ENVIRONMENTAL FLOWS
PROPOSED VALIDATION METHODOLOGY

- POTENTIAL APPLICATION
  - Tier I and II can be conducted right now
    - Examples provided in Section 4.3
  - Tier III – premature to evaluate
  - Additional Tiers – to be developed via additional studies and expert workshops

ENVIRONMENTAL FLOWS
FUTURE RESEARCH AND MONITORING RECOMMENDATIONS – SECTION 5

- Applied Research
  - Each component with different focus
    - Aquatics – major emphasis
    - Riparian and Oxbows – more site specific as needed
    - New ecological components?
- Long-term Monitoring
  - Limited initiation for each component
- Expert Panel Workshops
  - To refine methodology

QUESTIONS / COMMENTS?

- Acknowledgements
  - Landowners
  - BBASC
  - TWDB
  - TPWD and TCEQ
  - BBEST
  - Volunteers