Using National Surveys to Evaluate the Condition of Texas State-wide Fish Communities

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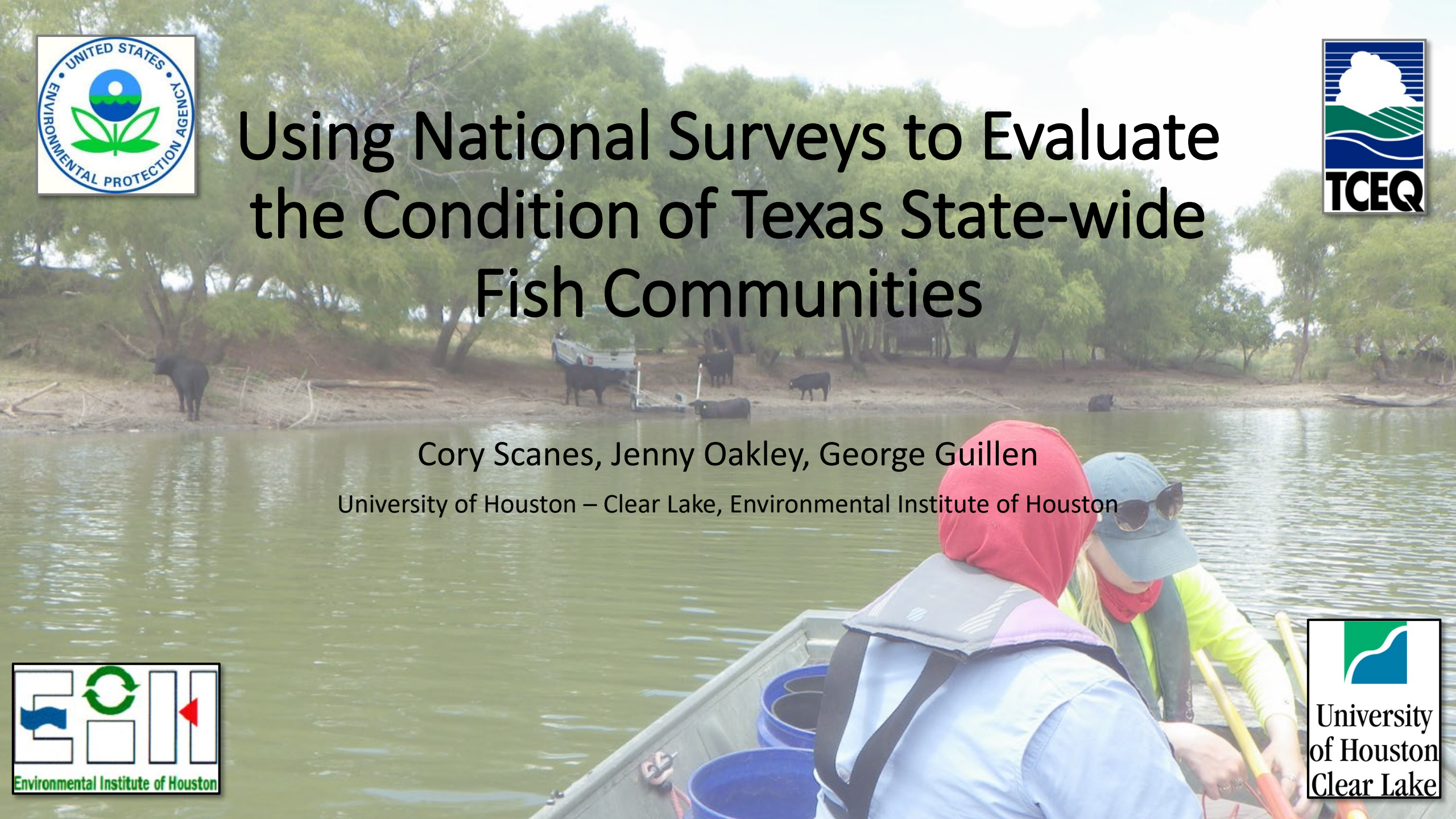


National Aquatic Resource Surveys (NARS)

- United States Environmental Protection Agency
  - Clean Water Act – must report on condition of nation's water resources

- Designed to assess health of water resources in the United States
  - Nationwide standardized collection protocols

- The Surveys:
  - National Coastal Condition Assessment
  - National Lakes Assessment
  - **National Rivers and Streams Assessment**
  - National Wetland Condition Assessment

National Rivers and Streams Assessment (NRSA)

- Wadeable Streams Assessment (2004)
  - First published report for NARS in 2006
  - Small, wadeable streams only
- NRSA implemented 2008-09, conducted every 5 years to:
  - Assess condition of lotic waterbodies of the USA
    - Wadeable and Non-Wadeable
- Site Characteristics Assessed
  - Water quality
  - Physical habitat
  - Fish and invertebrate communities

NARS and EIH

- Field collection for all 4 NARS surveys
  - Partner with USEPA and TCEQ
- Sampled 64 sites for 2013-14 NRSA
- Sampled 41 of 81 total sites for 2018-19 NRSA
  - 22 sites resampled from 2013-14

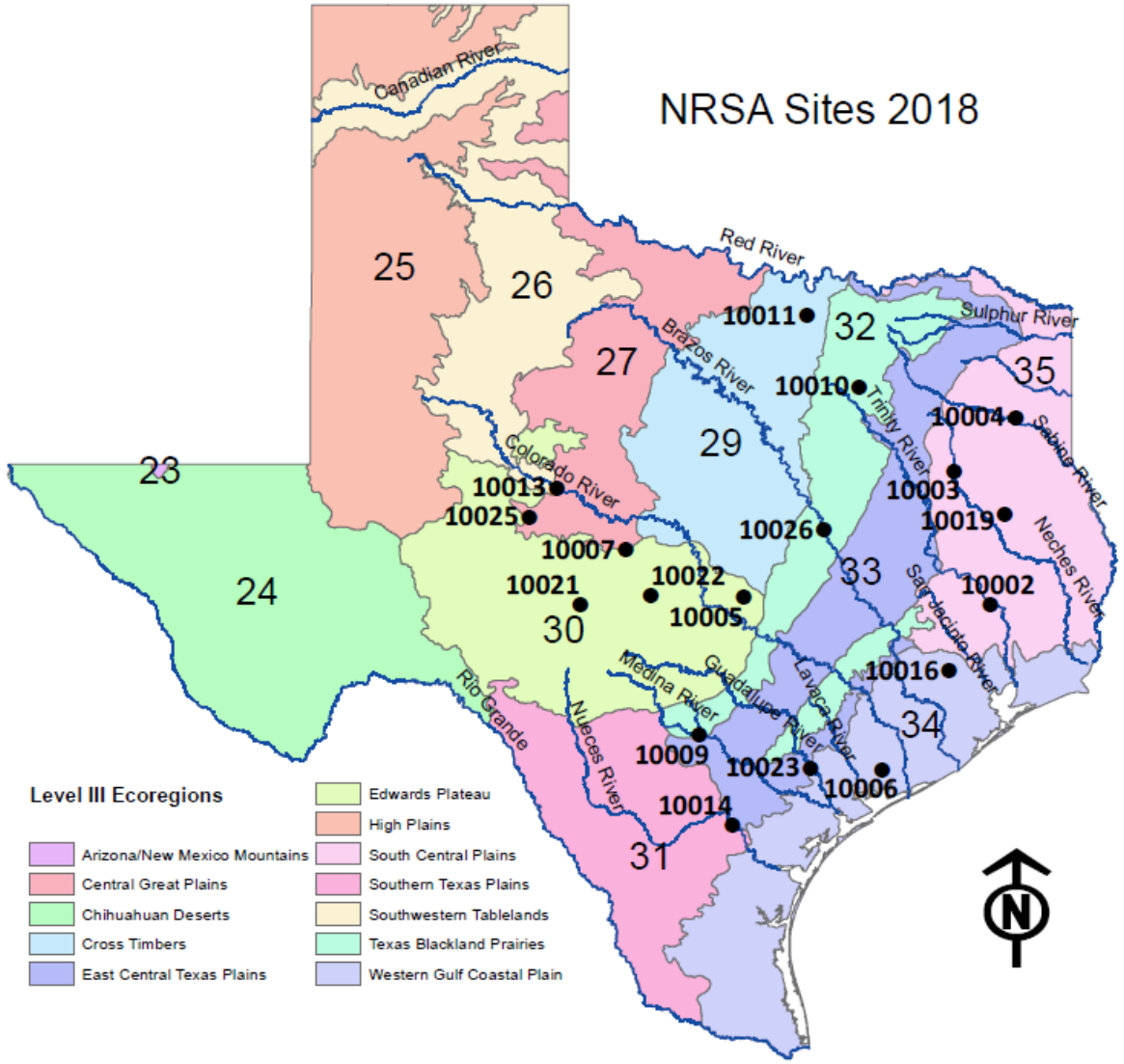
Objectives

- Compare fish community structure of 19 sites between two NRSA surveys
  - Detect spatial differences
  - Assess temporal changes

- Identify changes in stream health utilizing fish as indicators

Methods – Pre-Visit

- Probabilistic sampling design
  - Random site selection from National Hydrography Database provided by USEPA
- Desktop reconnaissance of sites
  - Wadeable vs. Non-Wadeable
  - Small vs. Large

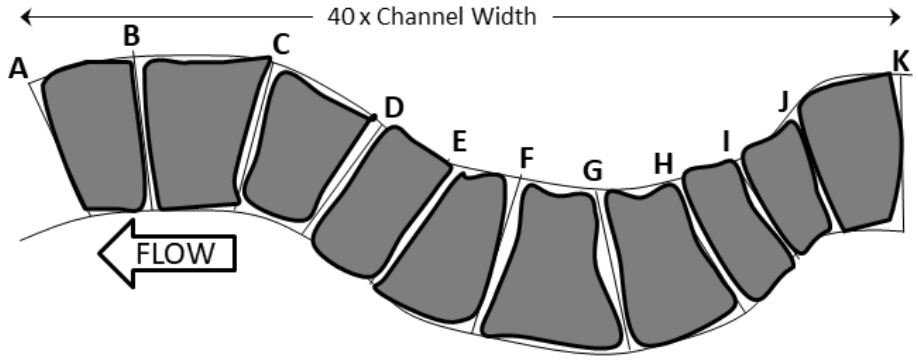


Methods

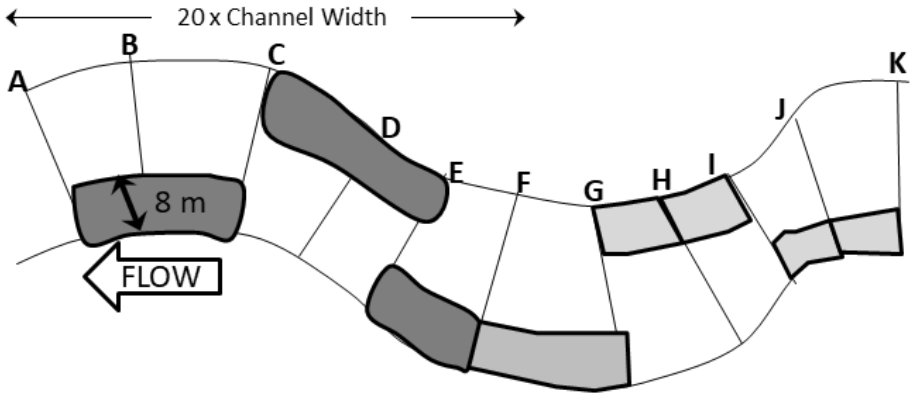
Reach length = 40x channel width

Wadeable

Small Wadeable Stream: Mean Channel Width ≤ 12 m

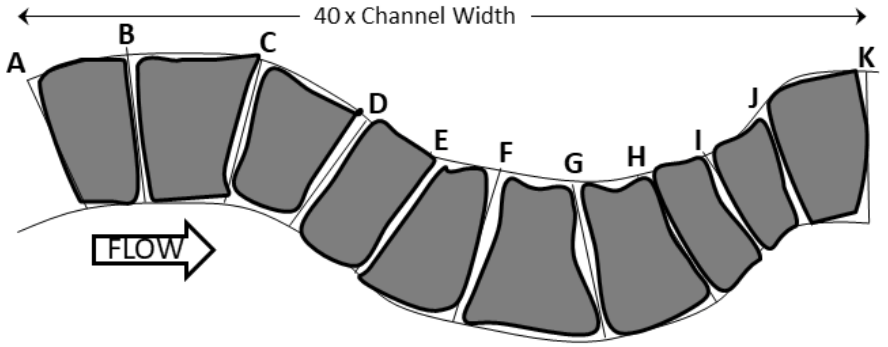


Large Wadeable Stream: Mean Channel Width ≥ 13 m

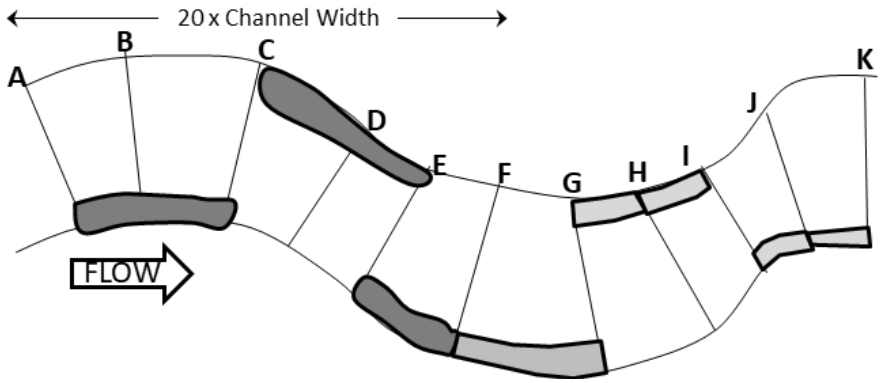


Non-Wadeable

Small Nonwadeable River: Mean Channel Width ≤ 12 m



Large Nonwadeable River: Mean Channel Width ≥ 13 m



USEPA NRSA Field Operations Manual (2018)

Methods

- E-shock protocol – Primary collection method
  - ~500-700 seconds of button time per subreach
  - Most effective shocking unit* selected for each site
- Fish identified to species and enumerated in field, unknowns pickled and processed in lab

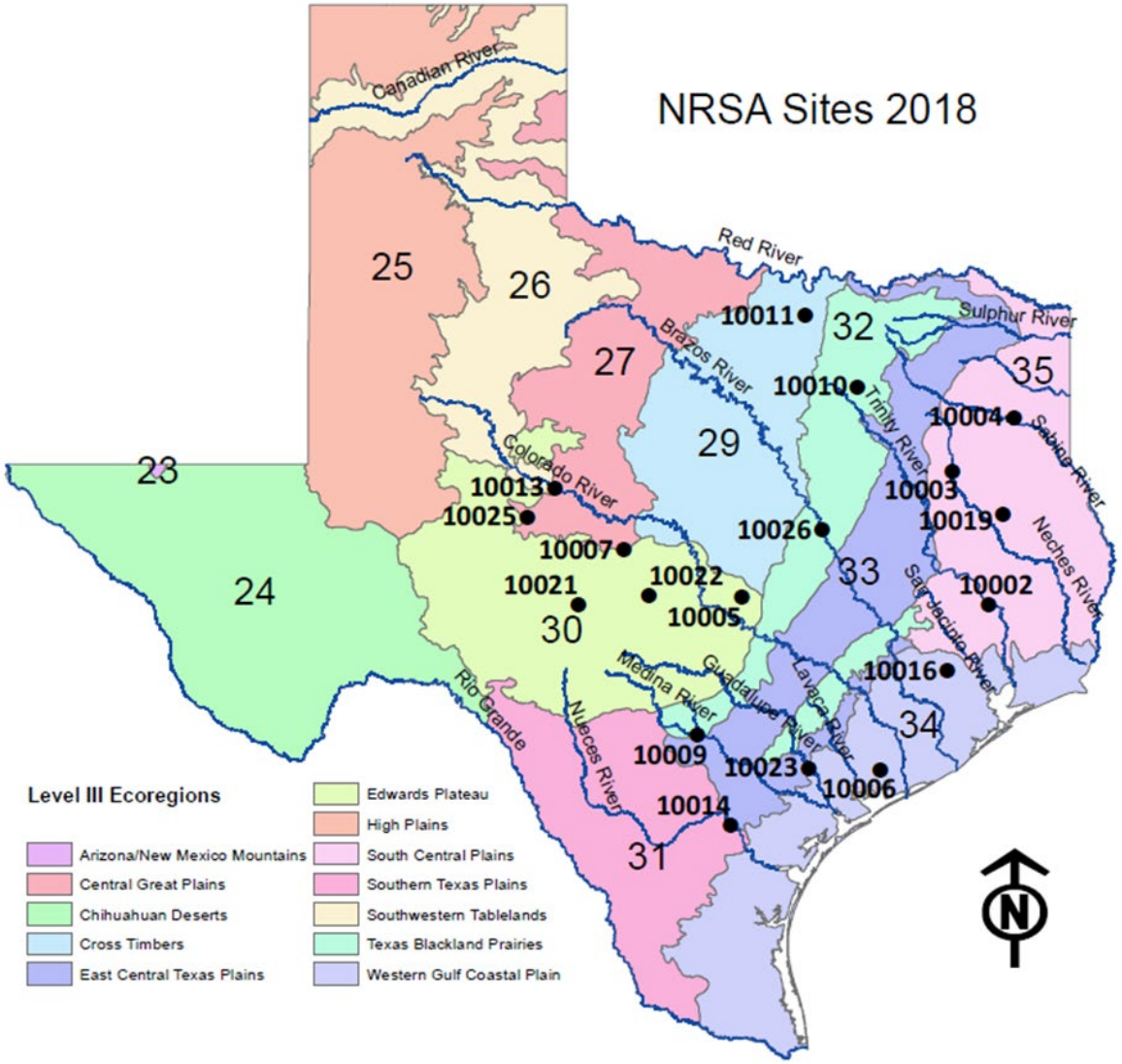
*Smithroot: LR-24, 2.5 GPP, 5.0 GPP, 9.0 GPP

Methods - Analysis

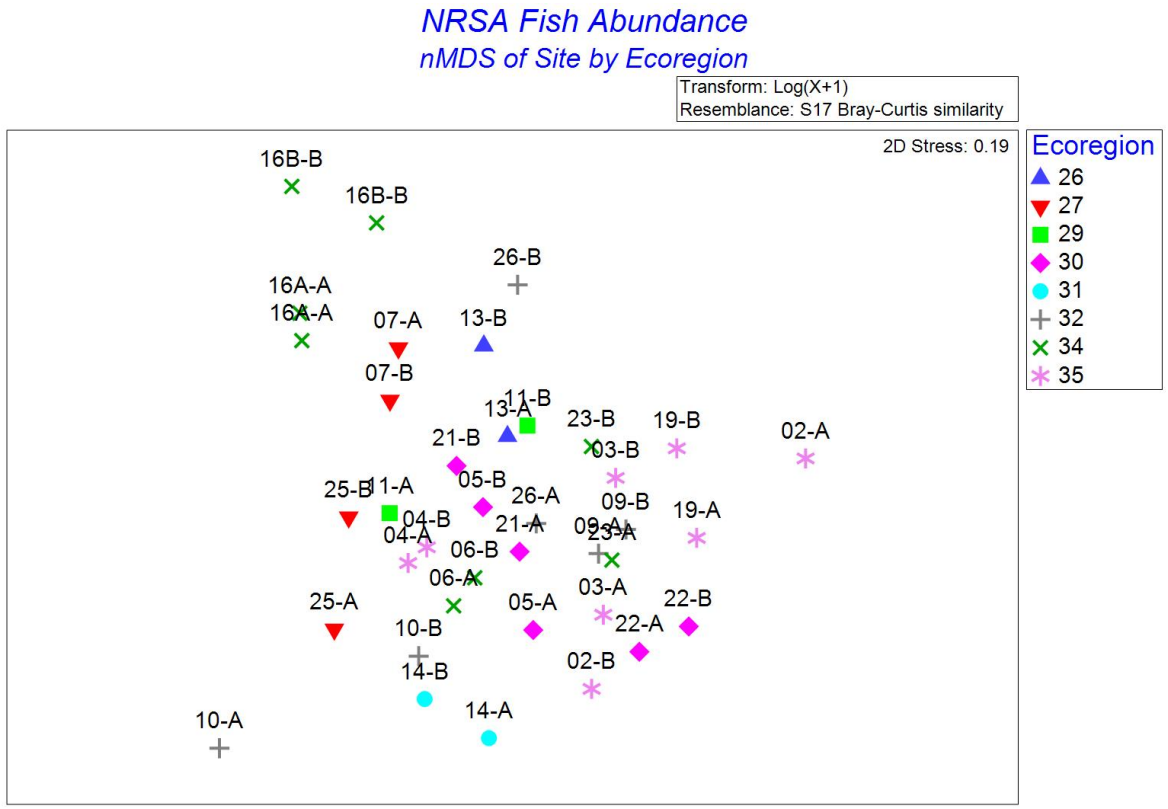
- PRIMER 7
  - CPUE → log(x+1) transformed
  - Bray-Curtis similarity
  - Ecoregion, River Basin, Stream Order
    - ANOSIM, SIMPER, nMDS

- Richness (S) & Shannon Diversity (H)

- Index of Biotic Integrity (IBI) calculated by Level III ecoregions (USEPA)
  - Aquatic Life Use (ALU): Limited, Intermediate, High, Exceptional

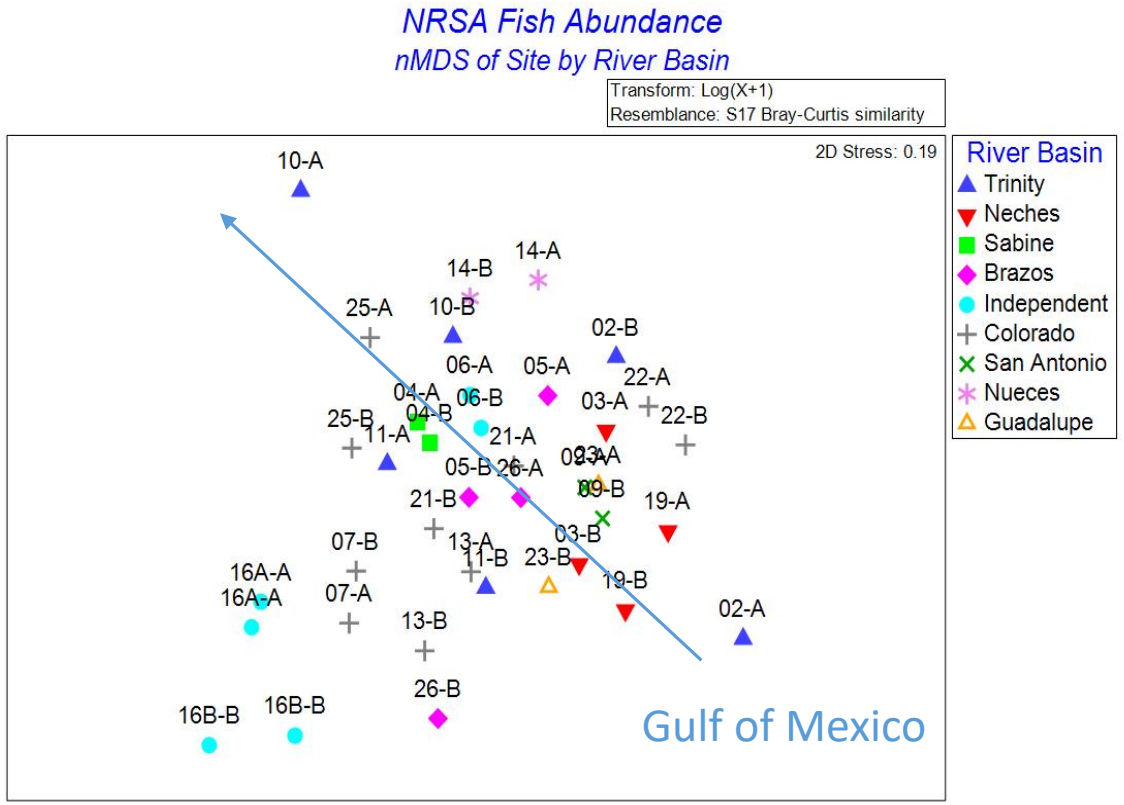


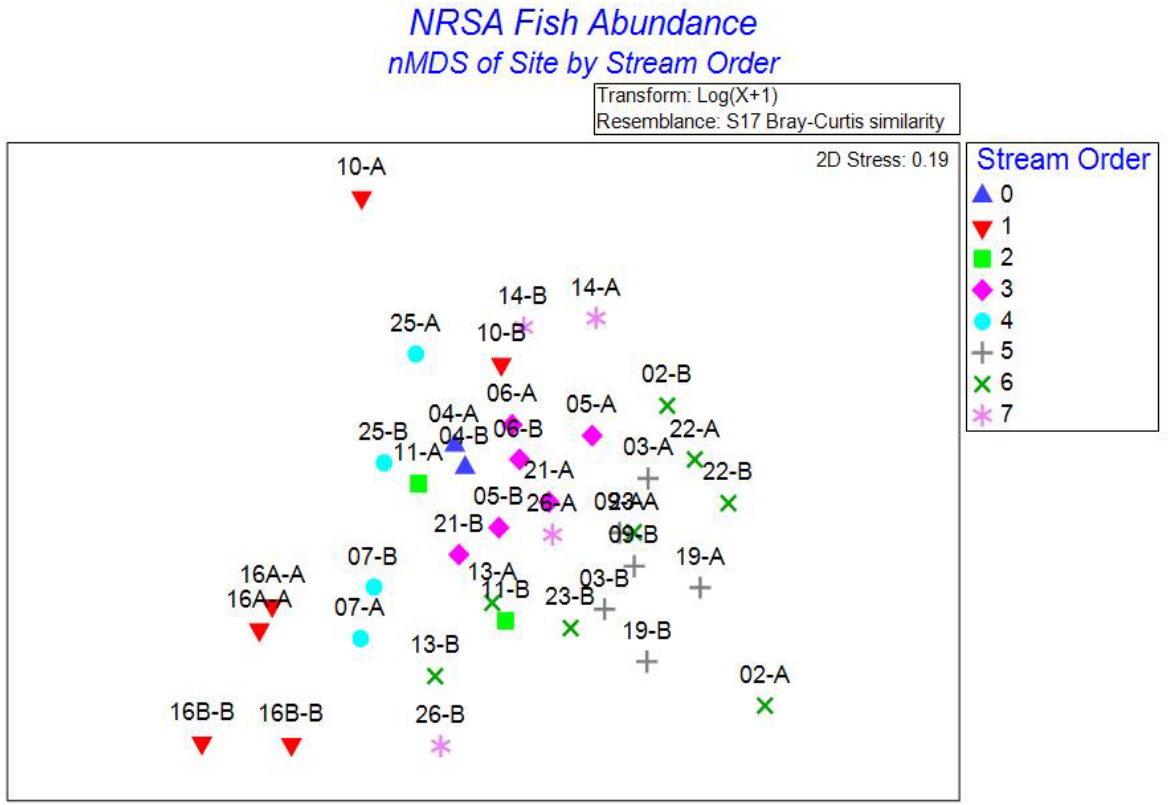
Results – Communities in Space



- ANOSIM
  - Edwards Plateau fish community significantly different from all other ecoregions:
    - Contributors (SIMPER):
      - ↑ *L. auritus*, *C. venusta*
      - ↓ *L. cyanellus*, *G. affinis*, *P. vigilax*

Results – Communities in Space





Results – Communities Through Time

- Richness (S)
  - 12 of 19 sites exhibited increase in number of species from 2013-14 to 2018
    - Greatest ↑ = Neches R., E. Carancahua C., Angelina R., Long C.
    - Greatest ↓ = Llano R., Brazos R., Colorado R.

- Diversity (H)
  - 9 of 19 sites exhibited increase in diversity
    - Greatest ↑ = Long C., Trinity R.
    - Greatest ↓ = Brazos R., Llano R., Colorado R.

Results – Communities Through Time

- Upgraded ALU:
  - Neches R., South Fork San Gabriel R., Brady C., Medina R., Spring C., Guadalupe R.
- Downgraded ALU:
  - Colorado R., Nueces R., White Oak Bayou

		2013-14		2018		% Change
Site Name	**Ecoregion**	**IBI**	**ALU**	**IBI**	**ALU**	**IBI**
Colorado River	26	36	Exceptional	27	Intermediate	-25.0
Brady Creek	27	39	Intermediate	43	High	10.3
North Concho River	27	39	Intermediate	35	Intermediate	-10.3
Spring Creek	29	42	High	51	Exceptional	21.4
South Fork San Gabriel River	30	32	Intermediate	46	High	43.8
Bear Creek	30	52	Exceptional	52	Exceptional	0.0
Llano River	30	50	High	46	High	-8.0
Nueces River	31	37	High	27	Intermediate	-27.0
Medina River	32	38	Intermediate	49	Exceptional	28.9
Long Creek	32	31	Limited	37	Intermediate	19.4
Brazos River	32	41	High	41	High	0.0
East Carancahua Creek	34	35	Intermediate	35	Intermediate	0.0
White Oak Bayou	34	37	Intermediate	23	Limited	-37.8
White Oak Bayou	34	35	Intermediate	29	Limited	-17.1
Guadalupe River	34	31	Intermediate	45	High	45.2
Trinity River	35	25	Limited	28	Limited	12.0
Neches River	35	40	Intermediate	52	Exceptional	30.0
Frost Creek	35	36	Intermediate	41	Intermediate	13.9
Angelina River	35	42	High	50	High	19.0

Discussion – Communities in Space

- Evident grouping of communities by Ecoregion – Expected (Linam et al. 2002)
  - Possible drivers: climate gradient; in-stream factors

- Sites by River Basin exhibit longitudinal gradient of fish communities
  - Coastal Plains and E. Texas sites exhibit greater abundance and diversity (Connor and Sutkus 1986, Lane 2014)

- Distribution of sites by Stream Order – Gear Limitations
  - 7^{th}-order streams located more central
    - Difficulty netting in swift waters
    - Location of e-fishing
    - Fish with the flow

Discussion – Communities Through Time

- Looking Better:
  - Long Creek consistently increased in S, H, IBI
    - Highly urbanized, transects not connected
  - Neches River greatest increase in S and IBI

- Impaired:
  - Colorado River – drop in all indices → greater % of non-native individuals
  - White Oak Bayou – drop in IBI → greater % of non-native and tolerant fishes in 2018
  - Nueces River – drop in IBI, H, J' → increase in non-native, tolerant, and diseased fish
  - Llano River – drop in all indices → greater % of non-native fishes

Limitations

- Data collected on paper forms (2008-09 & 2013-14) or USEPA NARS app (2018) on iPad
  - Habitat data recorded over multiple forms – difficult to consolidate into one database
  - NARS app does not output data into usable format
    - **More user-friendly output being discussed with EPA
- Limited staff and numerous projects
  - Need graduate students!!
    - Not enough hours in the day to analyze all this data

Conclusion

- The NRSA allows for comprehensive assessment of water bodies across the nation
  - Useful to inform managers of state waterbody conditions
- Elucidates need for management plan for several Texas streams
- Future Work
  - Sample more sites in 2019!
  - Analyze ecoregion and basin trends using all NRSA data
  - Assess changes in habitat through time

Acknowledgments

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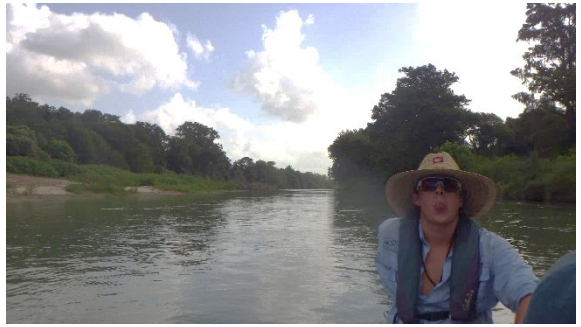

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