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# Preliminary Analysis of Spatial Patterns in Texas Lotic Fish Communities



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## Background

The Environmental Protection Agency (EPA) first implemented the National Rivers and Streams Assessment (NRSA) in 2008-2009 to assess the condition of the nation's flowing waters. The findings of their study suggested that 55% of the nation's river and stream miles did not support healthy populations of aquatic life. A second NRSA survey is underway for 2013-2014, utilizing the same random sampling design and analytical procedures to ensure that comparisons can be made across the country and over time. Collaboration between state, tribal, and federal partners is intended to improve monitoring across jurisdictional boundaries and enhance states' ability to assess and manage water quality. The Environmental Institute of Houston (EIH) is coordinating with the Texas Commission on Environmental Quality (TCEQ) and the EPA to conduct these surveys in Texas.



## Study Area

- Thirty one sites across Texas were sampled from June through September 2013 (Figure 4)
- Major river basins visited include the Red, Sabine, Neches, Trinity, Brazos, Colorado, Guadalupe, San Antonio, and Nueces
- Sites were classified as either "boatable" or "wadeable" and were visited only once (with the exception of three EPA designated revisit sites)

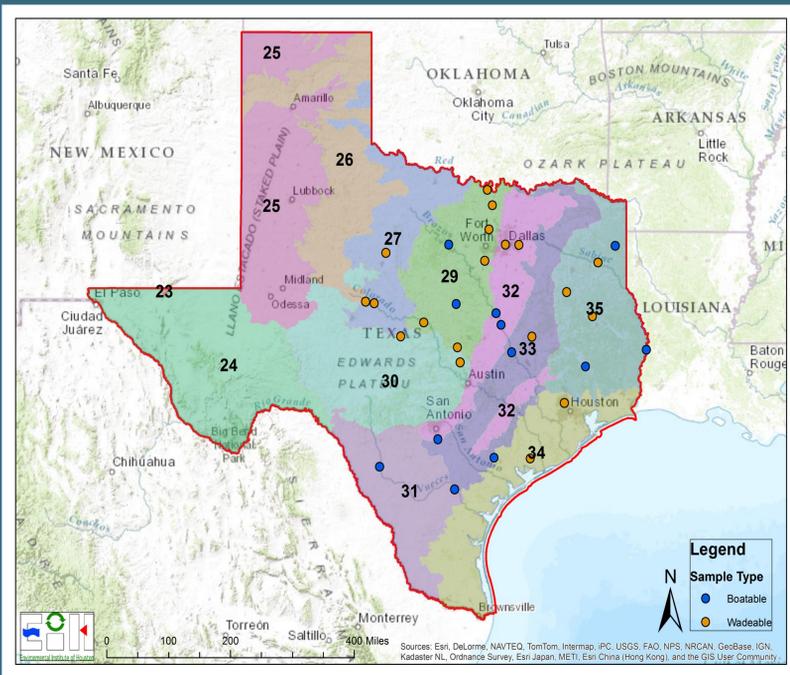


Figure 4: Map of 2013 study area (Texas) and sample sites. Note the TCEQ ecoregions.



Figure 5: Photo voucher of *Lepomis cyanellus*

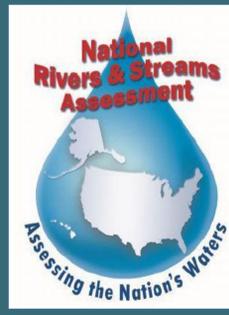
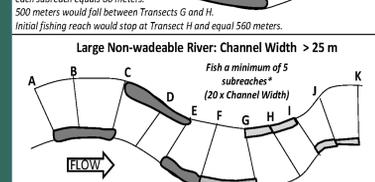
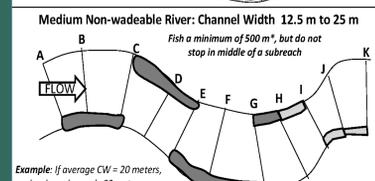
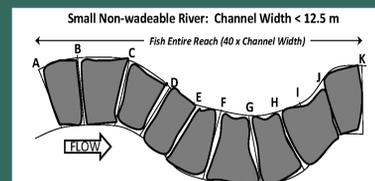


Figure 6: Photo voucher of *Minytrema melanops*

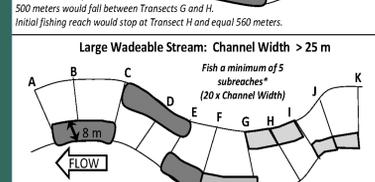
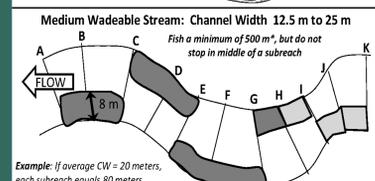
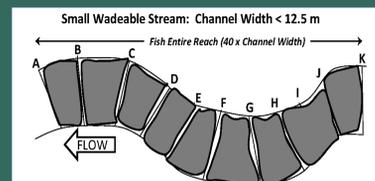
## Methods

- Sample reaches were oriented around an "X" site with given GPS coordinates which in most cases is transect F for each site (Figures 7 & 8)
- EPA protocol mandated that electrofishing be the primary method of sampling fishes, while seining was utilized only if absolutely necessary



\*At medium & large rivers, if < 500 individuals have been collected after minimum sampling reach, continue fishing to next transect (alternating banks) until 500 individuals are collected or Transect K is reached. (10 subreaches fished)

Figure 7: Laying out the sample reach for a boatable stream (Source: EPA 2013)



\*At medium & large streams, if < 500 individuals have been collected after minimum sampling reach, continue fishing to next transect (alternating banks) until 500 individuals are collected or Transect K is reached. (10 subreaches fished)

Figure 8: Laying out the sample reach for a wadeable stream (Source: EPA 2013)

- Additional parameters were collected at each site including benthic macroinvertebrates, periphyton, water chemistry, and physical habitat
- Index of Biotic Integrity (IBI) was calculated for each sampling event using the TCEQ ecoregion calculators developed by Linam et al. (2002)
- Fish community structure were grouped by ecoregion, major river basin, and stream order and analyzed using PRIMER 6 and Minitab 16 software.
  - All abundance data was Log(X+1) transformed

## Results

- At 30 different sample sites in 33 sampling events:
  - 15,999 total individuals were captured
  - 19 families were represented with a total of 43 genera and 78 species
    - 6 of these species were non-native
- IBI scores ranged from 23 to 52 (Figures 9 & 10)
  - IBI scores are slight underestimates because they were calculated without seining data (except for 2 sites)

## Results

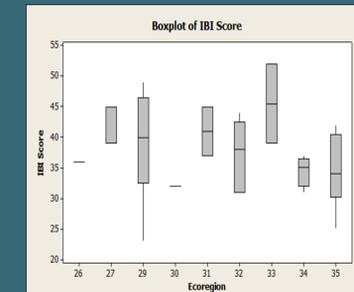


Figure 9: Breakdown of IBI scores by ecoregion

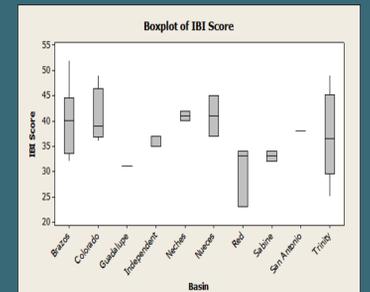


Figure 10: Breakdown of IBI scores by basin

- The highest mean values of Shannon diversity (H') were found in the San Antonio and Guadalupe basins (2.34 and 2.20)
- The lowest mean value of H' was found in coastal streams independent of a major basin (1.19)

Aquatic Life Use → Ecoregion ↓	Limited	Intermediate	High	Exceptional
25, 26	<24	24-33	34-35	>35
27, 29, 32	<35	35-40	41-48	>48
30	<30	30-41	42-51	>51
31	<25	25-36	37-41	>41
33, 35	<36	36-41	42-51	>51
34	<31	31-38	39-48	>48

Table 1: IBI scores by ecoregion and aquatic life use

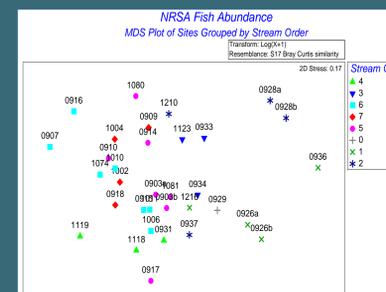


Figure 11: Non-metric Multi-Dimensional Analysis of NRSA sites utilizing Strahler stream order

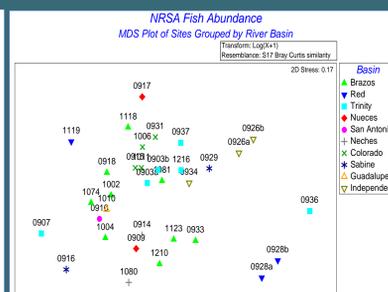


Figure 12: Non-metric Multi-Dimensional Analysis of NRSA sites utilizing major river basin

- MDS analysis by stream order produced gradients separating low order (0, 1, and 2) sites from high order (5, 6 and 7) sites (Figure 11)
- MDS analysis by basin produced less defined groups; Colorado River basin sites were the most similar to each other (Figure 12)

## Conclusions & Future Work

NRSA sampling will recommence in May 2014 and data collection is expected to be complete in September 2014. The addition of 2014 sample sites will complete the data collection for this project and allow for more thorough analysis of community assemblage by stream order, river basin, ecoregions and other parameters. The EPA will be analyzing and compiling data from all states over the next few years, while our project will be completed during 2015.

## Acknowledgments

We thank the EPA for funding NRSA research. We also thank Christine Kolbe with the TCEQ for project oversight and assistance with private landowner access and Robert Cook with the EPA for project oversight. We also thank EIH staff, students, and volunteers that have spent long, hot days in the field collecting page after page of data.

## For Further Information

Please contact [lane@uhcl.edu](mailto:lane@uhcl.edu). More information on this and related projects can be obtained at EIH webpage: [www.eih.uhcl.edu](http://www.eih.uhcl.edu). TCAFS: February 14, 2014