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

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 $\rightarrow$ 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

NRSA Fish Abundance
nMDS of Site by River Basin

NRSA Fish Abundance
nMDS of Site by Stream Order

Gulf of Mexico
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
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
  • 7th-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 $\rightarrow$ greater % of non-native individuals
  • White Oak Bayou – drop in IBI $\rightarrow$ greater % of non-native and tolerant fishes in 2018
  • Nueces River – drop in IBI, H, J’ $\rightarrow$ increase in non-native, tolerant, and diseased fish
  • Llano River – drop in all indices $\rightarrow$ 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
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