NUTRIENT IMPACTS ON AQUATIC COMMUNITIES IN SIX WADEABLE BRAZOS-BASIN STREAMS

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Southeast and South Central Texas Regional Watershed Coordination Steering Committee – 2 September 2010

Water Quality Regulations

Nutrients from permitted discharges or other controllable sources shall not cause excessive growth of aquatic vegetation which impairs an existing, attainable, or designated use

Texas Surface Water Quality Standards, 2000

Clear Lake (Houston) *Prorocentrum* bloom, Feb. 2005

Texas Schedule

Reservoirs – 2008

Streams - 2011

Estuaries – 2011

Wetlands - TBD

Project Outline

Goal: to help TCEQ develop science-based numeric nutrient criteria for Texas streams

- assess fish, benthic macroinvertebrates, water quality and habitat
- explore potential of mussels and periphyton to indicate nutrient impacts

Little Elm Creek

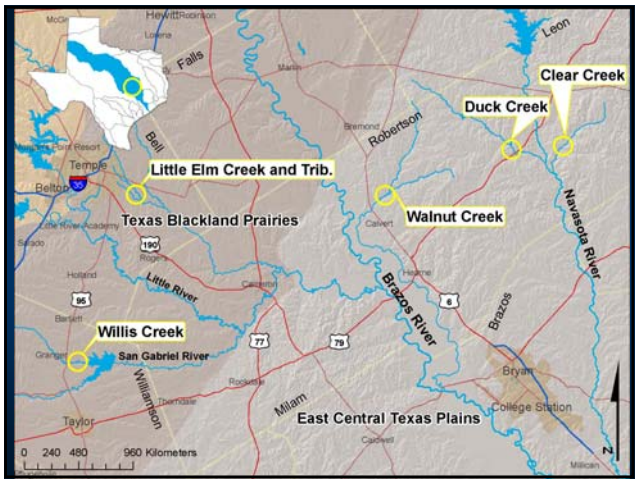
Bowfin, Clear Creek

Funded by USFWS State Wildlife Grant

Sampling Effort (2007-2008)

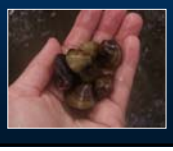
- Six wadeable streams
  - three in East Central Texas Plains (ecoregion 33)
  - three in Texas Blackland Prairies (ecoregion 32)
  - varying nutrient levels and sources
- Hydrologic conditions
  - 2007 unusually wet
  - 2008 severe drought
- Data collection
  - Four events
  - April through October

Clear Creek

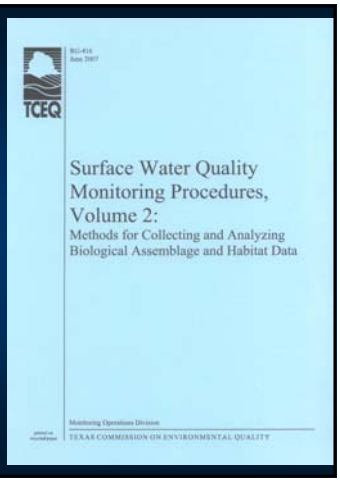


Results - freshwater mussels

- Methodology – random visual survey
- Results – found shells and valves, but no live mussels. 14 species. Four of streams had only 3 species. Willis had 9 and Walnut had 6 species.
- Live *Corbicula* was common in all streams



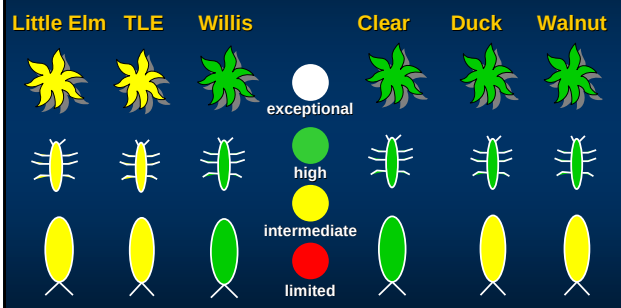
Evaluating habitat, fish and benthic macroinvertebrates



Results – Water Quality

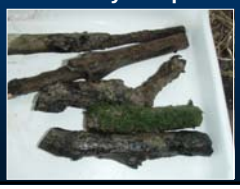
- Blackland Prairies streams had higher average nutrient levels (mg/L):
  - nitrate-N 2-6
  - total P 0.05-0.55
- East Central Texas Plains:
  - nitrate-N 0.11-0.36
  - total P 0.001-0.05
- DO looked good except during low flows in drought of 2008
- Diel DO swings at TLE

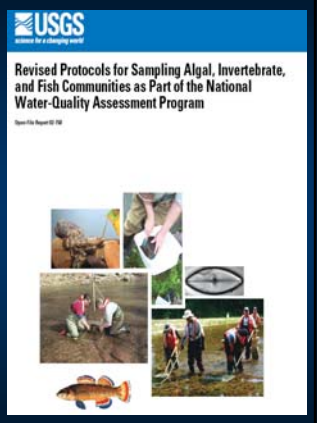
Results – habitat, “bugs” and fish



Periphyton

- Periphyton = algae, fungus, and bacteria
- Sampled from woody debris (no riffles)
- Biomass estimated by chlorophyll-a and ash-free dry mass (AFDM)
- Community composition

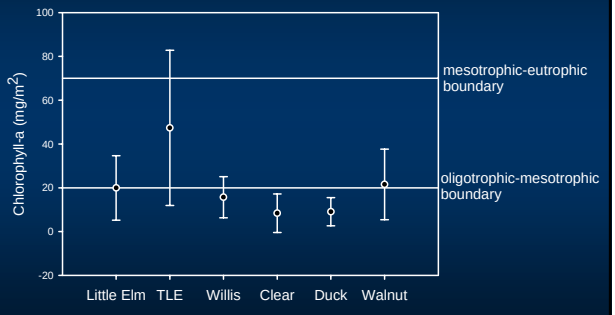




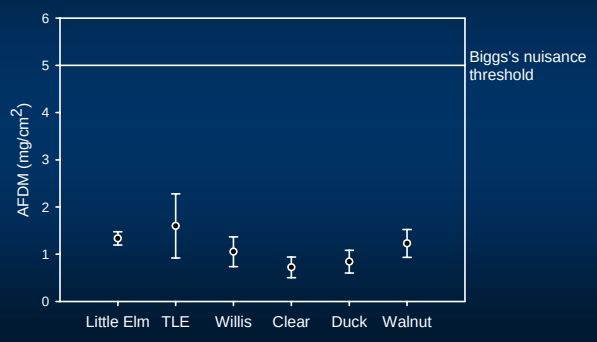
Periphyton Collection (Biomass)

- Composite from 5 pieces of woody debris
- Scrape a known area
- Homogenize sample
- Filter aliquots for lab analysis for chlorophyll-a and AFDM
- Per TCEQ and USGS procedures
- Taxonomic ID

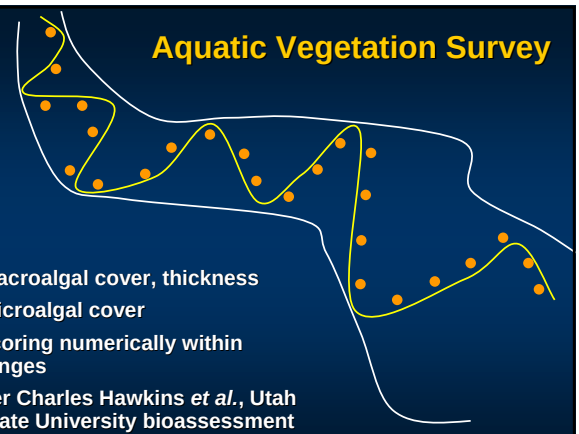
Results – Benthic algal chlorophyll-a



Results – Benthic algal AFDM



Aquatic Vegetation Survey



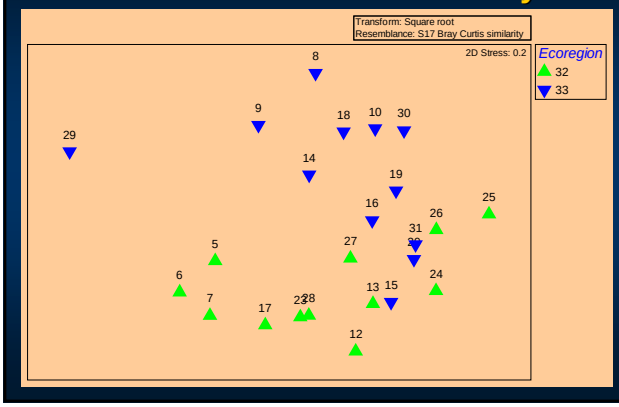
- macroalgal cover, thickness
- microalgal cover
- scoring numerically within ranges
- per Charles Hawkins *et al.*, Utah State University bioassessment protocols

Estimating periphyton growth

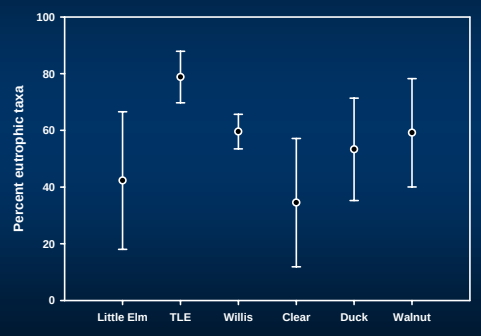
Spearman rank correlations (ρ)	Benthic chl-a
Benthic AFDM	0.70
Algal cell density	0.75
Macroalgae cover	0.53
Macroalgae thickness	0.52

Also, benthic AFDM and algal cell density (ρ = 0.57)

Results – Diatom Community



Results – diatom metrics



Lessons Learned

- Flow matters! Scouring affected sampling of periphyton, benthic macroinvertebrates and fish. Flow must be taken into account when sampling and interpreting results.
- Dr. King and Dr. Winemiller study looking at similar parameters is a good study to read relating to this topic.
- Diatom communities appear to be ecoregion-specific
- Periphyton growth may show elevated nutrient levels before extreme conditions occur.
- Periphyton biomass and the diatom community differentiated wastewater dominated streams from non-wastewater dominated streams.

Lessons Learned

- Periphyton cheap and easy to collect.
- Diatom metrics show promise.
- Good agreement between periphyton biomass, algal cell density, and visual/tactile measures of aquatic vegetation
- Nutrient criteria may need to acknowledge ecological differences, i.e. ecoregions.
- We would recommend periphyton as a potential way to collected nutrient data.

Thanks!

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TCEQ Region 4 - Wilson Snyder, Robbie Ozment

Baylor University – Thad Scott (now at U. of Arkansas), Ryan King

LCRA – Gary Franklin

Tehuacana Creek

Duck Creek

Questions?

Report available
at http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/