Riparian Habitat Quality Assessment Following Stream Restoration

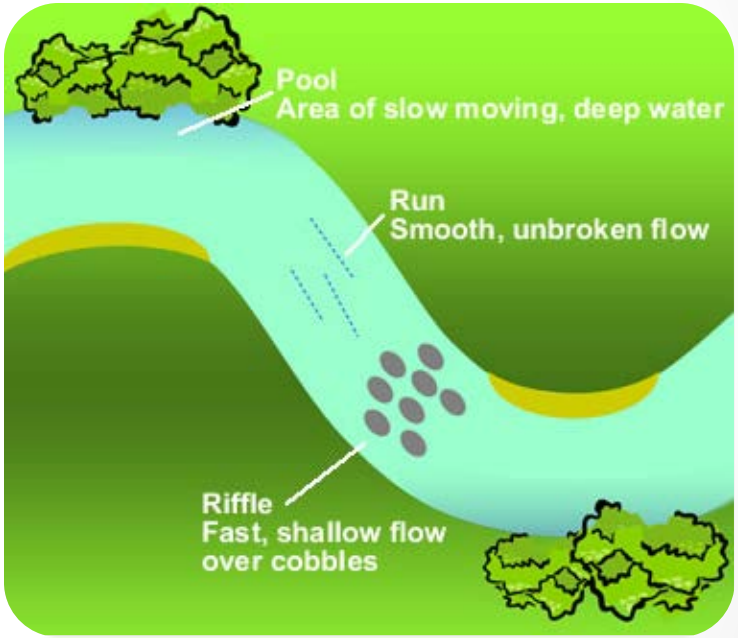
Michele Goodfellow
Earth and Environmental Sciences
College of Science and Engineering
University of West Florida

Outline

- Importance
- Objectives
- Existing Indices
- The Index
  - Index Criteria
  - Index Components
  - Field Data
  - Index
- Future Direction
- Sources

Riparian "Buffer"

- Importance of the riparian habitat
  - Species habitat
  - Stream temperature
  - Bank stabilization



(University of Arizona)

Riparian Habitat

- Biodiversity:
  - Ecosystem services: plant diversity
  - Riparian plant diversity: wildlife diversity
- Vegetation linked to macroinvertebrate diversity/ abundance

Restoration on Diversity

- Studies show increases in species diversity
  - Vascular plants (+45%) (Meli et al., 2001)
- Biodiversity rarely reaches predegradation levels

Objectives

A. Create an index to assess riparian habitat quality in a southeastern Alabama
B. Reflect both flora, fauna, and stability components of habitat in the index
C. Calibrate the index in D'Olive watershed
D. Assess capability to distinguish site category
    A. Compare Index stability to Pfankuch/ NBS
    B. Compare Index capability to assess habitat quality to Simpsons Index

Existing Indices

- Riparian Quality Index
  - spatial distribution of vegetation and lateral connectivity focus
    - does not capture environmental sensitivities in microenvironments
- Index of Biological Integrity
  - Cumulative environmental impacts as determined through macroinvertebrate, fish, and algae samples
    - not calibrated in study area
    - Requires intensive field work

Index Criteria

- Minimize field component
- Specific to the region
- Minimal weighting of all factors
- Able to distinguish between poor, moderate and good site conditions
- Created specifically for Restored Urban Streams

Index Components

- Buffer Width
  - Protected by legislation
  - Southeastern United States:
    - 12.1m intermittent streams
    - 19.4 m large streams
- Bank Erosion Hazard Index (BEHI)
  - Subjective index to rate erosion risk
  - Erosion is essential part of stream life
  - Taxon diversity found greatest during intermediate rates of sedimentation/deposition

Index Components

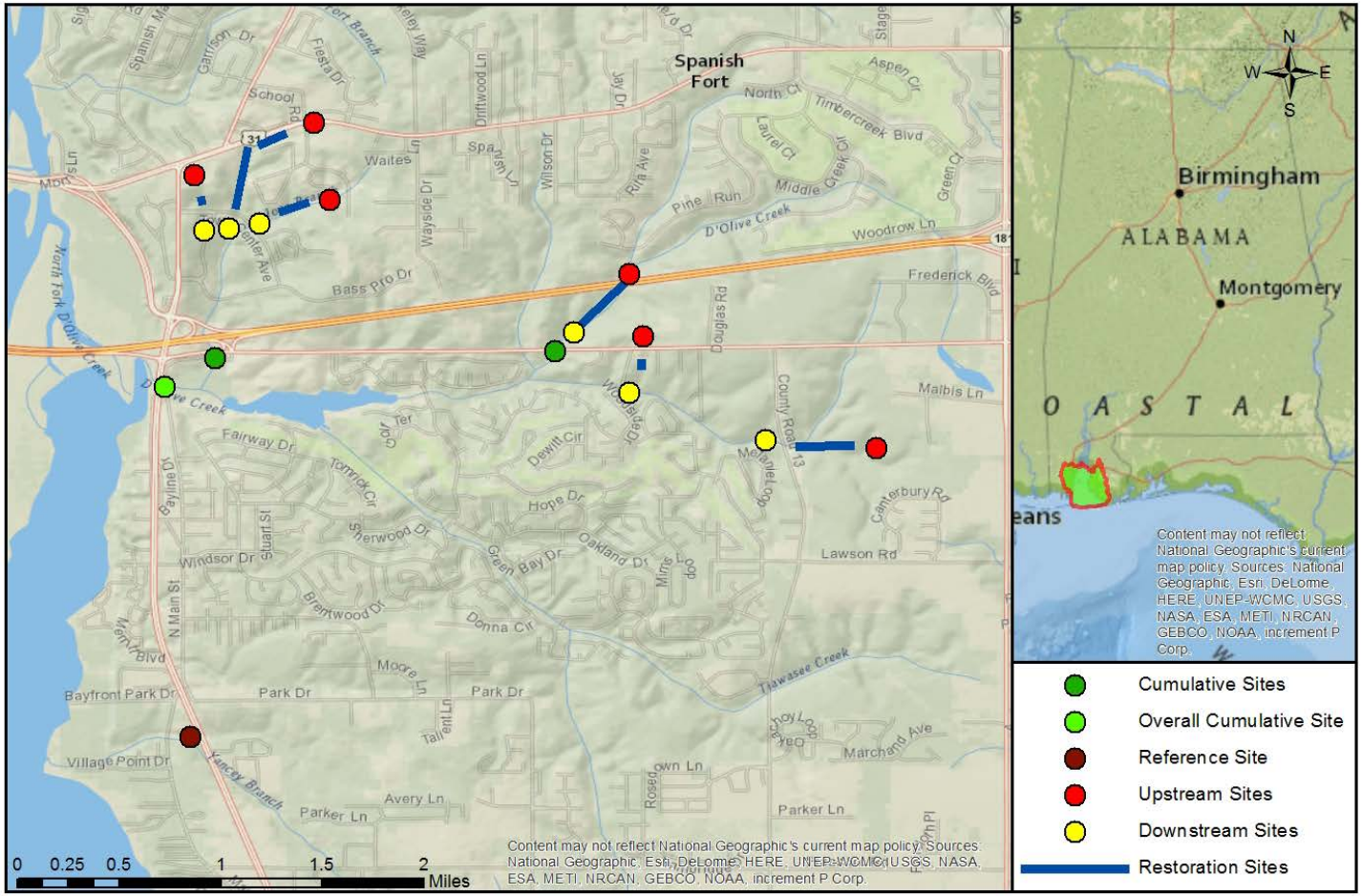
- Canopy Cover
  - Stream shading
  - Light attenuation
  - Provides organic matter/biogeochemical elements to system
- Tree Basal Area
  - Average area occupied by trees
- Bank Root Density
  - Stability measure of streambank
  - Objective measure

Index Components

- Leaf Litter
  - Primary source of nutrients/minerals to system
- Structural Complexity
  - Vertical structure increases habitat complexity
  - Increased complexity allows for increased carrying capacity
- Presence of Non-Natives
  - Display human impact on urban streams

Field Data

D'Olive Watershed Restoration sites



Field Data

D'Olive Watershed Restoration sites

Field Data Collected:

- BEHI
- NBS
- Vegetation Survey (Overstory, understory, streambank cover)
- Longitudinal Stream Profile
- Riffle Cross Section Geomorphology
- Root density analysis

Habitat Condition

	Poor (1)	Moderate (2)	Good (3)
Buffer Width [3,4, 5, 6,7,14,15,18]	low (0-10m)	moderate (10-20)	high (>20m)
BEHI[1, 10, 11, 14, 15]	high- extreme (29.6-50)	moderate (20-29.5)	very low -low (5-19.5)
Canopy Cover[12]	high (89-100%)	low (30-50%)	moderate (51-88%)
Tree Basal Area[9,12,13]	very high (>100)	moderate (71-100)	low (<70)
Bank Root Density[2,14]	low % (0-29%)	moderate (30-55%)	high percent (55-100%)
Leaf Litter[8, 14]	very low or very high (0-10%,>90%)	Low-moderate (11-39%)	moderate-high (40-89%)
Structural Complexity[14, 16]	low (1 stratum)	moderate (2 strata)	high (>2 strata)
Non-Native Species Present	Yes (1)		No (3)

Data

SITE NAME	VISIT	INDEX VALUE	CATEGORY
JBD	1	17.0	MODERATE
JBD	**2**	**14.0**	**MODERATE**
J41-2 U	1	17.0	MODERATE
J41-2 D	1	18.0	MODERATE
J41-2 D	2	18.0	MODERATE
TCC	1	16.0	MODERATE
JBC	1	17.0	MODERATE
JBC	2	17.0	MODERATE

Score 7-13	Score 14-19	Score 20-24

Future Direction

Assessing Index capabilities:

- Determine if index is able to identify poor habitats qualitatively (visit 3)
- Compare results to other stability/habitat metrics (i.e., Pfankuch, NBS)
- Compare results to Simpsons diversity index

Sources

1. Brown, B.L., (2003). Spatial heterogeneity reduces temporal variability in stream insect communities.*Ecol. Lett*. *6* (4), 316–325
2. Casatti, L., Ferreira, C. P., & Langeani, F. (2009). A fish-based biotic integrity index for assessment of lowland streams in southeastern Brazil. *Hydrobiologia*, *623*(1), 173–189. http://doi.org/10.1007/s10750-008-9656-x
3. Hodges, M. F., JR., & D. G. Krementz. (1996). Neotropical migratory breeding bird communities in riparian forests of different widths along the Altamaha River, Georgia. *Wilson Bull*, 108, 496– 506.
4. Keller, C. M. E., C. S. Robbins, & J. S. Hatfield. (1993). Avian communities in riparian forests of different widths in Maryland and Delaware. *Wetlands, 13*, 137–144.
5. Kilgo, J. C.,. A. Sargent, B. R. Chapman, & K. V Miller. (1998). Effects of stand width and adjacent habitat on breeding bird communities in bottomland hardwoods. *Journal of Wildlife Management 62,* 72-83.
6. Lee, P., Smyth, C., & Boutin, S. (2004). Quantitative review of riparian buffer width guidelines from Canada and the United States. *Journal of Environmental Management*, *70*(2), 165–180. http://doi.org/10.1016/j.jenvman.2003.11.009
7. Lowrance, R.R., Sheridan, J.M. (2005). Surface runoff water quality in a managed three-zone riparian buffer. *Journal of Environmental Quality*, *34*(5): 1851-1859.
8. Mesa, L., Reynaga, M., del V. Correa, M., & Sirombra, M. (2013). Effects of anthropogenic impacts on benthic macroinvertebrates assemblages in subtropical mountain streams. *Iheringia*, *103*(4), 342–349.
9. MS Wildlife, Fisheries, & Parks. *BASAL AREA A Guide for Understanding the Relationships between Pine Forests and Wildlife Habitat.* : MS Wildlife, Fisheries, & Parks, *Hunting Management Literature*. MS Wildlife, Fisheries, & Parks. Web.
10. Miyake, Y., & Nakano, S. (2002). Effects of substratum stability on diversity of stream invertebrates during baseflow at two spatial scales. *Freshwater Biology*, *47*(2), 219–230. http://doi.org/10.1046/j.1365-2427.2002.00798.x
11. Mykra, H., Heino, J., Oksanen, J., Muotka, T., (2011). The stability–diversity relation-ship in stream macroinvertebrates: influences of sampling effects and habitat complexity. *Freshwater Biology, 56*, 1122–1132.

Sources

12. Nislow, K. H., & Lowe, W. H. (2006). Influences of logging history and riparian forest characteristics on macroinvertebrates and brook trout (Salvelinus fontinalis) in headwater streams (New Hampshire, U.S.A.). *Freshwater Biology*, *51*(2), 388–397. http://doi.org/10.1111/j.1365-2427.2005.01492.x
13. Sagar R. & Singh J.S. (2006). Tree density, basal area and species diversity in a disturbed dry tropical forest of northern India: Implications for conservation. *Environmental Conservation*, *33*(3), 256–262.
14. Simpson, Aiden, Ian Turner, Eve Brantley, and Brian Helms. "Bank Erosion Hazard Index as an Indicator of near Bank Aquatic Habitat and Community Structure in a Southeastern Piedmont Stream." *Ecological Indicators* 43 (August 2014): 19–28. doi:10.1016/j.ecolind.2014.02.002.
15. Stewart, J. S., Wang, L., Lyons, J.,Horwatich, J. A., & Bannerman, R. (2001). Influences of watershed, riparian-corridor, and reach-scale characteristics on aquatic biota in agricultural watersheds. *Journal of the American Water Resources Association*, *37*(6), 1475–1487. http://doi.org/10.1111/j.1752-1688.2001.tb03654.x
16. Townsend, C. R.,Scarsbrook, M. R., & DolèDec, S. (1997). The intermediate disturbance hypothesis, refugia, and biodiversity in streams. *Limnology and Oceanography*, *42*(5), 938–949. http://doi.org/10.4319/lo.1997.42.5.0938
17. University of Arizona Website
18. Wegner, S. (1999). A review of the scientific literature on riparian buffer width, extent and vegetation. University of Georgia.

QUESTIONS?