Landscape Characteristics of a Stream and Wetland Mitigation Banking Program

The North Carolina Ecosystem Enhancement Program

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Overview and Objectives

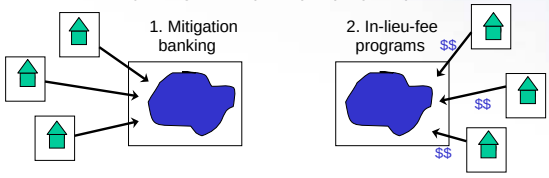
- Introduction and Background
- EEP and Corps Data
- Analysis Methods
- Results and Discussion

Wetland Mitigation in North Carolina

- 1989 – NC General Assembly passes Highway Trust Fund Act
  - Increases Section 401 and Section 404 permit needs
  - Fin du Monde: **delayed road construction**
- DOT performed own restoration until 1996
- Wetland Restoration Program (WRP) in 1996
- Established *in lieu fee* Ecosystem Enhancement Program (EEP) in 2003
- SB 1885, 2008 – Private mitigation banks must be used first

Off Site Wetland Mitigation

- Compensation of wetland damage by paying other people to restore/create/preserve alternate wetlands
  - "Third Party Mitigation" (Multiple projects)



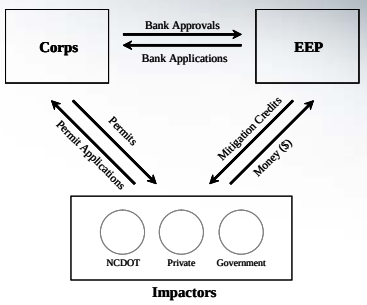
Wetland Mitigation Policy

Change is the rule

- Federal command-and-control regulation
  - Clean Water Act of 1972 (1977 Amendments)
    - "Waters of the United States" = 'navigable waterways'
    - Judicial interpretation eventually includes wetlands (continuing)
- Policy chaos
  - 1984 FWS Status and Trends Report: No change, continued losses
- "No Net Loss" Policy – 1988 Wetlands Policy Forum
  - Prevent a net loss of Nation's wetland acreage or function
  - Sequencing guidelines:
    - 1. Avoid
    - 2. Minimize
    - 3. Compensate

•EPA/Corps 1990 *guidance* on 'mitigation' - allow continued wetland conversion (takings)
•EPA/Corps 1995 ***guidance*** on 'mitigation banking'
•EPA/Corps 2000 ***guidance*** on 'in-lieu fee programs'
•EPA/Corps 2008 ***federal rule*** on "compensatory mitigation programs"

NC Compensatory Mitigation Structure



Research Questions

(1) What are the spatial relationships between stream and wetland impact and compensation sites?
- How do the characteristics of impacts sites compare with mitigation sites?
- Spatial characteristics of transactions
- How do impacts compare among types of developers?

(2) To what extent does mitigation relocate high quality streams within the river network?
- How does this affect localized loss or gain of aquatic resources?

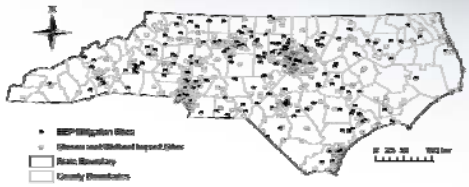
Data Sources

- An exercise in database management!
- EEP Ledger: impact and mitigation database
  - 1,406 (879) transactions
- EEP Restoration Database
  - 553 (191) mitigation sites
  - **Location** / type / size / information
- Corps and NC DWQ Impact Permits
  - 52,001 (677) + 29,707 (104) permit records = 676 impacts
  - **Location** / owner / size / date / information

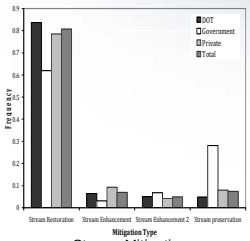
Analysis Methods

- Descriptive Statistics of wetland impacts and restoration projects by developer type
- Euclidean and Stream Network distance between Impact and Restoration Sites
- Drainage Area Comparison (NHD+ Flow Accum.)
- Global (Moran's I) and Local (LISA) Cluster Analysis (Anselin 1995; Brody and Highfield 2005, Anselin 2007)

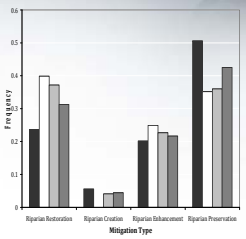
EEP Impact and Mitigation Sites



Mitigation and Impactor Types

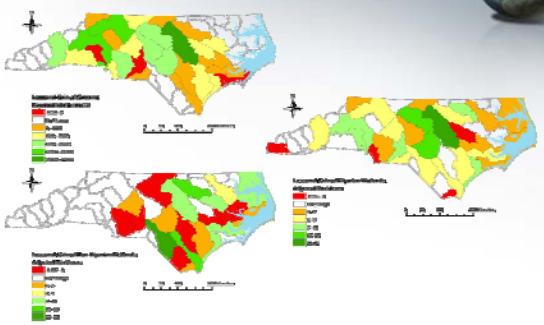


Stream Mitigation

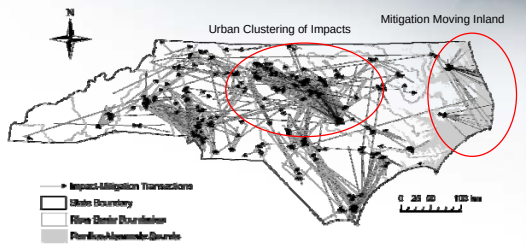


Riparian Wetland Mitigation

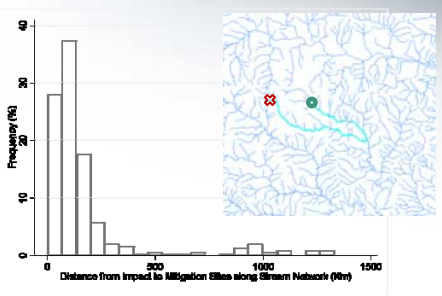
Loss & Gain of Wetlands



EEP Mitigation Transactions

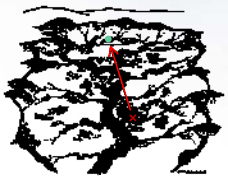


Network Distance Analysis

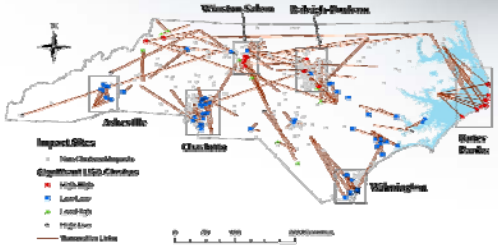


Drainage Area Comparison

- Impact sites drained, on average, 144 km^2 compared to 43km^2 at mitigation sites ($p < 0.0001$, n=408)
- Differed among impactor type
- Restoration sites high in catchment may not receive as much flow as the impact sites they mitigate.



Cluster Analysis



Consequences of NC EEP

- NCEEP: permitted aquatic resource impacts have led to virtually no net-loss of streams or wetlands at the 8-digit watershed scale
  - 2:1 Mitigation ratio
- Permitted impacts on streams tend to be comparatively larger and more common than impacts on wetlands.
  - Stream Restoration becoming more prevalent in NC
  - EEP incentives restoration over other forms of enhancement
- Transaction Distances fairly high, even within 8 digit HUC
  - NC DOT demonstrated highest transaction distance (63.3 km)
- Clustering based on transaction distances
  - High-high clusters problematic

Ecological Consequences

- Affects on local urban amenities
  - Open space, recreation, urban flooding, access to nature
  - Shuts off ecological services and values in one place/time and starts services/values in another
  - Wetland *relocation* from urban areas to rural areas & loss of Ecosystem Services
- Ecological differences
  - Place-specific ecological processes
    - Barrier wetlands migrating inland
    - Headwaters vs. downstream wetlands
    - Isolated, fragmented wetlands vs. large, contiguous (SLOSS debate)

Tradeoffs in Wetland Mitigation

Wetlands Tradeoffs

Thank you! Questions/Comments?

Ecological Criticism of EEP

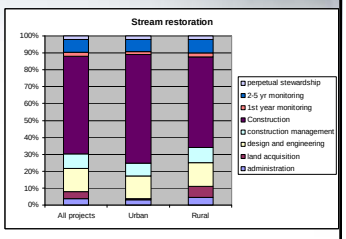
- EEP Restoration sites have not been effective (Penrose 2006)
- No project has met basic ecological success criteria to date

Economic Criticism of the EEP

- Approximately $48 million spent on design-bid-build stream restoration by EEP
  - 191,374 total linear feet restored (128,997 ft in 25 rural projects and 62,377 in 19 urban projects)
- EEP has 'bought high, and sold low' (Templeton 2006)
  - Costs $287/linear ft, sold at $232/linear ft
- Because EEP is undercharging for credit production, private banks have difficulty competing
- Because EEP has misjudged credit creation in many areas
  - Undershot in many urban areas, overshot in rural areas (Dye 2007)
- Urban-rural migration issues

Public Lands Issue

- EEP preferentially works with municipalities and others that donate land (e.g., UNC)
- Bankers primarily work with private landowners (imagine asking for land to make profit)
- Inequality of land acquisition costs
  - EEP undercutting private bank system?



Summary: Wetlands/Streams and the Mitigation Paradigm

- "Mitigation paradigm"
  - Restoration and market for restoration credits are panacea for environmental damage
- We see problems
  - Markets are spatial: space matters
  - Commodification is different – many types of wetlands
  - Restoration takes time – discounting is important
  - How do we enforce regulations and promote efficiency in the mitigation system?
- How and when can environmental restoration be promoted in an economically efficient manner, as well as ecologically *and* socially responsible manner?
  - Who wins? Who loses?
- What role does planning play in all of this?

Relationship to urban areas

- Urban stream degradation traded for rural restoration?
  - Landscape implication #1: We are replacing streams with streams that are worse off (urban areas where they will be degraded quickly)
  - Landscape implication #2: Good/restored streams are 'relocating' to publicly owned spaces rather than privately owned spaces
- NC: Sharp urban-rural interface (85 of 100 counties are rural)

Displacement Distances

	N	Mean (km)	Std. Dev.
Permitting Source			
ACOE	808	13.68	22.1
DuPage	206	7.89	7.78
Kane	19	15.71	12.53
Lake	67	12.24	9.43
Mitigation Method			
Bank	375	→ 25.56	24.55
ILF-Corlands	79	→ 24.68	14.24
ILF	91	12.71	8.08
OFF	93	11.86	16.74
Total	1100	12.54	19.57