Ecosystem Restoration: Reference Systems, Trajectories, and Measures of Success

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Ecosystem Restoration - Wake Up Calls

Kissimmee River 1961-1972: channelized & floodplain drained
Ecosystem "collapse" WRDA '92: restoration program authorized

Katrina 2005 - The value of coastal wetlands is front page news

Mississippi River – '93 Flood 70 towns completely inundated; Principal causes were extensive levee system & lack of wetland buffer areas

Nonpoint source/stormwater runoff are a leading cause of eutrophication and use non-attainment

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What is Ecological Restoration?

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. The intent is to return an ecosystem to a sustainable community structure with a natural complement of species and ecological functions.

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Why Restore Ecosystems?

- Ecological Benefits
- Public Benefits
- Regulatory Requirements/ Mitigation
- Public Relations/Community Involvement

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Attributes of Restored Ecosystems
(SER Primer)

1. Species composition (mimic reference systems)
2. Native (indigenous) species
3. Functional groups (stability)
4. Physical environment (stability)
5. Seral stage functioning normally
6. Landscape context (integration)
7. External threats reduction
8. Stress resilience
9. Self-sustaining

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Restoration Project Questions

- What do we want to restore?
- What do we want it to be like?
- What are our restoration goals?
- Working with the stakeholders?
- Where's the money?
- Did we succeed?

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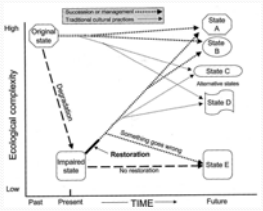
What do we want it to look like?

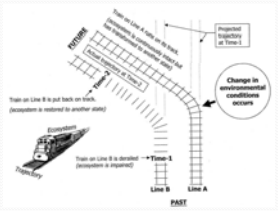
Reference systems

- Reference System Models
  - Same place, same time
  - Different place, same time
  - Same place, different time
  - Different place, different time

What do we want it to look like?

Ecological Trajectories





Measuring and Communicating Success

- Measuring Success
  - Make goals reasonable
  - Set measurable goals
  - Tailor monitoring programs to measurable goals
- Communicating Success
  - Press releases
  - Press events
  - Newsletters
  - Signs and displays
  - Public meetings/workshops
  - Awards

Ecosystem Restoration Measures of Success

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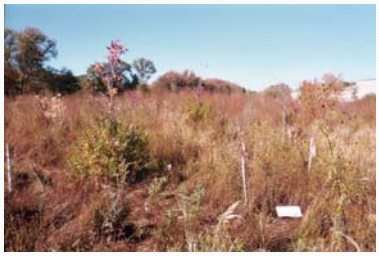
Measures of "Success"

- Qualitative Assessment of Health (the Good, the Bad, and the Ugly)
- Simple Stem Counts: % Survival/% Recruitment
- Percent Bare Ground, Open Water
- USACE Wetland (Vegetative) Criteria
- Functions and Values Based Criteria
- Species Diversity and Dominance Indices

Qualitative Assessment of Health (the Good, the Bad, and the Ugly)

Simple Stem Counts: % Survival/% Recruitment



Number and percentage of originally-planted and recruited species within each upland plot in Year 5

Upland Plot	Recruited Species	Original Species	% Recruits	% Originals
U1	4	3	57.1	42.9
U2	9	2	81.8	18.2
U3	2	1	66.7	33.3
U4	5	2	71.4	28.6
U5	2	1	66.7	33.3
U6	2	2	50.0	50.0
U7	No data	No data	No data	No data
U8	3	2	60.0	40.0
U9	3	2	60.0	40.0
U10	3	2	60.0	40.0
Average	**3.7**	**1.9**	**63.7**	**36.3**

Percent Bare Ground or Open Water

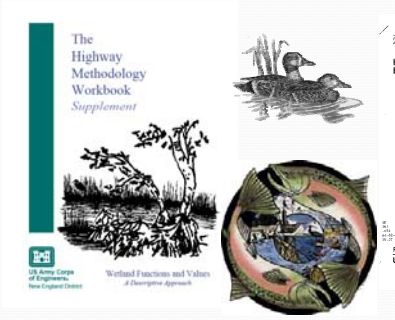
	% Cover of Bare Soil				
Upland Plot	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
U1	38	10.5	10.5	0	0
U2	63	38	10.5	3	3
U3	10.5	3	3	20.5*	3
U4	20.5	10.5	10.5**	3	0
U5	20.5	20.5	0**	0	0
U6	38	20.5	10.5	0	0
U7	20.5	***	***	***	***
U8	0	0	0	0	0
U9	20.5	20.5	0	0	0
U10	10.5	0	0	3	0
Average	**27**	**16**	**5**	**3**	**0**

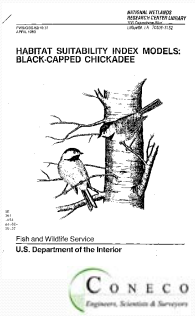
* Upland Plot 3 was recreated in Year 4.
** Upland Plots 4&5 were recreated in Year 3
*** Upland Plot 7 was destroyed by site activities in Year 2.

USACE/USFWS Wetland Criteria


FIELD DATA SHEET -- WETLANDS MONITORING

Functions and Values Based Criteria





Species Diversity (Richness) Index

Margalef (d_1) Index

$d_1 = (S-1)/(\ln N)$

where S = number of species and
N = total stem count

low (0) d1 = no diversity
high d1 = high diversity

Species Dominance Index

Simpson's (c) Index of Dominance

$$c = \Sigma(n_i/N)^2$$

where n_i = count per species, N = total count

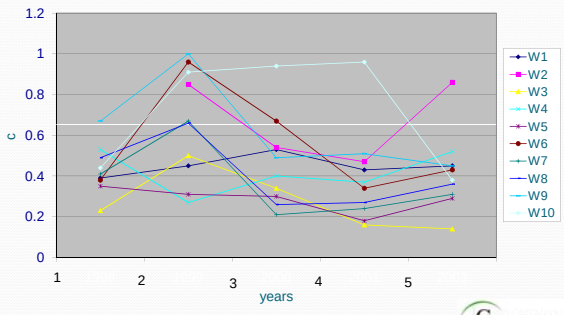
c = 0 - no one species dominates
c = 1 - one species dominates

Simpson's Index of Dominance (c), comparison of wetland ($1m^2$) plots

Plot	Year 1	Year 2	Year 3	Year 4	Year 5
W1	0.39	0.45	0.53	0.43	0.45
W2	*	0.85	0.54	0.47	0.86
W3	0.23	0.50	0.34	0.16	0.14
W4	0.53	0.27	0.40	0.37	0.52
W5	0.35	0.31	0.30	0.18	0.29
W6	0.38	0.96	0.67	0.34	0.43
W7	0.41	0.67	0.21	0.24	0.31
W8	0.49	0.66	0.26	0.27	0.36
W9	0.67	1.0	0.49	0.51	0.45
W10	0.44	0.91	0.94	0.96	0.38

*created in Year 1

Simpson's Index of Dominance for Wetland Plots

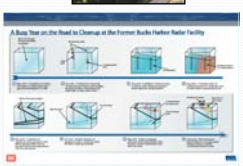


Example of multi-tier analysis

- First level of analysis: does each plot still qualify as a wetland.
- Second level of analysis: are there changes in the community makeup.
- Third level of analysis: species diversity.

Measuring and Communicating Success

- Measuring Success
  - Make goals reasonable
  - Set measurable goals
  - Tailor monitoring programs to measurable goals
  - Choose Your "Success Metrics" Wisely, and Often!
- Communicating Success
  - Reports
  - Press releases/events
  - Newsletters
  - Signs and displays
  - Public meetings/workshops
  - Awards



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Thank You!