Evaluating S&T models and ESDs

What are the objectives?

How do we develop models?

Is our model appropriate?

Did we accomplish our objectives?

Science

Policy
Politics
Society etc.
What is/are the objective(s) and who is the target?

<table>
<thead>
<tr>
<th>Agencies</th>
<th>Land Managers</th>
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<tbody>
<tr>
<td>– Communication Tool</td>
<td>– Livestock</td>
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<tr>
<td>– Repository for ecological information</td>
<td>– Biodiversity</td>
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<td>– Assist land management</td>
<td>– Wildlife management</td>
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<tr>
<td>– Assist policy makers</td>
<td>– Water quality and quantity</td>
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<td>– System resiliency</td>
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<td></td>
<td>– Minimize accelerated erosion</td>
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<td>– Etc.</td>
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</tbody>
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Are models designed to PREDICT or RECORD change?

Are all objectives possible with one model?
Can we standardize model development?

• Threshold based
  – Tautology of states and thresholds
  – Should there be unified definition?

• Process criteria
  – The 'action verbs' of an ecosystem: consume, decompose, exchange, produce, transfer, recycle, reproduce, and succeed; they unite biological communities [www.nps.gov/grsa/resources/curriculum/glossary.htm](http://www.nps.gov/grsa/resources/curriculum/glossary.htm)
  – How much of a change justifies a new state?

• What are indicators of change?
  – Abiotic vs. biotic; wildlife?

• What is the spatio-temporal scale of a S&T model?
Who needs to worry about scale?

WELL, NO LIFE HERE
Do we want science (ecology) to be involved in S&T models?

• If no, then status quo (avoids criticism)
• If yes, then science should be considered during model development
  – Science-based management
  – Models can generate testable hypotheses
  – “Testable” requires numbers
  – Science can lead to refinement of models
  – Must engage scientists outside of range
  – Can we test our current S&T models?
Shallow Savanna
Cross Timbers, Oklahoma

Mature Oak Overstory

Seeded Site

Oak Savanna

Oak/Cedar

Thick Cedar

Tall/Midgrass

Peacock 2000- Logan, Utah
• Will a grassland transition to a woodland?
• How long will it take?
• Are there predictable indicators?
• What are the drivers?
• Are the changes reversible?
• At what point do they become irreversible?
• Time?
  • If fire is removed for 150 years then how long should it be restored before we recognize a threshold?
Ways science can test/contribute to S&T models

- Remote sensing
- Simulation modeling
- Long-term experiments
- Test mechanisms associated with states, transitions, and thresholds
Mechanisms associated with grassland to woodland model

![Graph showing the relationship between scorch and tree height. The x-axis represents tree height in meters, and the y-axis represents scorch. The graph includes a point at 1.8 meters on the x-axis, indicating a change in scorch.]
Mechanisms associated with grassland to woodland model
$r^2 = 0.051$

$P = 0.35$
The graph shows the relationship between fuel load and scorch proportion (%). The data points are fitted with a linear regression line, and the following regression statistics are provided:

- $r^2 = 0.876$
- $P < 0.01$

The equation of the regression line is given as:

$$\text{Scorch proportion} = 0.0001 \times \text{Mean fuel load} + 0$$
How do we integrate emerging ecological concepts and alternative objectives?

• Emerging Ecological Concepts
  – Heterogeneity
  – Climate change
  – Invasive species
  – Fragmentation

• Alternative Objectives
  – Wildlife management
  – Ecotourism
  – Threatened and Endangered species
  – Biodiversity
  – Wind energy
Importance of Heterogeneity


• **Species invasion** – Deutschewitz et al. 2003, Cummings, Fuhlendorf, Hickman and Engle (In review)


• **Etc.**
Summary of Issues and Concerns

• What is/are the objective(s) and who is the target?
  – PREDICT or RECORD change
• Can we standardize model development?
• Do we want science to be involved in S&T models?
• What is needed to make S&T models predictive and testable (science based)?
• How do we integrate emerging ecological concepts and alternative objectives?
Issues and Concerns— from Joel Brown in Utah in 2000


• What is a state?
• What is a transition?
• What are thresholds?
• What about soil loss?
• Should Riparian areas be separate sites—1st point
• What are time frames and how do we express them?
• Is there a way to integrate wildlife into STMs?
Biggest Issue: Why no advancement?

• S&Ts are based on thresholds which are mostly untested
• Models have not been developed in a testable manner
• S&Ts not considered high priority within the broader scientific community
• No Science = No Advancement
• No Funding = No Science
New Scientific Method
Herding cats in the 21st century

- Make observation
- Develop hypothesis
- Do data support fundable hypothesis?
  - Yes
    - Collect Preliminary Data
    - Develop proposal for funding
    - Communicate Findings
    - Analyze and draw conclusions
    - Initiate Experiment
  - No
    - Discard Hypothesis
- Is hypothesis fundable?
  - Yes
    - Develop hypothesis
  - No
    - Discard Hypothesis

Interact with scientific peers to determine trendy funding priorities
Box and arrows won't get rid of cedar, but a box matches will

John Weir 2006
What is the role of science in S&T models and ESDs?

– If there is to be scientific involvement in the development and justification of S&T models then they need to be testable, i.e. quantifiable.

– Scientifically testable models are essential for science-based management
  • Do we want science based management?

– If we keep referring this to an ecological theory then it needs to be evaluated with ecological sciences.

– What is needed to make them quantifiable or testable?
Is S&T a scientific (ecological) theory?


• A hypothesis that is widely accepted by the scientific community. [www.ametsoc.org/amsedu/WES/glossary.html](http://www.ametsoc.org/amsedu/WES/glossary.html)

• A statement that postulates ordered relationships among natural phenomena. [farahsouth.cgu.edu/dictionary/](http://farahsouth.cgu.edu/dictionary/)

• A body of knowledge using controlled-variable experimental methods to construct a formal and mathematically structured system. It studies the character of natural reality. [www.udmercy.edu/faculty_pages/staudenmaier_sj/ethics/glossary](http://www.udmercy.edu/faculty_pages/staudenmaier_sj/ethics/glossary)
Redland Ecological Site - Draft
Edwards Plateau, Texas

Oak Savanna

Seeded Site

Oak/Juniper Complex
20 ft + Ashe juniper
20 + Year old stand
30% + Canopy

Oak/Grassland
Ashe juniper <3 ft
<5% Canopy

Oak/Juniper/Grassland
Ashe juniper 4-12 ft
10-20% Canopy
5-20 Year Old

Peacock 2000- Logan, Utah
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