New Connections in Ecological Planning for Transportation: 
Addressing Barriers to Ecosystem Management and Strategic Conservation 
Venner, Heilman, and Manson
Overview

• Agency and Planning Challenges
• New Ways to Measure and Integrate
• Monitoring and Adaptive Management
Agency and Planning Challenges

• Integrated planning desirable, but DOTs and resource agencies hampered by
  • Availability of data for effective decision-making at that stage
  • Ability to make decisions at that stage
  • Resource agency participation in planning (divergent priorities)

• Normal way of doing things – current capacities and preferences
  • Staff review and evaluate projects with detailed design data. Staff accustomed to a certain level of detail on a project level.
  • Less familiarity with robust, planning level analyses, such as predictive modeling with field testing
Planning and Permitting Challenges

- Stagnant or declining budgets at resource agencies
- Little programmatic guidance and other drivers that dominate time allocation and decision making
- Until recently, decision making tools have been cumbersome and recovery science has not been formatted for decision making
Even with Better Tools

- Deciding on & integrating data
- Unknowns & duplicated efforts
- Limits posed by jurisdictions
- Permitting & Consultations processes that can be piecemeal and less effective when limited to
  - project by project
  - site by site
  - single resources
- Vanishing opportunities for conservation and restoration that will make a difference for multiple species, at larger scales

NEEDED: Commitment and Multi-Agency Process Change to Improve Environmental Outcomes
Corps Jurisdiction
... But wait - we can and will reach for more
New Ways to Measure and Integrate

- Support Multiple Scales
- Integrate Multiple Resources
- Reconcile Overlapping Policies and Authorities, as well as Gaps that Still Need to be Addressed to Take an Ecosystem Approach
- Maximize Mitigation Decisions
- Monitoring and Adaptive Management
Emerging Options

- Landscape Suitability Analyses
- Ecosystem Service Assessments
Ecosystem Services:

- The services and products that the natural environment provides.
- If impacted or lost – we replace with built solutions – very expensive and often less effective.
Source: Millennium Ecosystem Assessment

(www.maweb.org/)
Why Ecosystem Services?

• **Quantitative Measure:**
  Allows comparisons across resources and land uses.

• **Public Transparency:**
  Clear measures that capture unique issues or settings.

• **Innovative Implementation:**
  Opportunities to use incentives or markets to meet goals.
Identify functions that contribute to the performance of ecosystem services . . .

For example:
Identify indicators needed to assess how well functions are being performed . . .
For each indicator, establish incremental units of measurement

Number of pieces of down wood:

- 1-3
- 4-7
- 8-12
- 13-20
- >20

Soil texture:

- Organic
- Silt
- Sand
- Gravel
- Clay
- >20

For example:
Establish the effect of adding or subtracting measurable units of each indicator on the ecosystem function.

For example:
Preferred Design Alternative

B-017 Proposed Emergent Wetland

B-024 Proposed Mixed Stand
Biodiversity Scorecard

• Objective: Develop an intuitive, repeatable, easy-to-understand approach for evaluating the viability and status of a state’s biodiversity.
  • Identify measurable attributes which quantify viability and conservation status
  • Produce summary statistics
Components of Conservation Success

- Biodiversity Status
  (abundance and quality)
- Threat Status
  current and potential future threats to "target"
- Protection/Management Status

Effectively Conserved
Scope of Colorado Pilot Project

• 92 Plant Species  
  Evaluated all rare (G1-G2)

• 180 Animal Species  
  Evaluated all Tier 1 species

• 11 Ecological systems  
  Evaluated all “matrix-forming” systems
Example of Attributes for Animals and Plants Scored from 0-10)

- Number of individuals
- Number of occurrences (populations)
- Occupied area
- Number of occurrences with good viability
- Short and long-term trends
- Threats (scope, severity, and immediacy)
- Percent protected and semi-protected
Examples of Attributes for Ecological Systems (Scored from 0-10)

- Proportion of total acres in patches of “preferred” size
- Percent natural vegetation within ½ mile of patches
- Landscape integrity
- Fire condition index
- Energy development potential
- Projected population growth and development
- Potential for future transportation development
- Protection level
Examples of Landscape Integrity Layers
(e.g., patterns of land use, integrity, and fragmentation)
Future Threats

Transportation development

Population growth

Energy development
Landscape integrity
Cumulative High and medium impacts from roads, oil & gas wells, urban development, agriculture
## Excerpt from Plant Scorecard

<table>
<thead>
<tr>
<th>Scientific Name (Global)</th>
<th># Occurrences</th>
<th>Occupied Area</th>
<th>Range</th>
<th>Abundance Score</th>
<th>Primary Threat</th>
<th>Threats Status Score</th>
<th>Quality Score</th>
<th>Landscape Integrity Score</th>
<th>Potential for Energy Development Score</th>
<th>Land Status Score</th>
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<td>oil and gas</td>
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<td>2.9</td>
<td>4.9</td>
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<td>5.0</td>
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</table>
Plant Species Energy Development Potential Score
Includes 92 Species (52 endemic to Colorado)
<table>
<thead>
<tr>
<th>Ecol Sys</th>
<th>Proportion of total acres larger than minimum*10</th>
<th>Proportion of total acreage in patches of preferred size</th>
<th>Percent natural within 1/2 mile of patches</th>
<th>Landscape Integrity Score</th>
<th>Condition Index Score</th>
<th>Biodiversity Status</th>
<th>Energy Development</th>
<th>Population Growth &amp; Development</th>
<th>Threat Status</th>
<th>Protection Status</th>
<th>Historic Trend</th>
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<tr>
<td>Alpine Tundra</td>
<td>7.9</td>
<td>5.2</td>
<td>9.9</td>
<td>9.8 n/a</td>
<td>8.2</td>
<td>9.6</td>
<td>9.2</td>
<td>9.8</td>
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<td>8.6</td>
<td>-1%</td>
</tr>
<tr>
<td>Spruce-fir</td>
<td>8.3</td>
<td>5.9</td>
<td>9.8</td>
<td>9.5</td>
<td>7.9</td>
<td>8.4</td>
<td>9.7</td>
<td>9.8</td>
<td>8.4</td>
<td>8.5</td>
<td>-1%</td>
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<tr>
<td>Aspen</td>
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<td>4.8</td>
<td>9.5</td>
<td>7.3</td>
<td>7.1</td>
<td>7.1</td>
<td>5.9</td>
<td>8.9</td>
<td>9.7</td>
<td>5.9</td>
<td>6.4</td>
</tr>
<tr>
<td>Lodgepole</td>
<td>6.4</td>
<td>4.1</td>
<td>9.4</td>
<td>8.0</td>
<td>6.8</td>
<td>7.0</td>
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<td>7.4</td>
<td>9.6</td>
<td>7.4</td>
<td>-6%</td>
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<tr>
<td>CO Plateau PJ</td>
<td>9.1</td>
<td>6.9</td>
<td>8.3</td>
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<td>2.3</td>
<td>6.7</td>
<td>4.2</td>
<td>7.6</td>
<td>9.6</td>
<td>4.2</td>
<td>-14%</td>
</tr>
<tr>
<td>Sagebrush</td>
<td>6.9</td>
<td>4.7</td>
<td>8.1</td>
<td>5.9</td>
<td>4.1</td>
<td>5.9</td>
<td>4.6</td>
<td>8.3</td>
<td>9.8</td>
<td>4.6</td>
<td>4.8</td>
</tr>
<tr>
<td>Oak &amp; Mixed Mtn Shrub</td>
<td>7.0</td>
<td>6.7</td>
<td>8.9</td>
<td>4.7</td>
<td>5.4</td>
<td>7.3</td>
<td>4.5</td>
<td>6.6</td>
<td>9.2</td>
<td>4.5</td>
<td>4.0</td>
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<tr>
<td>SRM PJ</td>
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<td>3.4</td>
<td>5.4</td>
<td>6.4</td>
<td>5.9</td>
<td>9.5</td>
<td>5.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Ponderosa</td>
<td>7.2</td>
<td>3.8</td>
<td>9.2</td>
<td>6.3</td>
<td>2.9</td>
<td>5.9</td>
<td>7.4</td>
<td>3.6</td>
<td>8.5</td>
<td>3.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Shortgrass</td>
<td>8.1</td>
<td>6.5</td>
<td>4.9</td>
<td>3.8</td>
<td>6.1</td>
<td>6.5</td>
<td>4.9</td>
<td>7.0</td>
<td>9.5</td>
<td>4.9</td>
<td>-48%</td>
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<tr>
<td>Sandsage</td>
<td>7.9</td>
<td>5.8</td>
<td>6.4</td>
<td>4.0</td>
<td>2.6</td>
<td>5.9</td>
<td>4.4</td>
<td>9.6</td>
<td>9.6</td>
<td>4.4</td>
<td>-19%</td>
</tr>
</tbody>
</table>

*10

Excerpt from Ecological System Scorecard
# Ecological System Summary Scores

<table>
<thead>
<tr>
<th>System Name</th>
<th>Biodiversity Status</th>
<th>Threat Status</th>
<th>Protection Status</th>
<th>Historic trend</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine Tundra</td>
<td>8.2</td>
<td>9.2</td>
<td>8.6</td>
<td>-1%</td>
<td>Effectively conserved</td>
</tr>
<tr>
<td>CO Plateau Pinyon-Juniper</td>
<td>6.7</td>
<td>4.2</td>
<td>7.0</td>
<td>-14%</td>
<td>Moderately conserved</td>
</tr>
<tr>
<td>Shortgrass</td>
<td>6.5</td>
<td>4.9</td>
<td>1.7</td>
<td>-48%</td>
<td>Poorly conserved</td>
</tr>
</tbody>
</table>
Biodiversity and Threat Summary Statistics for Ecological Systems
% Acres in Each Status Category (Poor-Very Good) Biodiversity

Biodiversity Status - patches

- **Alpine Tundra**: Mostly in the Very Good category.
- **CO Plateau PJ**: A mix of Fair and Good categories, with a small portion in Poor.
- **Shortgrass**: A mix of Poor, Fair, and Good categories, with a larger portion in Very Good.

Legend:
- Poor
- Fair
- Good
- Very Good

Percent of acres by status category.
Biodiversity and Threat Summary Statistics for Ecological Systems
% Acres in Each Status Category - Threats Status

Threat Status - patches

- Alpine Tundra
- CO Plateau PJ
- Shortgrass

Legend:
- Poor
- Fair
- Good
- Very Good

percent of acres
# Ecological System Summary Scores

Table 12. Matrix ecological system summary scores.

<table>
<thead>
<tr>
<th>System Name</th>
<th>Biodiversity Status</th>
<th>Threat Status</th>
<th>Protection Status</th>
<th>Historic trend</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine Tundra</td>
<td>8.2</td>
<td>9.2</td>
<td>8.6</td>
<td>-1%</td>
<td>Effectively conserved</td>
</tr>
<tr>
<td>Spruce-fir</td>
<td>7.9</td>
<td>8.4</td>
<td>8.5</td>
<td>-1%</td>
<td>Effectively conserved</td>
</tr>
<tr>
<td>Lodgepole</td>
<td>7.0</td>
<td>7.4</td>
<td>7.1</td>
<td>-6%</td>
<td>Moderately conserved</td>
</tr>
<tr>
<td>Aspen</td>
<td>7.1</td>
<td>5.9</td>
<td>6.4</td>
<td>-3%</td>
<td>Moderately conserved</td>
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<td>6.7</td>
<td>4.2</td>
<td>7.0</td>
<td>-14%</td>
<td>Moderately conserved</td>
</tr>
<tr>
<td>Southern Rocky Mtn. Pinyon-Juniper</td>
<td>5.4</td>
<td>5.9</td>
<td>3.8</td>
<td>-3%</td>
<td>Weakly conserved</td>
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<td>Sagebrush</td>
<td>5.9</td>
<td>4.6</td>
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<td>-12%</td>
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<td>Oak &amp; Mixed Mtn. Shrub</td>
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<td>-8%</td>
<td>Weakly conserved</td>
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<td>Ponderosa</td>
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<td>-48%</td>
<td>Poorly conserved</td>
</tr>
<tr>
<td>Sandsage</td>
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<td>4.4</td>
<td>1.3</td>
<td>-19%</td>
<td>Poorly conserved</td>
</tr>
</tbody>
</table>
Overall Scores for Ecological Systems

Quality + Threats + Protection
Benefits of Biodiversity Scorecard

- Map overlays help illustrate relationships & gaps - graphically display results
- Summarize biodiversity/conservation status
- Allow attributes to be analyzed and summarized
- Measure conservation success (State of the State)
- Provide foundation for developing conservation strategies
- Provide a database/storage place for conservation data
- Excellent education/outreach tool: ideal for the web
Monitoring and Adaptive Management

“a systematic approach for continually improving management policies and practices by learning from the outcomes of operational programs”

“support action in the face of limitations of scientific knowledge and the complexities of large ecosystems”
Problem Assessment
- Purpose
- Define Goals and Objectives
- Develop and Review Options
- Decision-Making Framework
- Monitoring Plan
- Develop Performance Standards

Design
- Procedures, Schedules, and Responsibilities
- Parameters, Responsibilities, and Schedules
- Data Management

Implementation
- Review New Information
- Review Monitoring Results
- Determine Cause of Changes
- Document Successes and Failures

Monitoring
- Incorporate Information from Other Arenas
- If Needed, Modify Design
- Exchange Insights with Other Practitioners

Evaluation

Adjustment
Three Components of the Adaptive Management Framework

1. Cooperative Federal-State Regulatory Team
2. DOT Environmental Program
3. Site-Specific Management Plans

These components are interconnected, indicating a cyclical relationship where information and feedback flow between each component.
New Knowledge from DOT Environmental Projects

Policy/Law Updates

Latest Research

Environmental Program

Reassessment and Sharing of Conservation Practices & Results

Site Management Plans

Adaptive Conservation Plans

Cooperative Federal-State Regulatory Team
Adaptive Management Framework for ODOT M/C Program

1. Define Problem
2. Identify Mitigation/Conservation Goals
3. Develop Program Strategy:
   - Future Credit Needs
   - Site Selection Criteria
   - Evaluation Criteria
4. Develop a Network of M/C Sites
5. Monitor Program Accomplishments:
   - M/C Credits
   - Ecological Response
6. Evaluate:
   - Program Needs
   - Science and Policy
   - Implementation Status and Success
7. Work with CMCS/MCBRT to Assess Options
8. Document Successes & Failures
9. Is Program Performance Adequate and Appropriately Focused?
   - Yes: Goals Being Met
   - No: Adjustments Needed
10. Wait Specified Period of Time
11. Work with CMCS/MCBRT to Assess Options

Guidance from Regulatory Process
Knowledge from Mitigation/Conservation Sites

ODOT M/C Program
CMCS/MCBRT
Site Mgmt. Plans
Shared Learning
Site Adaptation Process

1. Identify Specific Goals Not Being Achieved And Causes of Shortcomings
2. Adapt Existing Site Mit./Cons. Design
3. Adapt Existing Site Management Plan
4. MCBRT
5. Incorporate Into Other Elements of Adaptive Management Framework (If Applicable)
6. Acute Episodic Event Expected to Prevent Achievement of Success Criteria
7. Monitor
8. Implement Adjustments To Site Mit./Cons. Design
9. Document Successes and Failures
Moving Forward

- Develop the Setting to Integrate
  - Agency Interaction
  - Planning Integration

- Collaborative Landscape Measures
  - Identify Key Issues
  - Develop and Implement Measures
Thank You

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