Integrated Landscape Assessment Project (ILAP)
Arid Lands Models and Data
Principles

• Leverage existing work
• Modular approach – new methods and emerging interests
• Designed for journey-level analysts
• Useful, on time
Landscape-wide Data and Models
State-and-Transition Models

- **State A** → Transition X → **State B**
- **State C** → Transition Y → **State B**

- **Native Shrub Steppe**
  - Grass → Shrub

- **Exotic Annual Grass**
  - Exotic Grass → Exotic Grass with Shrub

- **Juniper Woodlands**
  - Phase I → Phase II → Phase III
Prioritization

Wildfire-fuel hazards
Aquatic habitat
Terrestrial habitat
Economic potential

Decision Support
Example Products
Washington and Oregon Arid Lands

- Cheatgrass and juniper maps
- Management scenario analysis
- Sage-grouse habitat
- Climate change
Projected Exotic Grass and Juniper

- Maps of exotic grass and juniper
  - Year 2000: from current mapped conditions
  - Year 2050: from state-and-transition model projections
- Reported at the modeling stratum level
  - Huc-Ownership/allocation-PVT; not pixel scale runs
- Projections assume no management and unrestricted grazing
- Megan Creutzburg, OSU/INR
Projected Exotic Grass

Current – Year 2000

Projected – Year 2050

Percent of Stratum in Exotic Grass
- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%

Washington

Oregon

DRAFT – subject to change
Projected Juniper

Percent of Stratum in Juniper

- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%

Current – Year 2000

Projected – Year 2050

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Management Scenario Analysis
Southeast Oregon

Three simple management scenarios:
- No management (Unmanaged/Grazed)
- No management or grazing (Unmanaged/Ungrazed)
- Restoration (Managed/Grazed)
Management Scenario Analysis
Southeast Oregon

Initial Conditions

Projected 2050 Conditions
Management Scenario Analysis
Southeast Oregon

A. Warm-dry sagebrush

B. Cool-moist sagebrush

Initial Conditions

Projected 2050 Conditions
Management Scenario Analysis
Southeast Oregon

Exotic Annual Grass Projections

Initial Conditions
Year 2000

Percent of Stratum in Exotic Grass
- 0-25%
- 25-50%
- 50-75%
- 75-100%

Unmanaged/Grazed Year 2050
Unmanaged/Ungrazed Year 2050
Managed/Grazed Year 2050

Active restoration
Management Scenario Analysis
Southeast Oregon

Western Juniper Projections

Percent of Stratum in Juniper Phases II and III

- 0-25%
- 25-50%
- 50-75%
- 75-100%

Unmanaged/Grazed Year 2050

Unmanaged/Ungrazed Year 2050

Managed/Grazed Year 2050

Initial Conditions Year 2000

Active restoration
Greater Sage-Grouse Habitat

- Characterize state-and-transition model states in terms of sage-grouse habitat
  - Habitat or non-habitat

- Information sources:
  - Literature search
  - Expert review

- Results aggregated to watersheds

- Future analyses will incorporate more detailed work on habitat in varying life stages (Evers 2010)

Greater Sage-Grouse Habitat

Year 2000

Projected - Year 2050

Percent of Watershed Modeled Identified as Sage-Grouse Habitat

<table>
<thead>
<tr>
<th></th>
<th>0-20%</th>
<th>20-40%</th>
<th>40-60%</th>
<th>60-80%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2000</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Projected</td>
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</tbody>
</table>

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Climate Change Linking Models

MC1
Dynamic Global Vegetation Model

State-and-Transition Models

Juniper woodland
xeric Ponderosa Pine

Dry Mixed Conifer

Moist Mixed Conifer
Climate Change
Central Oregon Study Area

Hadley-A2 from MC1

Hadley-A2 from Coupled Model (MC1 with STMs)

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Future Work

- Extend mapping and modeling to more of the Great Basin? Not funded. Collaborate with TNC, others.
- Run Regional Climate Change models for SE Oregon
  - Monsoonal flow
  - Topographic effects
  - Funded NW Climate Science Center
- Construct climate-informed STM for SE Oregon
  - Funded NW Climate Science Center
- Examine management activities that may reduce impacts from climate change?
Watershed ties modeling units to a geographic location
Spatial Data Layers
Ownership/allocation

Divide landscape into management units

Ownership: Forest Service, BLM, tribal, state, private, other
Allocation: Intensity of use
• 1 – minimal use (wilderness/protected area)
• 5 – high-intensity use

Data developed by Melissa Whitman
Spatial Data Layers

Potential Vegetation Type (PVT)

Vegetation type determined by climate, soil, disturbance regime

Similar to biophysical setting (BpS) or Ecological Site Description (ESD)

One State-and-Transition Model (STM) per PVT

Map developed by Treg Christopher
Modeling Strata

Sets the spatial context for each State-and-Transition Model (STM) run

Minimum spatial resolution of model output

Combination of three spatial layers:
- Watershed (HUC)
- Ownership/allocation
- PVT

intersect
Spatial Data Layers

Current vegetation

Map of current/existing vegetation conditions in Year 2000

Map developed by Emilie Henderson
Generate initial conditions for simulation runs

Current vegetation

Use a rule set of IF/ELSE statements to allocate every pixel to a model state
Spatial Data Layers

Mask

Removes:
- Forest
- Agriculture
- Urban
- Riparian/wetlands
- Barren
<table>
<thead>
<tr>
<th>Site Type</th>
<th>Potential Vegetation Type (PVT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-desert</td>
<td>Wyoming big sage</td>
</tr>
<tr>
<td>Semi-desert</td>
<td>Wyoming big sage with juniper</td>
</tr>
<tr>
<td>Sparse</td>
<td>Rigid sage</td>
</tr>
<tr>
<td>Sparse</td>
<td>Salt desert lowland</td>
</tr>
<tr>
<td>Sparse</td>
<td>Salt desert upland</td>
</tr>
<tr>
<td>Sparse</td>
<td>Xeric low sage</td>
</tr>
<tr>
<td>Upland</td>
<td>Bitterbrush</td>
</tr>
<tr>
<td>Upland</td>
<td>Bitterbrush with juniper</td>
</tr>
<tr>
<td>Upland</td>
<td>Bluebunch wheatgrass grassland</td>
</tr>
<tr>
<td>Upland</td>
<td>Idaho fescue grassland</td>
</tr>
<tr>
<td>Upland</td>
<td>Low sage</td>
</tr>
<tr>
<td>Upland</td>
<td>Low sage with juniper</td>
</tr>
<tr>
<td>Upland</td>
<td>Mountain big sage</td>
</tr>
<tr>
<td>Upland</td>
<td>Mountain big sage with juniper</td>
</tr>
<tr>
<td>Upland</td>
<td>Mountain mahogany</td>
</tr>
<tr>
<td>Upland</td>
<td>Threetip sage</td>
</tr>
<tr>
<td>Upland</td>
<td>Western juniper</td>
</tr>
<tr>
<td>Subalpine</td>
<td>Montane meadow</td>
</tr>
<tr>
<td>Subalpine</td>
<td>Montane shrub</td>
</tr>
</tbody>
</table>
State-and-Transition Models (STMs)

- Simulate vegetation dynamics
  - Conceptual model of vegetation structure and dynamics
  - Project future conditions
- Box and arrow models
- State classes (boxes) defined by cover type and structural stage
- Transitions (arrows) represent processes such as succession, disturbance and management
- Non-spatial
- Monte Carlo simulations generate variability among model runs
State Classes

- Cover types list dominant species or functional groups
  - Wyoming big sage / native perennial grass
  - Salt desert shrub / exotic annual grass
- Structural stages indicate cover range of major life forms
  - Herbaceous
  - Open, mid, closed shrub
  - Woodland phases I, II, III

State-and-Transition Models (STMs)

- Transitions:
  - Succession
  - Wildfire
    - 3 severities
  - Drought
  - Grazing
    - 4 types, ranging in intensity
  - Insect outbreaks
  - Management treatments
    - Juniper cutting and/or burning
    - Seeding of native grasses
State-and-Transition Models (STMs) Wildfire Probabilities

- Monitoring Trends in Burn Severity (MTBS) (www.mtbs.gov)
  - 25 years of empirical fire data (1984-2008)
  - Perimeters of all fires over 1000 acres
- Overlayed fire perimeter polygons with PVT and exotic grass groups
- Calculated fire return intervals

**PVT burn groups**

- based on PVT map

- Upland (blue)
- Semi-desert (red)
- Sparse (yellow)

**Exotic grass cover classes**

- Based on current vegetation map

- 0-10% (green)
- >10-25% (yellow)
- >25% (orange)
**State-and-Transition Models (STMs) Wildfire Probabilities**

- Southeast Oregon MTBS results
  - PVT groups vary in fire return interval
  - Increasing fire frequency with higher cover of exotic grass (cheatgrass)

<table>
<thead>
<tr>
<th>PVT Group Exotic %</th>
<th>Upland PVTs</th>
<th>Semi-desert PVTs</th>
<th>Sparse shrub PVTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10%</td>
<td>148</td>
<td>160</td>
<td>269</td>
</tr>
<tr>
<td>10-25%</td>
<td>112</td>
<td>88</td>
<td>134</td>
</tr>
<tr>
<td>&gt;25%</td>
<td>58</td>
<td>56</td>
<td>117</td>
</tr>
</tbody>
</table>

Increasing fire
ILAP Modeling Process

**Base GIS Inputs**
- Watershed
- Ownership Allocation
- Potential Vegetation
- Current Vegetation
- Mask

**Model Inputs**
- Modeling Strata
- State Classes
- Other model parameters

**State-and-Transition Model Runs**
- Bring into Path
  - Path

**Model Outputs**
- Output maps
  - Summarize by: Watershed, Modeling Strata
- Output summaries
  - Acres in State Classes
  - Acres affected by transitions

- Link model output to other ILAP modules

- Fuel Characteristics
- Biomass
- Wildlife Species Habitat
- Community Economics
- Decision Support
ILAP Modeling Process
Example State-and-Transition Model Output

Summarized output for each annual time step:
- area in each state class
- area transitioning

Statistics reported:
(for 30 Monte Carlo simulations)
- average
- minimum
- maximum
ILAP process and data
• input data
  • spatial data layers
    • vegetation mapping methods
  • state-and-transition models (STMs)
    • structure
    • parameterization
• modeling process – step-by-step
ILAP output and products
• current conditions
• vegetation projections
• management scenarios
• wildlife
• climate change
• fuels
• biomass/carbon/timber
• community economics
• decision support
For more information

ILAP website: http://oregonstate.edu/inr/ilap

FTP site for data download and documentation: ftp://131.252.97.79/ILAP/Index.html

Western Landscapes Explorer (coming soon)

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