Integrating Silviculture & Landscape Ecology: Tools for Multi-scale Management

Figure from Travis Belote
Vegetation:
Structure: size & density
Composition: species & condition
Vegetation:
Structure: size & density
Composition: species & condition
Pattern: patch size distribution & arrangement of patches

Landscape Ecology & Silviculture
Vegetation:
Structure: size & density
Composition: species & condition
Pattern: patch size distribution & arrangement of patches

Pattern of Structure & Composition ➔ Heterogeneity

Resilience
Desired Functions & Ecosystem Services
**Landscape Level Tools**

**Inventory & Quantify:**
- Pattern of Structure Composition

**Evaluate Against:**
- Desired Functions Reference Conditions:
  - (HRV & FRV)
Inventory & Quantify:
- Pattern of Structure
- Composition

Evaluate Against:
- Desired Functions
- Reference Conditions: (HRV & FRV)

Treatment
- Prioritize Landscape Prescription

Landscape Rx
- Patch Types
- Patch Size & Pattern
- Practical Implementation
**Stand Level Tools**

**Variable Density Thinning**
- Free thinning
- Andy Carey
- Connie Harrington

**Multi-age management**
- ITS
- Group Selection

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**Patch Type**
- No-entry skips
- Openings
- Heavy Thin
- General Thin Area

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**Legend**
- Opening
- Small Skips
- Large Skip
- Roads

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**Fine scale variability**
- Individual trees
- Tree clumps
Stand Neighborhood:

- 1000-2500 acres, or larger.
- Add up patch types across stand neighborhood

Goal → pattern across
- Stand neighborhood
- Watershed

How much variability?
- Skips, Openings
- Heavy Thin, Clumps
- Area (%), Size, & Spatial Arrangement
<table>
<thead>
<tr>
<th><strong>Stand Neighborhood</strong></th>
<th><strong>General Implications for Stands</strong></th>
</tr>
</thead>
</table>
| Landscape Rx           | • Shift structure stage from 6 towards 7 on drier PAGs.  
                        | • Larger patches of SS6 on RC-WH sites |
| Biophysical Context:   | • More intensive treatments on drier slopes.  
                        | PAG's, topography, soils                |
|                        | • More skips in cooler, moister areas of stands |
| Structure, Composition, & Forest Health | • Shift species composition towards fire tolerants  
                                           | • Treat & expand some root rot pockets  
                                           | • Remove patches of mature LP in some stands |
| Bio-Hotspots           | • Mesic sites, skips ➔ patches with complex structure  
                        | • Heavy thin around old PP-WL-DF.  
                        | • Openings around Aspen |
| Habitat Needs          | • **Max area of thinning without skip (5-10 acres)**  
                        | • Create openings & HT areas for forage species |
| Rx Fire & Wildfire:    | • Need to break up continuity of fuels  
                        | • Create a landscape of low-mod-high severity patches  
                        | • “Let fire do some of the work”. |
| Access-operational     | • **Large portion untreated due to habitat & riparian buffers & lack of road access**  
                        | Issues | • Areas difficult to yard within stands ➔ can be skips |
Stand Level Tools

Fine Scale Variability with Stands
• Species preference & forest health
• Old Trees

• Variation in Basal Area or TPA targets
• Ghost species & dbh limits
• Multi-age management
• ICO approach (Individuals, clumps, & openings)

<table>
<thead>
<tr>
<th>Clump Size</th>
<th>Individual Trees</th>
<th>Small 2-4 trees</th>
<th>Medium 5-9 trees</th>
<th>Large 10-20+ trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>22%</td>
<td>34%</td>
<td>20%</td>
<td>24%</td>
</tr>
<tr>
<td>Target/ Acre</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Target Unit</td>
<td>90</td>
<td>50</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

• Basal Area/TPA target + medium & large clump targets
• 7-12 acre Stem maps
• Reconstructed to pre-settlement year (e.g. 1890)
Clump ID Algorithm

## Clump ID Algorithm

### Clump Table

Percent of trees in clumps of different sizes

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11+</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.56</td>
<td>0.19</td>
<td>0.12</td>
<td>0.06</td>
<td>0.04</td>
<td>0.01</td>
<td>0</td>
<td>0.01</td>
<td>0</td>
<td>0.01</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0.42</td>
<td>0.19</td>
<td>0.12</td>
<td>0.07</td>
<td>0.05</td>
<td>0.04</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td>5</td>
<td>0.31</td>
<td>0.17</td>
<td>0.12</td>
<td>0.09</td>
<td>0.08</td>
<td>0.04</td>
<td>0.05</td>
<td>0.03</td>
<td>0.01</td>
<td>0</td>
<td>0.11</td>
</tr>
<tr>
<td>6</td>
<td>0.22</td>
<td>0.15</td>
<td>0.1</td>
<td>0.09</td>
<td>0.07</td>
<td>0.07</td>
<td>0.05</td>
<td>0</td>
<td>0.01</td>
<td>0.03</td>
<td>0.21</td>
</tr>
<tr>
<td>7</td>
<td>0.17</td>
<td>0.11</td>
<td>0.1</td>
<td>0.09</td>
<td>0.05</td>
<td>0.06</td>
<td>0.08</td>
<td>0</td>
<td>0.01</td>
<td>0.03</td>
<td>0.29</td>
</tr>
</tbody>
</table>

**6m**: Max crown interlock distance
Clumping Targets:

Reference stands:
- Malheur NF: 15 plots
- Freemont-Winema NF: 12 plots
- Okanogan-Wenatchee NF: 7 plots
- Montana & Other Locations

<table>
<thead>
<tr>
<th>Clumping Level</th>
<th>Proportion of trees in clumps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>High</td>
<td>0.3</td>
</tr>
<tr>
<td>Mod</td>
<td>0.4</td>
</tr>
<tr>
<td>Low</td>
<td>0.5</td>
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Moist MC Clump Targets:

Reference stands:
- Contemporary Stands
- Larch - DF Reconstruction

Functions ➔ Professional Judgment

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<th>1</th>
<th>2-4</th>
<th>5-9</th>
<th>10-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Mod</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
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<tr>
<td>Low</td>
<td>0.5</td>
<td>0.4</td>
<td>0.1</td>
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Monitoring Tools for Stand Level Pattern

“QuickMap”
- Sample 15-20% of unit
- GPS clump centers
- ArcPAD template
- ArcMAP toolbox
Excel worksheet that compares clump size distribution of monitoring plot to reference plots using ArcTool output

The ICO Approach to Quantifying and Restoring Forest Spatial Pattern

Implementation Guide
Version 2.0. November 2013

Implementation

Prescriptions Targets for Pattern: Patch Size Distributions

- Ecological basis: Directly linked to HRV, FRV, & functions
- Flexible: work with existing conditions, soils, topography
- Operationally practical to implement

Can’t re-engineer pattern: Nudge in the right direction
Remote sensing information: pre-identify skips, openings. (LiDAR, Bing/Google Imagery, Topo-Polygon Tool)
Implementation

Topo-Polygon Tool

Water Balance Deficit

Legend
1: Ridge
2: Valley bottom
3: NE Slope
4: NE >30
5: SW slope
6: SW >30

Legend
Deficit
High : 236
Low : 143

Legend
Deficit
High : 236
Low : 143
Silviculture meets the Smart Phone Age:

1. Remote sensing information:

2. Tablets with GPS: ID potential skips during recon

3. Integrated GPS information ➔ Rx

4. Tablets use in Layout to locate & track skips

5. Information used during treatment, Rx fire, & monitoring

Implementation
Key Points

1. Managing for pattern of structure & composition:
   - Patch size distributions
   - Local Landscapes
   - Stands & within stands

2. Landscape Evaluation & Prioritization
   - Departure against HRV-FRV & Functions
   - Landscape Rx: patch types, size, & pattern to manage for

3. Stand Level Tools
   - Targets for skips, openings, heavy thin, thin areas across stand neighborhoods
   - Fine scale variability: ICO distributions
   - Monitoring with QuickMap

4. Implementation
   - Integrated GPS-GIS