MAPPING VEGETATION ACROSS THE NORTHWEST FOREST PLAN AREA: INTEGRATING TWO REMOTE SENSING APPROACHES

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USDA Forest Service
Relevance to Northwest Forest Plan

- NWFP result of contentious socio-economic debate that constrained forest management options
- Devised strategies to protect environment, assist affected communities, facilitate collaboration among federal land management agencies
- Monitoring of Plan objectives required establishment of consistent (start of Plan) baseline map of vegetation across all ownerships
Primary Considerations...

1. Need for consistent map products on all ownerships and 12 physiographic provinces of the 23 million ha (57 million acre) NWFP area
2. Must “cross-walk” with Vegetation Strike Team standards, including specs for percent tree cover, canopy structure, and overstory size class
3. Use previously acquired ground inventory (FIA, CVS, 5-point), airphoto, and ancillary data
4. Base map on Landsat image data
# VST Standards

<table>
<thead>
<tr>
<th>Element</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tree Cover</td>
<td>10 percent classes</td>
</tr>
<tr>
<td>Canopy Structure</td>
<td>Single-Layered / Multi-Layered</td>
</tr>
<tr>
<td>Overstory Size Class</td>
<td>0-4.9, 5-9.9, 10-19.9, 20-29.9, 30-49.9, 50+ inches DBH</td>
</tr>
</tbody>
</table>
Two mapping approaches...

1. Oregon and Washington
   IVMP (Interagency Vegetation Mapping Project)

2. California
   CALVEG (Classification and Assessment with Landsat of Visible Ecological Groupings)
Divergent histories...

- **OR/WA**
  - FS/R6 remote sensing program not well-developed, mostly relied on contractors; BLM program nascent; FS/PNW ample experience
  - IVMP brought these three together

- **CA**
  - FS/R5 advanced remote sensing program after decades of development & implementation
  - CALVEG joined with a variety of Federal and State agencies with interests in remote sensing
IVMP (USFS R6/PNW, BLM)

1. Mapping by province to stratify on relationships b/t image data and vegetation attributes
2. Forest v. non-forest (e.g., water, urban, agriculture, etc.) mask
3. Cover (% conifer v. % all other vegetation) and size modeled by regression as continuous variables; however, size by classification in non-closed-conifer & structure modeled from variations in % cover and size
4. Mapping at the pixel level, except structure
5. Map ca. 1996
CALVEG (USFS R5 & partners)

1. Integration of multiple existing map products and new analyses
2. Define and attribute polygons
3. Life-form by careful editing of existing maps (e.g., conifer, hardwood, mixed, non-forest)
4. Vegetation type by geoclimatic classification
5. Percent canopy cover G-O modeled
6. Tree size (DBH) translated from classified crown width
7. Structure modeled w/in type-% cover-size classes w/ aid of plot data
8. Map ca. 1994
### Accuracy Assessment

- **Purpose**: To inform developers and users about map quality.
- **Quantitative assessment**: By both IVMP & CALVEG comparing predicted/mapped values against observed.
- **Typical assessment**: Involves error matrices.

<table>
<thead>
<tr>
<th>Map</th>
<th>Deciduous</th>
<th>Conifer</th>
<th>Agriculture</th>
<th>Shrub</th>
<th>Row total</th>
<th>User’s Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciduous</td>
<td>65</td>
<td>4</td>
<td>22</td>
<td>24</td>
<td>115</td>
<td>57 %</td>
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<tr>
<td>Conifer</td>
<td>6</td>
<td>81</td>
<td>5</td>
<td>8</td>
<td>100</td>
<td>81 %</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0</td>
<td>11</td>
<td>85</td>
<td>19</td>
<td>115</td>
<td>74 %</td>
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<tr>
<td>Shrub</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>90</td>
<td>104</td>
<td>87 %</td>
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<td><strong>Column total</strong></td>
<td><strong>75</strong></td>
<td><strong>103</strong></td>
<td><strong>115</strong></td>
<td><strong>141</strong></td>
<td><strong>434</strong></td>
<td></td>
</tr>
</tbody>
</table>

| Producer’s Accuracy | 87 % | 79 % | 74 % | 64 % | 74 % Overall Accuracy |

*Conference on Science and the NWFP*  
19-20 April 2005, Portland, OR
IVMP

- Traditional error matrices for all mapped variables
- Accuracies reported for VST standards and broader classes tailored to monitoring needs
- Across provinces accuracies ranged from:
  - ✓ 40-80% for 20% cover classes
  - ✓ 60-80% for two size classes
  - ✓ 55-90% for two structure classes
CALVEG

- Traditional and “fuzzy” error matrices for life-form, percent cover, and size; nothing reported for structure
- Accuracies reported for classes somewhat broader than VST standards
- Overall accuracies within life-form classes ranged from:
  - 50-70% for four % cover classes (75-85% fuzzy)
  - 40-60% for six size classes (70-80% fuzzy)
Integration of IVMP & CALVEG

• Each map user group within NWFP has specific needs for map detail and accuracy
• Integration done informally by each group
• Example: LSOG Status & Trends
Start-of-Plan LSOG Variations

Medium-large
- Cover 10% min.
- Size 20 in. min.

Indexed to PNV Zone
- Cover 10% min.
- Size indexed to PNV zone

Large multi-story
- Cover 10% min.
- Size 30 in. min.
- Multi-story
Medium & large
Indexed to PNV Zone
Large multi-story
Summary

• Given differences in history & experience in the two regions, two separate but coordinated baseline vegetation mapping efforts

• VST standards gave mapping efforts compatible targets, enabling integration

• Greatest distinctions between the resulting maps are pixel v. polygon and numbers and definitions of classes

• From the baseline conditions, baseline habitat analyses are possible and changes can be monitored

• Role of remote sensing in the future of the Plan must now be considered