UNEVEN-AGED MANAGEMENT
NORTHWEST CERTIFIED FORESTRY
Rolf Gersonde, 6/6/2015
Uneven-aged Management in 90 Minutes

- Silviculture Background
- Forest Ecology
- Management Tools and Stocking Control
- Multi-aged Management Regime
  - Group Selection Example
  - Single Tree Selection Example
- Tools for Assessment and Management
- Operations
What is Uneven-aged Management?

Even-aged “age-class” Forestry

Uneven-aged Management System
Managing Multi-aged Stands
Alfred Möller, 1922
“Dauerwald”

Continuous Cover Forestry
Ecological Basis
- Diameter distribution of natural stands
- Small-scale disturbance regime

Meyer 1952

Tree Count

Tree Diameter
History of Uneven-aged Management in the Pacific Northwest

Kirkland and Brandstrom 1936
Leo Isaac 1956
Silvicultural System –
System of coordinated regeneration, tending, control, and harvest treatments

- Even-aged System
  - Clear Cut
  - Seed Tree
  - Shelterwood
  - Thinning

- Two-aged System
  - Variable Retention
  - Coppice with Reserves

- Uneven-aged System
  - Group Selection
  - Thinning
  - Single Tree Selection
Seed-Tree and Shelterwood Regeneration Methods
Continuum of Silvicultural Approaches
Forest Stand Dynamics
Stand development stages, disturbance dynamics, habitat

Franklin and Van Pelt 2004
Crown Differentiation

D – Dominant
C – Co-dominant
I – Intermediate
S – Overtopped
M – Mortality

Emmingham and Elwood 2004
Douglas-fir grown at three different densities, from Marshall and Curtis, 2002
Competitive vs. Agent Mortality
Natural Regeneration
- Understory Establishment Stage

- Seed Source
  - Species, seed year, predation

- Environment
  - Temp, water, light

- Seed bed
  - Soil, competition, mycorrhiza
Understory Development – Identify Shade Tolerance

- Grand fir
- Douglas-fir
- Western hemlock
- Western white pine
### Shade tolerance – Ranking of western tree species (Daniel et al. 1979)

<table>
<thead>
<tr>
<th>Shade Tolerance</th>
<th>Western hemlock</th>
<th>Pacific yew</th>
<th>Pacific silver fir</th>
<th>Vine maple</th>
<th>Western redcedar</th>
<th>Grand fir</th>
<th>Sitka spruce</th>
<th>Big-leaf maple</th>
<th>Douglas-fir</th>
<th>Western white pine</th>
<th>Ponderosa pine</th>
<th>Lodgepole pine</th>
<th>Red alder</th>
<th>Cottonwoods</th>
<th>Larch</th>
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</table>
Understory Growth – Morphological Plasticity

- Noble fir
- Pacific silver fir
- Western hemlock

- Sun and shade foliage
- Terminal vs. lateral growth
- Apical dominance
Mixed-species Forests
Mixed-Species Stands

- Species specific
  - Growing space
  - Height growth
  - Stratification
  - Shade tolerance
  - Senescence
  - Facilitation
  - Forage
Growing Space
- Resources, leaf area, basal area, and allocation
Growing Space Allocation – Trees versus Stands

The diagram illustrates the relationship between Volume Growth and Stand Density for both Trees and Stands. As Stand Density increases, Volume Growth decreases for Trees, and vice versa for Stands. The images show examples of dense and sparse stands.
Growing Space Allocation

80% Growing Space In Overstory

20% Growing Space In Understory
Growing Space Allocation – Overstory versus Understory

![Diagram showing the relationship between tree growth and overstory density. The diagram illustrates that as overstory density increases, tree growth decreases, and vice versa.](image-url)
Managing Uneven-aged Stands

Manage stand density to:

1. Sustain growth of all stand components
2. Maintain stand structure
3. Replace tree mortality and harvest through regeneration

# Sustainability Indicators
Transformation
Stand Volume and Rotation in Even-aged System
Cutting Cycle

1. Age 40
   - Stand Density
   - 200 TPA
   - BA 120

2. Age 60
   - 180 TPA
   - BA 180

3. Age 60
   - 90 TPA
   - BA 120

4. Age 80/20
   - 200 TPA
   - BA 160
Cutting Cycle
– cutting cycle length depends on cutting intensity and growth rates
Yield Tables for Even-aged Stands

Table 9: Scribner Board-Foot Volume Per Acre (7.0 Inches DBH and Larger) 6-Inch Top, 32-Foot Logs

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<thead>
<tr>
<th>Total Age</th>
<th>70</th>
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<th>90</th>
<th>100</th>
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Group Selection System
Group Selection System
- Area Control Method of Uneven-aged Management

Activities:
- Group-Selection Harvest
- Natural Regeneration Planting
- Pre-comm. Thinning
- Commercial Thinning
- Understory Thinning
## Scheduling Group Selection Treatments

### Area Control Method

<table>
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<tr>
<th>Cutting Cycle</th>
<th>1</th>
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<th>3</th>
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<td>Stand Area</td>
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<td>20%</td>
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<td>PCT</td>
<td>Commercial Thin</td>
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<td>Group Selection</td>
<td>PCT</td>
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<th>60</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>140</th>
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</table>
# Group Selection System – Prescription Matrix

## Uneven-aged Group Selection Management Regime

<table>
<thead>
<tr>
<th>Activity</th>
<th>Conditions</th>
<th>Prescription (SI 110)</th>
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<tbody>
<tr>
<td>Regeneration</td>
<td>at cutting cycle</td>
<td>20% in 1-2 ac gaps, min age 35 yrs, Cutting Cycle 20 yrs</td>
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<tr>
<td>Reforestation</td>
<td>at year 1 where cover &lt;40%</td>
<td>nat.regen WH 200 DF, 50 RA, 100 RC,</td>
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<tr>
<td>Density Management</td>
<td>Pre-commercial Thinning</td>
<td>Thin to 250 TPA</td>
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<tr>
<td></td>
<td>top height 15 ft. or age &gt;15 yrs</td>
<td></td>
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<tr>
<td>Commercial Thinning</td>
<td>at 55% of max SDI (or BA &gt; 260 sqft)</td>
<td>160 TPA thin from below or 30% CF volume, possible 2nd CT remove 20% of CFvol</td>
</tr>
<tr>
<td>Understory Thinning</td>
<td>at 2nd CT, after CT where WH</td>
<td>if understory h/d&lt;100 Thin to 150 TPA,</td>
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<tr>
<td></td>
<td>understory established</td>
<td></td>
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<tr>
<td>Habitat Enhancement</td>
<td>Riparian Management Zone</td>
<td>retain 20 TPA &gt;12”DBH or retain 20-40% cover in RMZ, underplant 100 RC/ac</td>
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<tr>
<td></td>
<td>applies to CT and group selection</td>
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<tr>
<td>Dead wood</td>
<td>retain 2 TPA as snags and 2 TPA as down wood</td>
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<tr>
<td></td>
<td>at Regeneration</td>
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Single Tree Selection
Single Tree Selection
– developing a guide curve from tree count and diameter

Tree Tally by 2 inch Diameter Class

Number of Trees

Tree Diameter

2 4 6 8 10 12 14 16 18 20 22 24
Single Tree Selection

Guide Curve:
Total basal area
Maximum Diameter “slope”

At each cutting cycle we thin trees in classes that exceed the guide curve.
Uneven-aged Management
Forest Products – Marketing Product Diversity
Assessing growth and control density of all tree sizes and species in the same stand
Assessment of Growth –
Overstory diameter increment
Assessment of Growth – Mid-canopy trees

- Crown ratio
- Height-diameter ratio
Assessment of Growth – Understory trees

Growth of terminal shoot versus lateral branches - Douglas-fir

Large Gap >30% Light

Small Gap ~20% Light

Under Canopy >20% Light
## Tools For Assessment – Diameter Distribution

### Tree Diameter Tally Sheet

<table>
<thead>
<tr>
<th>DBH Class (Inches)</th>
<th>Plot 1 Count</th>
<th>Plot 2 Count</th>
<th>Plot 3 Count</th>
<th>Sum Tree Count</th>
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<td>8</td>
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Tools For Assessment –
Diameter Distribution of Even-aged Stand

Tree Count

Diameter Class (Midpoint, Inch)

2 6 10 14 18 22 26 30 34

0 5 10 15
Growing Space Distribution –
Diameter Distribution of Multi-aged Stand
Growing Space Distribution – Basal Area of Diameter Classes
Permanent Sample Plots

- Species composition
- Size classes
- Stand volume
- Diameter growth
- Height growth
- Mortality
- Harvest
Permanent Sample Plots – Diameter distribution and increment

Inventory Period 1: Diameter distribution

Inventory Period 2: Diameter distribution
Diameter class transition
Thinning and Harvest

- **Objectives**
  - Stocking Control, Regeneration, and Timber

- **Timing**
  - Recovered previous harvest, market conditions, boat payments

- **Make a plan**
  - Long-term plan as Guide not Rule

- **Creating habitat**
  - CWD, snags, canopy layers
Tree Selection and Marking

- Creating growing space
- Selection guide
- Basal area
- Diameter distribution
- Mark your Trees
Harvest Layout

- Units and boundaries
  - Uneven-aged stands are more variable
- Forest Practices
- Roads and trails
  - Long-term planning and reuse
- Collaboration
Group Selection System – Planning operations

- Layout for thinning and group selection harvest
- Location for yarding corridors
- Tracking regeneration
- Prescriptions for matrix thinning
- Estimating stocking and ingrowth
Implementation
Harvest Impacts