Silviculture for old-growthness

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Structure of presentation

1. The disappearance of old-growth and the ageing of regrowth
2. Old-growthness – a structure-based approach
3. Silviculture and Old-growth: 3 cases, where these come together
4. Potentials and limitations of structural retention and structural complexity enhancement approaches
5. Outlook
The disappearance of old forest

Change in average percentage of forests older than 120 years in Finland

Few frontier/primary forests remain - but other forests become older

Predicted changes in timber stock on private forest land until 2050

Bryant et al. 1997
Some forests are ageing fast

The increment in old forest area in Germany between 1987 and 2002

Old-growth and ecosystem disturbance

After Scherzinger 1996

After Swanson et al. 1994
The concept of old-growthness – a structure based approach

- Number of large trees
- Number of dead standing trees
- Amount of CWD on the ground
- Number of canopy layers
- Number/cover of late successional species
- Diameter distribution
- Spatial patterning of trees
- Number, size, distribution of gaps
- Forest floor thickness
- Special attributes (pit and mound relief, presence of lichens, tree skirts, etc.)

Degree of old-growthness

OG vs Regrowth

The place for silviculture for old-growthness in the landscape

Old-growth reserve

Regrowth in reserve

Old-growth

Secondary forest

Regrowth

Peri-Urban

Agriculture
Different cases of silviculture for old-growthness

1. OG forests, resulting from the long-term absence of intensive disturbance, which are available for timber production
2. OG forests requiring regular, minor disturbances for maintenance of their structure – cultural old-growth
3. Regrowth and secondary forests, which should re-develop OG attributes

Silvicultural strategies for OG structures
1. Silviculture in existing old-growth forests

- Long production periods
- Restricted selection approaches
- Retention strategies:
  - Patches (islands, strips, buffer strips)
  - Understorey
  - Individual trees
  - Coarse woody debris, standing and downed

Managing forests with long production periods

Suitable for long-lived, decay resistant species, which have few risks and can produce sought-after products in large dimensions. May also be suitable where old forests provide valuable ecosystem goods and services at a much higher level than young forests.

Long production periods do not automatically produce old-growth structures.
Selection approaches emulating small scale disturbances

Gap distribution in European Beech old-growth systems study

Date Creek silvicultural systems study

Retention strategies for harvesting in old-growth forests

Single trees  Understorey islands  Aggregates/patches

Traditional uneven-aged systems (more than 70% Retention)  Variable-Retention-Systems (Franklin 1997)  Traditional even-aged system (less than 10% Retention)
Hypotheses for retention strategies

• Hypothesis 1: Retained structures help to maintain a higher level of biodiversity and ecosystem functioning on site.

• Hypothesis 2: Retained structures facilitate a more rapid recovery of biodiversity and ecosystem functioning.

The lack of preparation of OG structures for retention

Photo: R. Scott
What is retained, is not what is being kept in the long term

Mortality of retained overstorey trees over 3 years
Halpern and Halaj – Results from DEMO study

Mortality is likely to decline with time since harvesting, but few long-term studies exist

Edge effects and the loss of structure (Laurance et al. 2006)

Results from the Biological Dynamics of Forest Fragmentation Project after 22 yrs
Coarse dead wood retention

To retain CWD beyond the first regrowth cycle, new CWD must be recruited from retained patches.

Probability of presence of CWD in biodiversity-oriented silviculture in Norway spruce, Sweden

How do retained structural elements influence the coupe area and surroundings and how can they be used silviculturally?

- Retained structures as inoculum:
  - source for natural regeneration
  - energy: mycorrhizal colonization
- Retained structures to ameliorate micro-climatic and hydrological effects
- Retained structures as sources of pests and diseases
- Influence of retained structures on stability and productivity of new tree cohorts

Can retained structures have destabilising effects?
2. Cultural Old-growth

Photos: T. deLuca

3. Redeveloping old-growth attributes in regrowth and secondary forests
   Structural complexity enhancement

- Hypothesis 1: Silvicultural practices can accelerate development of late successional structural elements in forest stands

- Hypothesis 2: Active restoration of OG structures offers advantages over passive (non-manipulative/unguided) restoration; e.g. reduced risks, higher level of provision of services and goods such as timber

after Keeton 2006
Structural attributes of OG forests and silvicultural approaches to promote these

<table>
<thead>
<tr>
<th>Desired attribute</th>
<th>Silvicultural interventions</th>
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| 1. Vertical canopy stratification | 1. a) Selection cutting  
b) Continuous regeneration  
and its release |
| 2. Horizontal variation in stand density | 2. a) Group selection and gap harvesting  
b) Variable density thinning |
| 3. Presence of large trees | 3. a) Crown thinning to release most vigorous trees  
b) Long rotations |
| 4. Presence of standing dead trees | 4. a) Allow self-thinning  
b) Tree girdling (morticulture) |
| 5. High levels of CWD on the ground | 5. a) Allow self-thinning  
b) Tree felling or pulling |
| 6. Dead wood in crowns | 6. Long rotations |
| 7. Presence of late successional understorey | 7. Maintain unthinned stand areas |

adapted from Keeton 2006

What can be achieved with traditional uneven-aged silviculture?

Postharvest changes in structural attributes in Northern Hardwood Forests through Uneven-aged Silviculture vs Structural Complexity Enhancement (Keeton 2006)

Reduction in cavity trees in Northern Hardwood Forests through traditional uneven-aged Silviculture (Kenefic and Nyland 2007)
Uneven-aged silvicultural maintains vertical structural diversity at small spatial scales, but may fail to emulate horizontal spatial heterogeneity.

Fig. 4. The shifting mosaic of the studied plot (10.65 ha), mapped in Suemp Skov, 1992.

"Optimal" diameter distribution in uneven-aged forests

Acceleration of "dominant old-growth" trees

Importance for moss, lichens and dead wood in the canopy

More integration between stand quality management and habitat tree prescriptions.
Big trees are not old trees

Possible differences:
• Amount of dead wood in crown
• Cavities
• Bark type
• Epicormic branches and secondary crowns
• Epiphytes
• Capacity to respond to release

In regrowth forests, trees can/should be prepared for retention

Effects of different thinning approaches on understorey composition

Modified from Berryman, unpubl.
Redevelopment of the woody detritus pool

- Girdling
- Pulling
- Self-thinning

Management of the seedling bank

- It may take a long time to establish the seedling bank that can respond to disturbance by release. This may require control of browsing wildlife.
- Seedling bank may represent a temporal buffer of genetic information.

Age class distributions of subalpine fir and Engelmann spruce < 1.3 m tall in the understorey of an old subalpine forests in south-central British Columbia, Antos et al. 2000
Summary – Managing old-growthness

- 3 Rs: Reservation – landscape
  - Retention and restricted selection – stand
  - Restauration – stand
- Heterogeneity instead of homogeneity
- We have sufficient silvicultural techniques in the tool box to manage old-growthness

“A good silvicultural system is not chosen but formulated as a solution to a specific set of circumstances” D. M. Smith 1962

Silvicultural research challenges

- Translating landowner objectives (societal objectives) and new scientific insights into forest structural objectives
- Assessing the long-term effects of structural arrangements on ecosystem functions and services
- Analysing trade-offs between different management objectives (C, water, timber, etc.)
- Designing efficient monitoring schemes to support adaptive management
„What I see in nature is a magnificent structure that we can comprehend only very imperfectly. And that must fill a thinking person with a feeling of humility."

A. Einstein