IMPROVEMENT, SALVAGE, & SANITATION CUTTING

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Background reading:

Sources cited:


In nature we find infinite variety ...

... and things can go wrong

- within our control
- beyond our control

... *sylviculture helps us to minimize the risks*

... can we help
But when / if uncontrollable forces overwhelm us …

... we take *DECISIVE ACTION*

- to recover
- to rebuild the future

*DECISIVE ACTION*

... to address the problem expeditiously
Note this basic principle of silviculture …

- take deliberate steps to identify potential injurious agents … *in advance*

- learn how they work / function, occur, and affect the growing stock … *in advance*

- build into the silvicultural system deliberate counter measures … *in advance*

... *to control these potential problems* … *to make the stands more resistant and more resilient*

**Called** *IFHM* …

*Integrated Forest Health Management* involving timely *ACTION* to…

- keep the trees healthy, more resilient, & more likely to recover from damage

- control important damaging agents before they reach outbreak levels & cause unacceptable risks
So what must we guard against ...

EXTERNAL FORCES ...

- external to our silvicultural system

- they actually comprise part of the natural systems we work with

Ecologically, THEY BRING CHANGE ...

- It may come abruptly

... as in a CATASTROPHE

... even a stand replacing event
Ecologically, *THEY BRING CHANGE* ...

- It may come abruptly
  ... *as in a CATASTROPHE*

- Have a less spectacular effect
  ... *as with an ENDEMIC IRRITANT*

... often affecting just a few trees
But all require our attention and thought …

... catastrophic

... irritating

In the long run these have greater *ECONOMIC*
than ecologic importance …

... to us
Catastrophic forces ...

- fire
- blowdown
- flooding
- insect outbreaks
- major disease infestations
- drought
- killing temperature
- mechanical injury

... often beyond our control
... they ravage entire stands or forests

Irritants ...

- animal predation
- insect attack of individual trees
- disease in individual in trees
- nutrient and moisture deficiency
- human harm to trees
- low-level versions of combinations of the above
Irritants can ...

**KILL**

... eat, trample defoliate, debark, uproot, break off or bend over, and/or destroy tissues
Irritants can ...

**KILL**

... eat, trample defoliate, debark, uproot, break off 
or bend over, and/or destroy tissues

**ALTER**

... defoliation reduces vigor 
... debarking opens wounds 
... breaking deforms 
... eating deforms and reduces vigor 
... diseases rot wood / destroy foliage 
... bending over increases risk
Irritants can ...

**KILL**

... eat, trample defoliate, debark, uproot, break off or bend over, and/or destroy tissues

**ALTER**

... defoliation reduces vigor
... debarking opens wounds
... breaking deforms
... eating deforms and reduces vigor
... diseases rot wood / destroy foliage
... bending over increases risk

**TRANSFORM ENVIRONMENT**

... compact and alter soil character
... pollute soil, water, and air
... often of our doing

... all due to an injurious agent
... including people

So how to react to these things ..

... the irritants

IMPROVEMENT CUTTING ...
IMPROVEMENT CUTTING ...

- in stands PAST SAPLING STAGE
- to improve quality and composition

By removing trees damaged by an INJURIOUS AGENT ...

- from the main canopy
- to favor more valuable trees

... like this one
BUT do you have sufficient stocking of “good trees”?
... if conditions justify continued management

One way to check in even-aged stands …
… use a stocking guide

Recommended minimum for continued management

After Roach 1977
C-LEVEL ...

... a guide to the minimum amounts of “good” trees to justify growing the stand for a longer rotation

... the minimum relative density that will grow to B-level stocking within 10 years

And this approach as well ...
Remember this ...

**Modified COMMERCIAL THINNING**

<table>
<thead>
<tr>
<th>AGS</th>
<th>RELATIVE DENSITY</th>
<th>LOCAL AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CLE BUGS</td>
<td>IN DIA</td>
</tr>
<tr>
<td></td>
<td>R300</td>
<td>R300</td>
</tr>
<tr>
<td>TOTAL STAND</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>UGS</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>POLES</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>SDAVY</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>MSKAVY</td>
<td>20.00</td>
<td>20.00</td>
</tr>
</tbody>
</table>

NOTE

Adjusting for UGS

... incorporating IMPROVEMENT CUTTING

**DISTRIBUTION OF CUT**

<table>
<thead>
<tr>
<th>CITY</th>
<th>ORIGINAL</th>
<th>EXCESS</th>
<th>FINAL DIST OF CUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>UGS</td>
<td>4.20</td>
<td>-4.20</td>
<td>4.00</td>
</tr>
<tr>
<td>UGS</td>
<td>9.19</td>
<td>-9.19</td>
<td>21.95</td>
</tr>
<tr>
<td>UGS</td>
<td>10.74</td>
<td>-10.74</td>
<td>10.74</td>
</tr>
<tr>
<td>UGS</td>
<td>1.90</td>
<td>-1.90</td>
<td>1.90</td>
</tr>
<tr>
<td>UGS</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Taking the UGS as improvement cutting ...
To accommodate the need to remove UGS ...

... you make a departure from doing a strict crown thinning

... trying to keep 60% RD

... but only if you find at least 45% RD of AGS in the stand
What about uneven-aged stands ...

With selection system ...

... what about keeping less stocking

... or truncating the diameter distribution when UGS dominate the largest sawtimber size classes

Also consider …

- LOWER residual stocking
- LONGER cutting cycle
- with improvement cutting included in the tending
You could sort the data by AGS and UGS ...

<table>
<thead>
<tr>
<th>Stand Heberg 99</th>
<th>Point 29.9 20.</th>
<th>Date Apr 83</th>
</tr>
</thead>
<tbody>
<tr>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>2-3</td>
<td>1.0</td>
<td>5.2</td>
</tr>
<tr>
<td>4-5</td>
<td>1.5</td>
<td>5.6</td>
</tr>
<tr>
<td>8-9</td>
<td>6.0</td>
<td>6.6</td>
</tr>
<tr>
<td>10-11</td>
<td>9.0</td>
<td>7.8</td>
</tr>
<tr>
<td>12-13</td>
<td>7.5</td>
<td>8.5</td>
</tr>
<tr>
<td>14-15</td>
<td>16.5</td>
<td>10.2</td>
</tr>
<tr>
<td>16-17</td>
<td>11.0</td>
<td>10.3</td>
</tr>
<tr>
<td>18-19</td>
<td>19.5</td>
<td>11.2</td>
</tr>
<tr>
<td>20-21</td>
<td>7.5</td>
<td>8.3</td>
</tr>
<tr>
<td>22-23</td>
<td>2.3</td>
<td>8.2</td>
</tr>
<tr>
<td>24+</td>
<td>3.5</td>
<td>3.1</td>
</tr>
<tr>
<td>All</td>
<td>79.5</td>
<td>92.0</td>
</tr>
</tbody>
</table>

Somewhat lowering the stocking by keeping little large sawtimber (saving only the good ones) ...

<table>
<thead>
<tr>
<th>DBH Class</th>
<th>ALL</th>
<th>AGS</th>
<th>(Arbogast Guide)</th>
<th>Excess</th>
<th>% Out</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤8</td>
<td>22</td>
<td>12</td>
<td>24</td>
<td>-2</td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>10-11</td>
<td>13</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>40%</td>
<td>2/5</td>
</tr>
<tr>
<td>12-17</td>
<td>49</td>
<td>35</td>
<td>20</td>
<td>20</td>
<td>41%</td>
<td>2/5</td>
</tr>
<tr>
<td>&gt;18</td>
<td>48</td>
<td>24</td>
<td>32</td>
<td>-8 AGS</td>
<td>49%</td>
<td>1/2</td>
</tr>
</tbody>
</table>

*To Reduce UGS,

UGS = Unacceptable Growing Stock

NOTE: Due to exceed UGS in LST, cut 1/2 instead of 1/3 as called for in the Arbogast Guide.

... incorporating IMPROVEMENT CUTTING
... leaving less LST due to the UGS

Where you have more ST UGS than a simple adjustment allows ...

<table>
<thead>
<tr>
<th>chb</th>
<th>15 yrs.</th>
<th>20 yrs.</th>
<th>25 yrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1n)</td>
<td></td>
<td></td>
<td>(ft²/ac)</td>
</tr>
<tr>
<td>2–5</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>6–11</td>
<td>25</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>12–16</td>
<td>35</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>17+</td>
<td>15</td>
<td>10</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>70</td>
<td>65</td>
</tr>
</tbody>
</table>

Hansen and Nyland 1987
... but keeping an appropriate structure

... to deal with the UGS
Some *FINANCIAL* considerations ...

You remove *low value* trees, and perhaps few per acre ...

… you may not recover sufficient volume and value to sustain a commercial logging operation

... improvement cutting often provides low revenues

... *e.g., biomass only*
You remove low value trees, and perhaps few per acre ...

... you may not recover sufficient volume and value to sustain a commercial logging operation

... it may prove less costly to poison the trees

Cost neutral means realizing sufficient revenues to cover costs of the operation, but leaving little as profit... particularly for unmerchantable ones
You remove *low value* trees, and perhaps few per acre ...

… you may not recover sufficient volume and value to sustain a commercial logging operation

… it may prove less costly to poison the trees

… or emerging biomass markets may pay sufficient for a *cost-neutral* operation

… chip harvesting of biomass for energy or other feedstock
You remove *low value* trees, and perhaps few per acre ...

... you may not recover sufficient volume and value to sustain a commercial logging operation

... it may prove less costly to poison the trees

... or emerging biomass markets may pay sufficient for a *cost-neutral* operation

**Cost neutral** means realizing sufficient revenues to cover costs of the operation, but leaving little as profit

You must repay any investment through *FUTURE* value growth ...

... you justify the operation by allocating more growing space to good and valuable trees (the AGS)
So DELIBERATE ...

- if you have sufficient trees to provide adequate site utilization

- if you should regenerate the stand instead
... keeping the AGS as a seed source

SO DELIBERATE ...

- if you have sufficient trees to provide adequate site utilization

- if you should regenerate the stand instead

But don’t forget to contemplate the **financial future** !
Ways to facilitate the harvest of small-diameter and log-grade trees ...

(1) Require cutting of small-diameter and poor-quality trees as part of the timber sales contract.

(2) Use lump-sum sales that allow contractors flexibility in what they actually remove from a stand or from the felled trees.

(3) Give away the small and low-grade trees with the sale of valuable ones.

(4) Link cutting of small and low-grade trees with that of high-value ones.

(5) Don’t feel compelled to cut all the small and low-quality trees at one time.

(6) Allow removal of materials from tops of sawtimber trees, but require felling of small and poor-quality ones.
Look for COST-NEUTRAL ways to do it …

… or poison them

… but consider the effect on wildlife habitat, and on the visual qualities in a stand
... and particularly the cavities...

To illustrate ...

<table>
<thead>
<tr>
<th>Minimum Nesting Height</th>
<th>Minimum Diameter at Breast Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>≥ 6 ft</td>
<td>3</td>
</tr>
<tr>
<td>≥ 15</td>
<td>—</td>
</tr>
<tr>
<td>≥ 30</td>
<td>—</td>
</tr>
</tbody>
</table>

*Generally, animals can readily use snags much larger than their minimum requirements. For example, although only four species—barred owls, Vaux’s swifts, pileated woodpeckers, and fishers—must have snags that are at least 30 feet tall and 20 inches in diameter, all 62 species can probably use snags of this size.

Sawtimber size trees
And you don’t need them at a high stem density …

A MODEL FOR ESTIMATING SNAG REQUIREMENTS

<table>
<thead>
<tr>
<th></th>
<th>Harry Woodpecker</th>
<th>Northern Flicker</th>
<th>Blackbacked Woodpecker</th>
<th>Williamson’s Sapsucker</th>
<th>Pilated Woodpecker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate territory size</td>
<td>25 ac.</td>
<td>40</td>
<td>75</td>
<td>10</td>
<td>300</td>
</tr>
<tr>
<td>Maximum number of pairs per 100 acres</td>
<td>4</td>
<td>2.5</td>
<td>1.3</td>
<td>10</td>
<td>0.3</td>
</tr>
<tr>
<td>Number of cavities per pair per year</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Minimum snag size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of snags needed per 100 acres</td>
<td>10 in.</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

... number per 100 acres

And when disaster strikes ...

... all gone
SALVAGE CUTTING:

... removing killed or severely damaged trees
  - those affected by an injurious agent
  - those that seem likely to die

... TO CAPTURE THE VALUE

SALVAGE CUTTINGS ...

- done for economic reasons *
- due to an injurious agent

... and not the result of inter-tree competition

*usually financial ...
... but sometimes for other economic reasons
Post-storm blowdown …

Salvage cutting …

Moving the timber …

Watch the salvage and results …

The aftermath …

... for financial or other economic reasons
Consider SANITATION cutting ...

- eliminate trees attacked by or in imminent danger of an IDENTIFIABLE INJURIOUS AGENT

... TO PREVENT spread of the disease or pest

Sanitation cutting ≠ thinning ...

... a FOREST HYGIENE measure
... like attacking early stages of a beetle infestation

... or cutting a buffer around a patch of dying Norway spruce
Economic importance of sanitation cutting …

- the problem may worsen and the losses multiply if you don’t invest in the treatment

- it may cost less to spend on sanitation measures than to suffer greater subsequent losses of volume and value if the problem spreads

SO you do sanitation cutting to minimize or prevent future losses from some destructive agent …

… and they do not include inter-tree competition

... before this happens
So sanitation cutting has

**HIGH ECONOMIC URGENCY**

And note this ...

**SOME DIFFERENCES BETWEEN**

<table>
<thead>
<tr>
<th>SALVAGE/ SANITATION</th>
<th>THINNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUTTING</td>
<td>INTER-TREE COMPETITION</td>
</tr>
<tr>
<td>INJURIOUS AGENT</td>
<td></td>
</tr>
</tbody>
</table>

same with IMPROVEMENT CUTTING
Similarities between salvage and sanitation cuttings ...

- both remove (potential) mortality
- both recover trees of economic worth
- neither deliberately triggers regeneration as a planned side effect

.... likewise with IMPROVEMENT CUTTING

Operational side effects of catastrophe ...

... drop other pre-planned work so you can react IMMEDIATELY
... start TOTAL READJUSTMENT of silvicultural plans for the stand and the forest

So you regroup ...

... to figure out HOW to rebuild to assure an acceptable future
Potential problems in recovering the value of “destroyed” timber through salvage cutting ...

The injurious agent may have destroyed some or all of the product value through its action ...

... this degrading may force you to sell the trees for a lesser use

A catastrophe over a wide geographic area may result in a glut of products flooding the market place ...

... no one wants your trees
... or only at a nominal price
... so you need to **ACT PROMPTLY!!**

... get them into the market quickly

But salvage leads to another potential problem ...

... how to insure replacement with adequate regeneration
Possible regeneration problems that may follow salvage cutting ...

- seed-bearing trees may have been destroyed, importantly reducing or eliminating the seed source over a large area

- you may salvage timber over an area of a size and configuration not fitted to seed dispersal of the desired or a suitable species from adjacent seed sources

- you may need to cut during a poor seed year or find that the causal agent prevented seed development or dispersion

- the injurious agent may affect regeneration as well, or may have create unsuitable seedbeds
As silviculturist you must look ahead ...

... and where necessary rely on even unusual measures to get a new stand started

That may mean ...

- site preparation
- adding measures to supplement or substitute for natural regeneration
… to reduce interference and/or remove obstacles

... followed by planting or seeding
... always acting decisively