Restoring Pine Plantations to Multifunctional Uneven-aged Stands
(Adaptive Management Project at Tate’s Hell State Forest, FL)

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THSF management goal: “convert and maintain plantations as low-density uneven-aged stand structures that will maintain biological diversity, while integrating public use” (DOF2007).

THSF is a
- 820 km² of poorly-drained lowland hydric flatwood site in NW Florida
- Historically a swamp site
- Currently under intensive pine plantations

Stand Conversion Experiment at Tate’s Hell State Forest
Even to Uneven-aged Conversion

Even-aged/plantation  Two- aged  Uneven-aged

- **Tree ha\(^{-1}\)**
  - DBH: Bell-shaped
  - DBH: Bimodal
  - DBH: Reverse J-shaped
Starting stand conditions

‘old’ dense, unthinned slash pine plantations

32-year old

BA = 35 m$^2$ ha$^{-1}$

QMD = 13.8 cm (all species)

= 20.5 cm (slash pine)

Trees/ha = 2500 (all species >bh)

= 670 (slash pine only)
Conversion Harvest Treatments

- 5 conversion harvest treatments (different initial harvest types), and
- uncut control
3rd row thin

Typical thinning operation, a preliminary step to open up stand before implementing uneven-aged methods, reduced BA by 33%.
Cut 2-Leave 3

Somewhat typical thinning operation to open up stand prior to uneven-aged methods; reduced pre-thin BA by 40%

Alternatively, under-planting seedlings can be done in the open rows to initiate a second age class.
Stutter-step/Staggered 3rd Row Thin

MARKING GUIDE: Cut trees in 50-60 m of every 3rd row, side step over to next row and cut another 50-60 m, then side step back to create a checker-board effect
Irregular shelterwood

MARKING GUIDE- Mark the best trees only as ‘leave trees’, so that residual basal area is ~ 7-9 m²/ha, dispersed somewhat uniformly across the stand.
Group selection

MARKING GUIDE- Create gaps of 0.1, 0.2, 0.4, and 0.8 ha sizes. Third row thin within “matrix” of the remaining forest.

Pre-harvest

Post-harvest

Aerial perspective

Terrestrial perspective
Control

No harvest was performed in the experimental controls; dense unthinned slash pine plantation.
Layout of Conversion Harvest Treatments

Operational scale, > 6 ha treatment plots
Data Collected

- Vegetation data (Overstory, Understory, Groundcover)
- Natural Regeneration
- Light availability and canopy characteristics (Gap fraction, Leaf Area Index, fAPAR etc.)
- Seed bank structure and composition
## Early Regeneration Response

<table>
<thead>
<tr>
<th></th>
<th>Density (seedlings/ha) by height class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;30cm</td>
</tr>
<tr>
<td><strong>3rd Row Thin</strong></td>
<td>5180\textsuperscript{b}</td>
</tr>
<tr>
<td><strong>Cut 2 Leave 3 Row Thin</strong></td>
<td>4332\textsuperscript{b}</td>
</tr>
<tr>
<td><strong>Group Selection</strong></td>
<td>6000\textsuperscript{b}</td>
</tr>
<tr>
<td><strong>Shelterwood</strong></td>
<td>6420\textsuperscript{b}</td>
</tr>
<tr>
<td><strong>Staggered 3rd Row Thin</strong></td>
<td>5292\textsuperscript{b}</td>
</tr>
<tr>
<td><strong>Uncut Control</strong></td>
<td>172\textsuperscript{a}</td>
</tr>
</tbody>
</table>

Although the harvest treatments resulted in significantly higher number of seedlings as compared to control they did not differ from one another.
Early Regeneration Response

<table>
<thead>
<tr>
<th>Harvest Treatment</th>
<th>Density (seedlings/ha) by height class:</th>
<th>Total seedlings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;30cm</td>
<td>30-60cm</td>
</tr>
<tr>
<td>Cut 2 Leave 3 Row Thin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Thinned Stand Area</td>
<td>6272</td>
<td>3232</td>
</tr>
<tr>
<td>Within Unthinned Stand Area</td>
<td>2600</td>
<td>900</td>
</tr>
<tr>
<td>Group Selection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Gap</td>
<td>2452</td>
<td>2680</td>
</tr>
<tr>
<td>Within Matrix</td>
<td>8532</td>
<td>2732</td>
</tr>
</tbody>
</table>

Varying spatial regeneration response in gaps and thinned areas
Artificial Regeneration Study Design: Slash Vs. Longleaf Pine

Seedling planting design inside the group opening. The circle represents the border of the gap and the lines represent the planting rows of slash and longleaf pine.
Groundcover Response

Shelterwood resulted in least shrubs as well as total groundcover, but highest proportion of graminoids.
Long-term Stand Structure and Productivity Evaluation Using Simulation Modeling

Even-aged/plantation  Two-aged  Uneven-aged

Tree ha⁻¹  Tree ha⁻¹  Tree ha⁻¹

DBH  DBH  DBH
Bell-shaped  Bimodal  Reverse J-shaped
Methods: Harvest approaches

“BDq” and “Low Thin”
• USDA Forest Vegetation Simulator (FVS) model and empirical data
• 73 possible conversion scenarios evaluated for
  • structural diversity,
  • C storage and
  • timber production
At all BA levels “BDq” approach will lead to higher overall structural diversity; “Thin first” approach equals “BDq” at around 50 years.
Sustained production at all basal area levels; higher residual BA leads to higher timber production; “Thin first” approach slightly superior to “Bdq” approach esp. at longer cutting cycle
Not surprisingly, higher residual BA maintains higher total stand carbon; “Thin first” approach slightly superior to “BDq” approach especially at longer cutting cycle.
Groundcover Restoration

- Seed bank and aboveground vegetation changes following restoration activities (thinnings and prescribed burning)
Thank You

Questions?
Comments?
Suggestions?