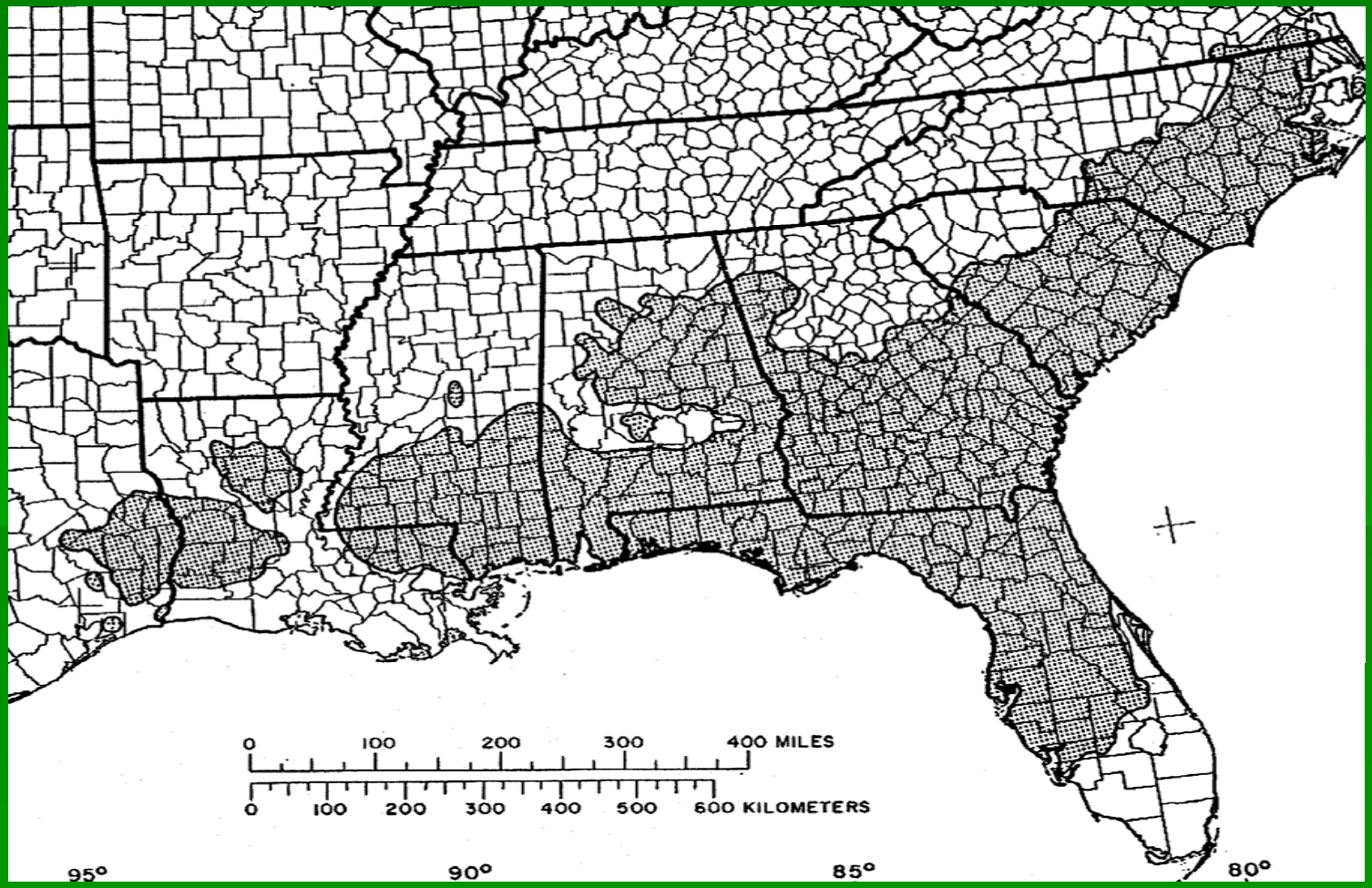
Restoring Longleaf Pine to the Overstory

A Manager's Guide

The Current Situation

- Estimates of pre-settlement longleaf acreage range from 60 – 90 million acres across the Southeast
- Today's estimates range from 2.75 to 3.5 million acres, a 95% decrease.
- Much of the previous acreage is unrecoverable, occupied by development.
- A significant amount is occupied by other forest types or is in agricultural uses.
- Restoration or conversion efforts are centered on these sites, requiring a variety of approaches for success.

Extent of Presettlement Era Longleaf



Why Bother?

- Longleaf pine forests offer ecological and economic benefits, supporting great biological diversity and producing high proportions of quality forest products.
- Longleaf is a significant component in the cultural history of the region and nation, supporting early industries and cultures and embedded in our history.

Mature Longleaf Forest

More reasons…

- Longleaf forests offer great flexibility for managers and owners, providing a range of products over a long period of time.
- Longleaf forests offer a low level of risk of catastrophic loss, tolerating fire, insects, disease, drought, ice, and wind as well as or better than other southern pine forests.

Longleaf is resistant to damage from fusiform rust and southern pine beetles

Management Choices

- Artificial Regeneration:
  - ✓ Direct Seeding not very cost effective or successful and generally not recommended
  - ✓ Planting may be done with either bareroot or containerized seedlings
  - ✓ Usually requires some sort of site preparation for satisfactory success
  - ✓ Spacing and stocking can be controlled to meet specific objectives

Seedling Choices

Bareroot

Containerized

Natural Regeneration

Management Choices

- Natural regeneration:
  - ✓ Requires a suitable, well distributed seed source
  - ✓ Can be used in even-aged and uneven-aged management systems
  - ✓ Sacrifices advantages of stocking control for low “upfront” regeneration costs
  - ✓ Uncertain seed crops make planning difficult if time is a factor

Some common situations

- Old fields and pastures
- Abandoned cutover forestland
- “Off-site” hardwoods
- Mixed Pine-Hardwood Stands
- Loblolly or Slash Plantations and Natural Stands
- Mixed Pine Species Stands
- Degraded Longleaf Stands

Old Fields and Pastures offer unique challenges

- Residual Fertilizers
  - Encourages competing vegetation
  - May encourage pests and facilitate disease, *e.g.*, sawfly larvae and pitch canker

Sawfly larvae damage to longleaf seedlings and saplings in an old field

Pitch canker can cause stem damage and mortality

Old Fields and Pastures offer unique challenges

- Residual Fertilizers
  - Encourages competing vegetation
  - May encourage pests and facilitate disease, *e.g.*, sawfly larvae and pitch canker
- Old Field Weeds
  - Full complement of grasses and weeds like crabgrass, ragweed, goldenrod, bermuda grass, bahia grass, etc.
- Agricultural Pests like white fringed beetles, charcoal root rot, etc.

Pasture approaches

- Control pasture grasses with chemicals
  - Imazypyr (*e.g.*, Arsenal™ or Chopper™)
  - Glyphosphate (*e.g.* Roundup™ or Accord™)
  - One effective strategy uses winter fire followed by spring herbicide treatment
  - Follow label recommendations for herbicide rates,application methods, and safety

Pastures…

- Follow grass control with scalping and subsoiling
- Scalping and subsoiling MUST be done on the contour to avoid erosion and washing
- Scalping and subsoiling should be done several months before planting to allow soil settling in the subsoiled “rip”
- Scalped areas should be 24” to 36” wide and 4” or so deep to get below the sod.
- Subsoiling can be done in the center of the scalped area in a one or two pass operation if hand planting is to follow.

Scalping and subsoiling can be done in one or two operations

Pastures…

- Subsoiling should be done off center and in a separate operation from scalping if machine planting is to be employed.
- Planting should take place as early in the fall as possible when there is good soil moisture.
- Planting should be done with containerized seedlings for best success.
- Seedlings should not be planted directly into the ripped or subsoiled area but several inches to one side.
- Seedlings should be planted so that 1” or more of the plug extends above the soil surface after planting.

Never plant directly into the ripped furrow!

Scalping in pastures

Scalping and subsoiling alone can lead to success in pastures if planting is done well

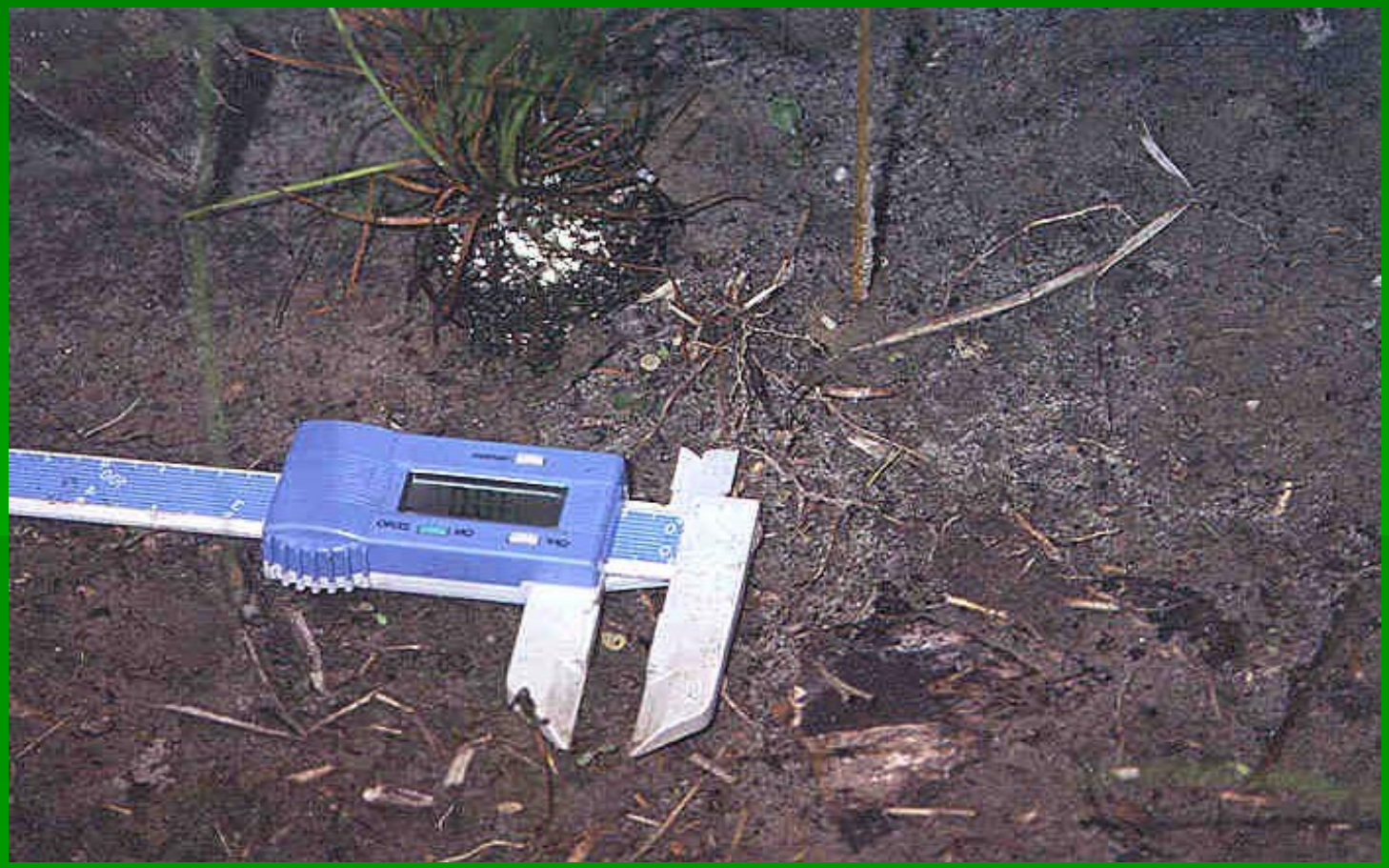
Old Fields…

- Like pastures, old fields should be scalped prior to planting.
- Scalped rows should be at least 2 inches deep and 24 inches wide.
- Subsoiling may or may not be necessary if it has been performed previously.
- Do not plant in rip furrow. Either offset subsoiling from scalped center or plant to one side of the ripped area.
- If containerized seedlings are used, they should be planted with at least one inch of the plug exposed. Containerized seedlings are recommended in these situtations.

Scalping in old fields

Scalping in old fields displaces weed seeds, disease organisms and root eating grubs. Depth of the scalped area can be as little as two inches.

Shallow planting with containerized seedlings gives better survival!



Old fields…

- It may be necessary to follow planting with an “over the top” release treatment, typically banded, in the Spring to control aggressive competing grasses and weeds.
- Suggested treatment regimes include Velpar™ (hexazinone) and Oust™ (sulfometuron) tank mixes or a premixed combination of the two, Oustar™ , applied in March or April .
- Other alternatives include an early Spring treatment with Oust™ followed by a later treatment with Arsenal™ after the onset of new foliage.
- Any Oust™ application should be deferred until the seedings have exhibited significant new root growth.
- In old fields and pastures, June and July plantings have been successful, particularly to fill gaps in earlier plantings.

Release Treatments

Dig before you spray!!

Be sure seedlings have new lateral root growth before spraying with Oust™

Old fields and pastures...

- Late germinants, like crabgrass, or persistent stoloniferous grasses, like bermudagrass, may be released by early chemical treatments and require a split treatment or late treatment to obtain control.
- It may be difficult to introduce fire into these situations early on due to the lack of fine fuels.

Late Germinants

Crabgrass in row 3 months after early release treatment with Velpar™ and Oust™

Cutover forest land

Abandoned cutovers

- Typically have woody as well as herbaceous competition to contend with.
- Do not have the residual soil fertility or aggressive agricultural weeds to control.
- Usually do require some sort of site preparation prior to reforestation.
- Array of choices including mechanical, chemical, fire and combinations.

Abandoned cutovers…

- Mechanical Site Preparation:
  - Chopping – Often followed by fire, causes minimal soil disturbance, woody sprouts often proliferate, single pass chop can be done without excessive damage to native understory grasses.

Drum Choppers

Savannah “3-in-1” plow

- Savannah or “3-in-1” plow – One pass operation clears, subsoils, and beds; can leave native vegetation in middles; prepares good seedbed; provides woody control

“3-in-1” or Savannah Plow

Abandoned Cutovers…

- Shear, rake and pile – Utilizes heavy equipment to shear stumps and rake debris into piles. Maximizes soil disturbance and disruption of native vegetation. Topsoil often lost into piles or windrows. Can provide good conditions for planters.
- Sometimes followed by disking.
- Piles or windrows usually burned before planting.

Raking logging debris into windrows or piles after shearing

Abandoned cutovers…

- Chemical site preparation, most effective if used in conjunction with fire
  - ✓ Variety of chemicals useful, including products containing imazypyr, glyphosphate, hexazinone, triclopyr, and picloram as active ingredients.
  - ✓ Broadcast burns, if possible, should be performed in the late summer or fall prior to planting.
  - ✓ Choice of chemical based on soils, vegetation to be controlled, desired residual vegetation.
  - ✓ On xeric sites, scrub oaks controlled well with hexazinone products.

Herbicides followed by fire

Abandoned cutovers…

- Planting can be done by hand or machine if site preparation is adequate
- Planting can be done with bare root or containerized seedlings although containerized seedlings lower risk of mortality
- Subsequent release treatments may or may not be necessary, depending on vegetative response.
- Fire may be introduced as soon as fuels allow. Seedlings are most vulnerable during first stages of height growth (0.5 – 4 feet tall).

Off-site Hardwoods

Off-site hardwoods

- Must be removed by harvest before reforestation with longleaf.
- Site preparation options same as cutover with addition of stem injection of herbicide as an option for some hard to kill species.
- Planting and release recommendations also similar to previous recommendations

Mixed pine-hardwoods

Mixed pine-hardwoods

- If pine component is sufficient, might remove or control hardwoods and try to introduce fire into stand before removing pines.
- If successful using fire and/or herbicides to control woody sprouts, gaps might be planted with longleaf seedlings to smooth transition to longleaf stand.

Mixed pine-hardwood…

- If pine stocking is inadequate to provide fuel for fires, another option is to clearcut stand and begin again with longleaf or other pines.
- Possible to establish plantation of pines other than longleaf to allow quick control of site through shading and fire before planting longleaf.
- Longleaf can be planted on site after pine is removed by clearcut harvest or into gaps created by partial harvests.
- Containerized seedlings are recommended and slower growth should be anticipated if residual trees are retained.

Mixed Pine Stands

Mixed pine stands

- If sufficient numbers of well-distributed longleaf are present in the overstory to provide some seed, the stand can be managed to regenerate naturally.
- Fire should be a regular part of a management regime until woody understory competition is controlled.
- One treatment to control woody brush that has proven successful employs Garlon 4™ (triclopyr) applied with ground equipment or backpack sprayers in early Fall, followed by an early Spring fire.
- Fire must be employed to prevent seedlings from other pine species from occupying the site before longleaf can become established. Longleaf has sporadic seed crops, unlike the annual seed crops of other southern pines, and may fail to capture the openings when they occur.

Fire must be used to control understory hardwoods and unwanted pine regeneration

Mixed pine stands…

- If sufficient seed producing longleaf are not present, planting is a viable option.
- Clearcutting and planting after controlling the woody understory via fire, site preparation or a combination of the two is an option.
- Another option includes controlling the understory and creating gaps in the overstory of ¼ to ½ acre to be planted with longleaf.

Stands of other pine species might be thinned to create gaps for planted longleaf seedlings

Fire must be used to keep these gaps open. Loblolly pine is a particularly aggressive colonizer and must be kept at bay with fire.

Mixed pine stands…

- Successive cuts to increase the number and/or size of the previous gaps will create a mixed stand of several age classes, that will, over time, become an all-aged longleaf stand.
- It may be desirable to keep some pines of species other than longleaf in the overstory to help provide fuel for fires.
- It is difficult to burn into the center of gaps larger than ¼ acre because of the lack of pine fuels.

Degraded Longleaf Stands

Degraded longleaf stands

- Longleaf stands or stands that are predominantly occupied by longleaf may be regenerated either by artificial or natural means.
- Fire suppressed longleaf stands may have heavy litter buildups as well as hardwood encroachment. “Draped” fuels can lead to hot fires, but most mortality in the overstory is due to smoldering fires at the bases of older trees.

“Draped” fuels can serve as fire ladders, leading fire high into the overstory

Degraded longleaf stands..

- Mature longleaf in fire suppressed systems accumulate litter in deep pyramidal heaps around the bases of the trees. These piles are composed of foliage, bark, cones, and shed limbs.
- Smoldering fires in these fuel beds can damage surface roots, creating entry points for root decaying fungi and other pathogens.
- Wetting or raking these piles may help avoid these problems.

Litter beds around fire suppressed longleaf can be a foot or more deep and smolder for days

Degraded longleaf stands..

- The shelterwood system, as utilized in longleaf management, can result in either even-aged or multi-aged longleaf stands.
- The first step in natural regeneration should be to control the woody understory prior to opening up the canopy with a cut.
- Fire, particularly growing season fire, or fire and herbicide used in combination can be effective in this effort. Combinations of dormant season and growing season fires may be necessary to reduce initial fuel loads.

Degraded longleaf stands..

- When the understory is reduced to a manageable level, a preparatory cut is used to reduce Basal Area to 50 to 60 square feet per acre, favoring trees of good form, large crowns, and good seed producers. The residual trees should be well-distributed across the area.
- After several years, the crowns will have expanded into the intervening gaps. At that time, a second “seed” cut should be used to reduce Basal Area to 25 to 30 square feet per acre, again favoring well formed good seed producers distributed evenly across the stand.
- When a good seed crop is anticipated (through flower and/or cone crop counts), the stand should be burned in the winter or early growing season prior to seed fall to prepare a good seed bed.

The seed cut should lower basal area to about 30 square feet per acre

Degraded longleaf stands..

- Longleaf is a sporadic seed producer, producing seed anywhere from annually to once every 20 years in some areas.
- Longleaf is a “two-year” cone, with female cones or flowers appearing one year and maturing the next, the year of seed fall.
- Surveys of female flowers anticipates cone crops but can be difficult for inexperienced observers. Cone counts are easier, but give less lead time to prepare the site to receive seed.
- There should be about 30 cones per tree or 1000 cones per acre to provide adequate seed to naturally regenerate an entire area with longleaf seed.

Cone or flower counts can guide natural regeneration decisions

Almost anyone can count cones, but it takes a trained eye to count flowers

Degraded longleaf stands..

- A minimum of 4,500 seedlings per acre are considered sufficient to consider a site successfully regenerated from natural seed. At least 75% of all 0.001 acre plots should have at least one live seedling present.
- If the above conditions can be met, the site can be considered stocked with new seedlings and, if desired, the overstory trees removed within two years of the seed year. This will yield an even-aged stand.

Naturally regenerated stands should have from 4,500 to 6,000 seedlings per acre the spring after seed fall

Degraded longleaf stands..

- Naturally regenerated stands cannot be burned in the year following seedfall without endangering the new seedlings. Seedlings with a root collar diameter of 0.25 inch or greater generally can survive most fires.
- If even-aged stands are not desirable, all or a portion of the seed trees may be retained, creating a two-aged stand. Subsequent repetitions of this process with later seed crops will eventually yield a multi-aged stand.
- Seedling growth rates may be adversely affected by competition from the residual overstory.

New longleaf seedlings cannot survive fires until they reach a root collar diameter of at least 0.25 inches (6 mm)

Retaining some or all of the seed trees produces a two aged stand

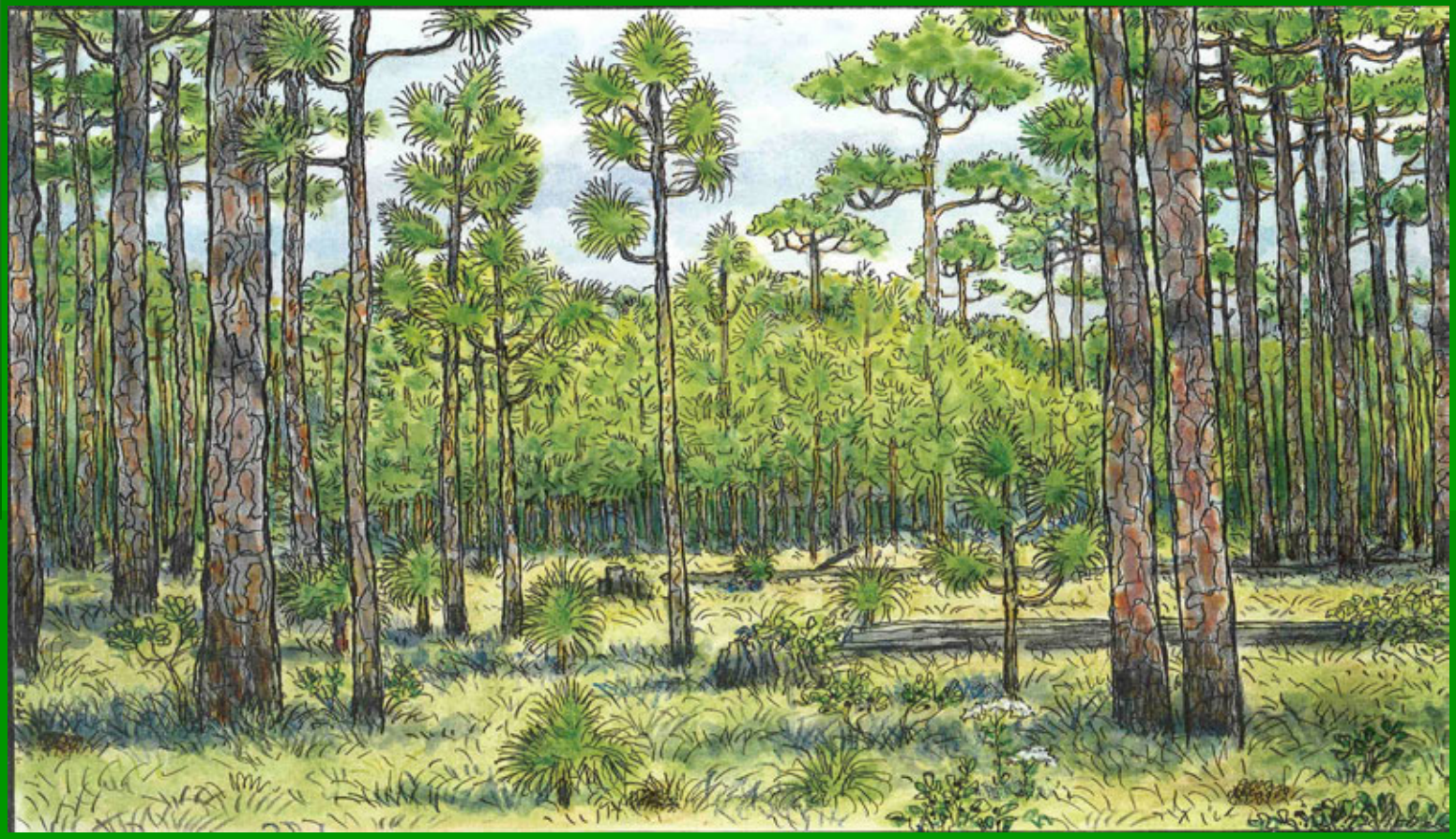
Degraded longleaf stands..

- Other natural management alternatives are available if the understory is controlled.
  - ✓Single tree selection
  - ✓Group selection
  - ✓Stoddard-Neel System
  - ✓Reverse “J” or BDQ method

Degraded longleaf stands..

- Single tree removal
  - Small gaps may cause extremely slow seedling growth and even mortality
  - Best applied in open or low BA (<30 ft^2/acre) stands
  - Retains appearance of a forest at all times
  - Economies of scale may lower economic viability.

Single tree selection creates small gaps in the overstory, resembling small scale natural events



Degraded longleaf stands..

- Group selection systems:
  - Create larger gaps which better support seedling growth and survival.
  - Make timber sales more efficient.
  - Gaps or openings can be enlarged to create a “dome” of seedlings and saplings with the oldest in the center and the youngest at the edges…
  - or more gaps can be created over time to yield a mosaic of age classes across the stand.

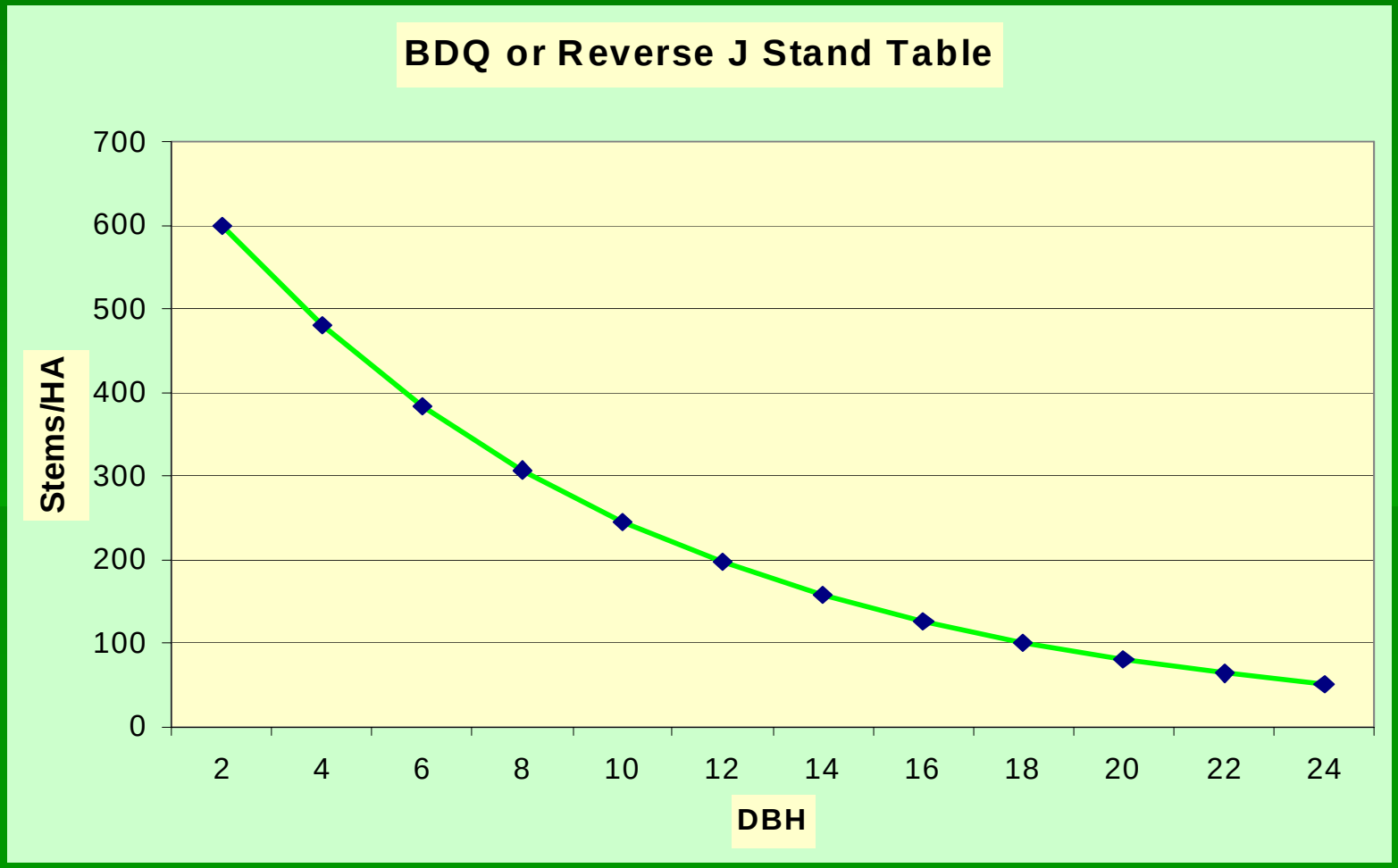
Degraded longleaf stands

- “Stoddard – Neel system” a modified form of group selection
- Combines elements of improvement cuts, regeneration cuts, and aesthetics to create and maintain “natural” forest condition and appearance
- Hard to describe or define and can be highly individualistic. Concentrates growth on high quality stems.
- Like other uneven or all-aged systems, may lose efficiencies of scale, but has proved to be economically viable and very attractive in practice.

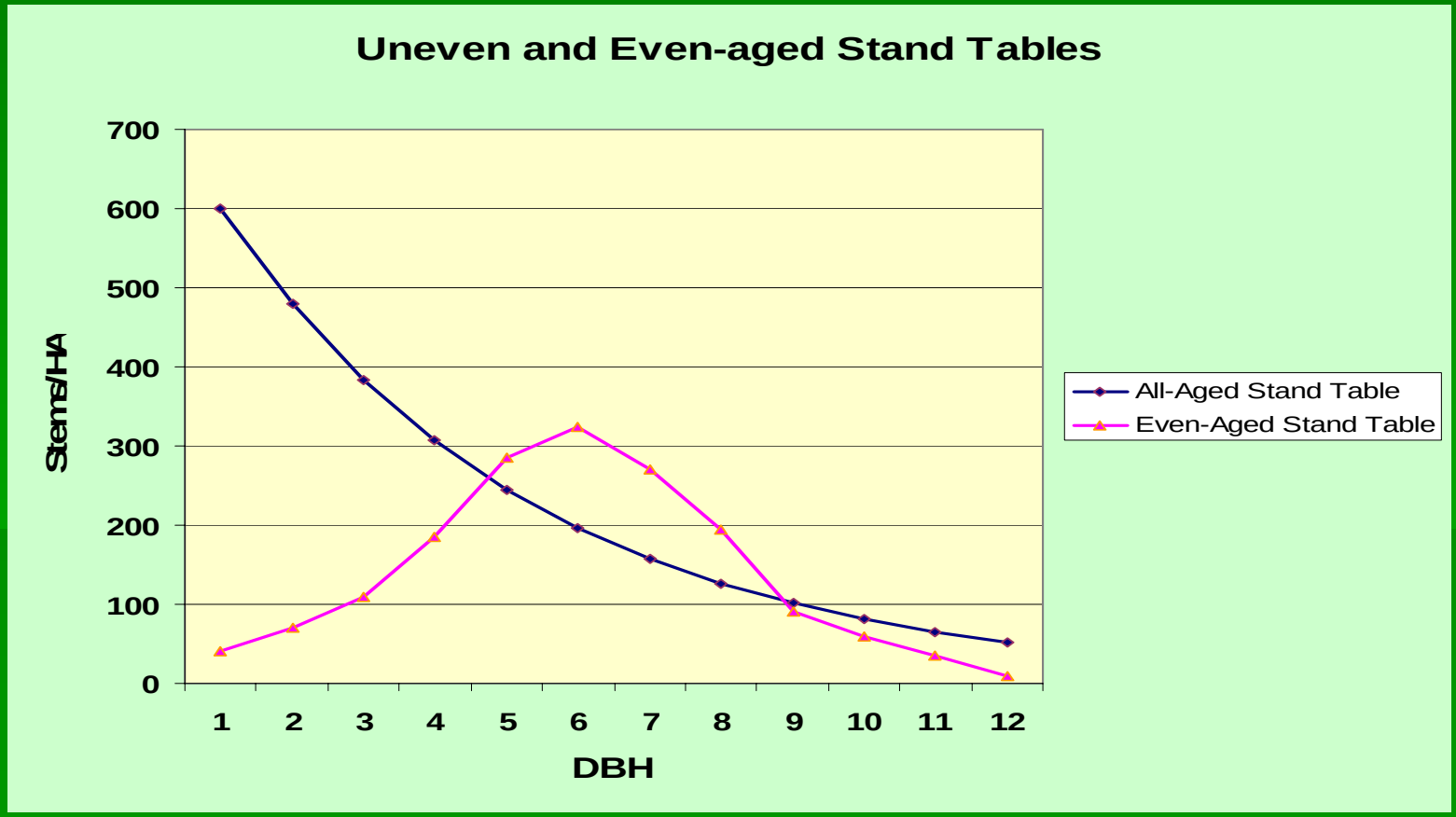
“BDQ” or “Reverse J” system

- Sets maximum diameter and basal area targets, as well as stocking ratio between successive diameter classes
- Each periodic harvest removes stems across all product classes
- Stocking table (numbers of stems by diameter class) resembles a reverse “J” when regulated
- Can be achieved by converting even-aged stand over several successive cuts.

BDQ or Reverse J Stand Table



Even-Aged to All-Aged Conversion



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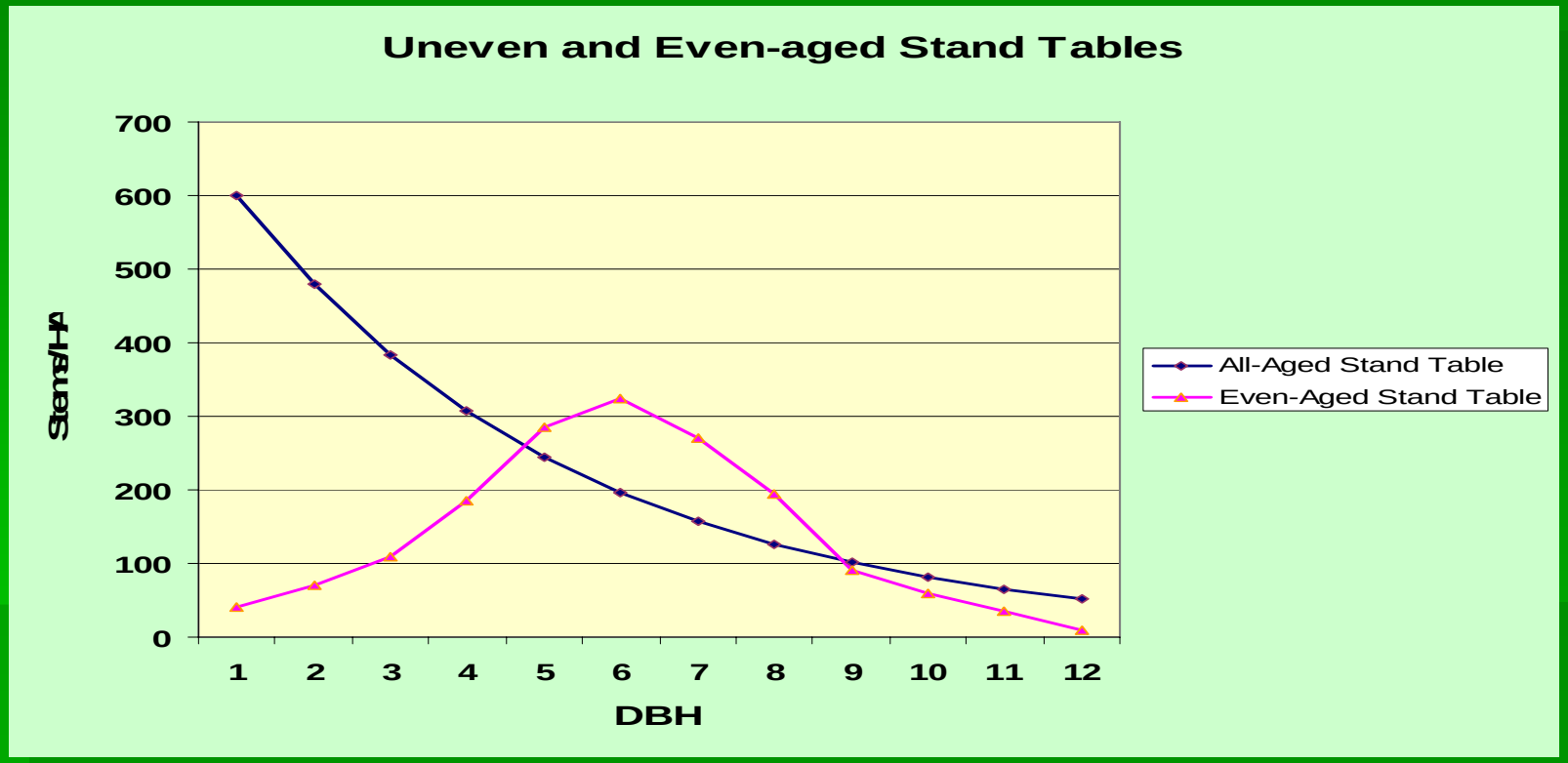

The long term goal should be a longleaf forest that looks something like this…

...or this