

Evaluation and Management Of Storm Damage to Southern Yellow Pines

Hurricanes cause extensive damage to forest stands from the high winds as well as floods resulting from the heavy rains that accompany them. Hurricanes damage trees by uprooting, breaking, bending, leaning, wounding, and flooding. Some of the damage is so severe or obvious that tree mortality is inevitable. With other damage the tree may be stressed but will recover.

The purpose of the following outline is to provide guidelines to help the forester decide whether damaged trees will recover and can be managed through rotation or will not recover and should be salvaged. Specific guidelines for setting salvage priorities not addressed in this paper can be found at www.ces.ncsu.edu/nreos/forest/disaster

Don't panic the damage looks worse than it actually is. Take time to first assess the damage and base your actions accordingly.

Silvicultural Considerations

- Southern yellow pines exhibit strong apical dominance. When the top breaks a dominant leader will emerge that allows the tree to continue height growth. With some trees two or more leaders may fight for dominance resulting in the classic lyre or forked top. Other leaders form below the break producing a distinct crook. Typically enough trees produce a single leader close to a break to make a quality stand of straight bole trees.
- Juvenile wood is flexible so younger trees have less breakage. Young trees that are bent or leaning will straighten within the first growing season.
- Trees on the edge of openings suffer more damage. Interior trees tend to be buffered and support each other. For this reason newly thinned stands are susceptible to windthrow.
- Pines with fusiform rust are susceptible to breakage.
- Pines exhibit strong phototropic response allowing the tip of the tree as well as the stem to recover. Young stands will recover during the first growing season.
- Compression wood formed in response to leaning forms immediately and may have a negative impact on wood quality.
- Longleaf pine with its deeper rooting characteristics, less taper, and higher specific gravity is less susceptible to storm damage.
- Loblolly pines are tolerant of short duration flooding and salt intrusion. Minimal damage occurs to young plantations inundated for 1-2 days.
- Because of pines rapid growth rates, understocked stands recover quickly to biological and economically acceptable stocking levels.

First Evaluate the Damage

Since stand edges are more heavily damaged than the stand interior, storm damage may initially look worse than it really is. **An intensive survey is an important first step to get an accurate estimate of the extent and degree of storm damage.** The survey should include an evaluation of the condition of the trees as well as an estimate on the volume of timber damaged.

For heavily or lightly damaged sites a walk through exam may be enough to evaluate storm damage. However, if the extent of the damage is not obvious an intensive survey is required. A grid survey method where 30 plus 100th acre plots symmetrically arranged across the tract (suggest a 2 x 4 chain spacing) is recommended. This method is the same as suggested for natural regeneration determination or seedling survival count. See Attachment #1 for an example of a survey form.

From the survey we will determine the amount of damage, its distribution, and the type of damage. Sound forest management decisions based on the landowner objectives, an economic analysis, availability of harvesting equipment, and the wood product market can then be made.

Types of Damage

Hurricanes produce strong winds, tornadoes, and lots of rain. Extensive damage by uprooting, breaking, leaning, bending, twisting, wounding, and flooding can cover a wide area.

Recovery Potential

The information gathered from a field survey allows us to evaluate the recovery potential of the stand. Recovery potential is dependent on the type of damage and the age of the pine. Will the tree survive? Will it grow vigorously or become suppressed? Is it susceptible to insect or disease? Will it have good form? Consider the following points to answer management questions.

Immature Pine Stands

Because of the flexibility of juvenile wood, higher stocking density, lower tree height, and less foliage, damage in young pine stands usually takes the form of bent trees or from broken tops.

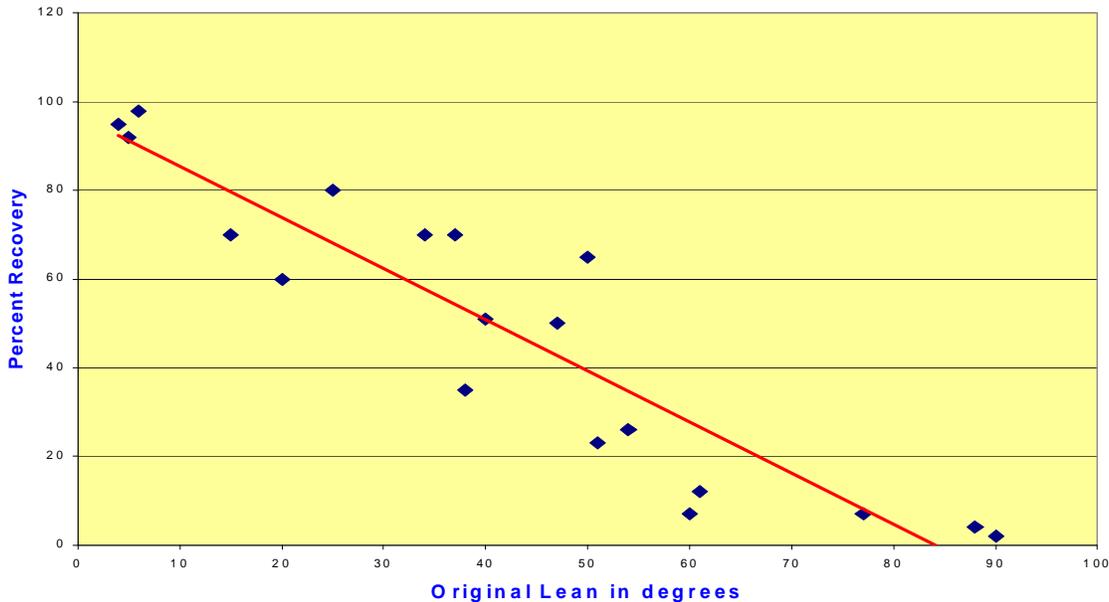
Figure 1. Illustrates the general concept that **the less the lean or bend the greater the chance an immature tree will completely straighten.** The younger the stand is the better chance it has to fully recover even from severe leans. The angle of the lean is determined by measuring from the base of the stem to the top of the crown.

Chart 1. provides guidelines for management decisions for immature pine less than 15 years old..

Chart 1. Recovery potential of leaning immature pines.

If the bend or lean is.....	Likely recovery is.....
➤ > 40 degrees	No Recovery – poor crop tree
➤ 30 – 40 degrees	Minimal recovery – will likely become suppressed
➤ 15 – 30 degrees	Partial recovery – 60 80 %
➤ < 15 degrees	Full recovery – good crop tree

Figure 1. Potential recovery of an 11-year-old loblolly pine from storm damage. Adapted from a study by Brewer & Linnartz, LSU Forestry Notes, 1973.



Recovery of immature and mature stands from crown or top damage is dependent on the amount of crown remaining. Again the more crown remaining to support the growth of the tree the better and the greater the chance for full recovery. **If the tree has less than 4 branches it should be salvaged or removed.** Chart 2. provides general guidelines applicable to both mature and immature trees.

Chart 2. Recovery potential for immature and mature pines based on amount of crown present.

If the amount of crown present is	
➤ > 3/4	Full recovery.
➤ 1/2 to 3/4	Slower growth likely; susceptible to insect damage.
➤ < 3/4.....	Likely to become suppressed.

Mature Stands

Damage to mature stands (greater than 15 years) is likely to be stem breakage, leaning, and root damage. **Expect mortality of trees with visible root damage especially if associated with lean greater than 45 degrees.** While trees with less severe lean will live their growth is slowed and they will likely become overtopped if surrounded by more vigorous competitors. Significant crown loss results in mortality or slows growth. Bole damage from twisting or shake that separate internal fibers is often not easily seen. Look for pitch flow to identify internal bole damage. Because they support each other mature stands often have less trees with severe leans. The guidelines that follow summarize potential recovery in a mature stand.

Chart 3. Recovery potential for mature pine stands (age 20 or greater)

If the tree is.....	Recovery potential is
Root Sprung	No Recovery
Cracked or Twisted Stem	No Recovery
Broken Stem	No Recovery
Top Broken	Lateral branches will assume terminal growth, slight crook is likely.
Lean > 45 Degrees	No Recovery
Lean 15 to 45 degrees	Partial Recovery, Likely will to become suppressed, crook will develop, susceptible to next storm
Lean < 15 degrees	Full Recovery

Management Options – Stand Level

Recommendations for management of storm damaged forest areas must consider the following factors.

- Amount and distribution of the damage
- Extent of the damage
- Recovery potential
- Landowners objectives
- Economics
- Availability of harvest contractors
- Local wood products market

Management options are limited to two basic choices, 1) to start over or 2) to manage what is not damaged or will recover. Management priorities depend on the risk of a pest outbreak that result from the weakening of the tree defenses by the storm damage. Remove or salvage the most severely damaged trees first. Consider salvage of damaged trees in the following priority; root sprung, broken tops, lean > 30 degrees.

When considering whether to clearcut and start over or to manage what is not damaged or will recover keep in mind that the damage is never as bad as it looks. Often a thinning is all that is needed to improve the health and look of a pine plantation. **Economically it is likely that the return on investment will be higher if you manage what is left even if it is considered understocked.**

Flood Tolerance

Loblolly pine is moderately tolerant to saturated soils and flooded conditions. Mature stands can survive periods of root flooding for up to 3 weeks without any adverse impact. Young seedlings are more susceptible and will die if completely covered with floodwaters for more than a week. Loblolly is less tolerant to salt water. Mortality is likely for areas that are flooded for more than 3 days particularly if the salt is not flushed out of the soil by fresh water. Sedimentation coating the foliage of young seedlings may cause additional stress and even mortality. A follow-up inspection is warranted.

Manage to reduce the risk

It is impossible for the landowner to eliminate the risk of damage from the powerful winds and large amount of rains associated with hurricanes. There is some management options that may minimize losses. The following activities are recommended:

1. Species vary in wind resistance, but live oak, pondcypress, and baldcypress are the best. These trees are also deep rooted making them fairly windfirm. Longleaf is a good choice for sandy and sandy loam soils. Resistance of tree species to common hurricane damages is shown in Chart 4.
2. Vary the age and size class of your stands. Young trees are usually not damaged or recover complete while older trees are prone to being uprooted or break.
3. Conduct frequent light thinning to reduce taper and increase DBH. Maintain a low basal area. Stagger thinnings to limit exposure of recently thinned areas.
4. Use wider spacings for establishing loblolly and longleaf pine plantations.
5. Avoid planting loblolly in areas subject to frequent flooding. Bottomland species are a better choice.

Chart 4. Tree species resistance to hurricane related damage (in descending order from most resistant

Breakage	Uprooting	Salt	Deterioration by insects and disease
live oak	live oak	live oak	live oak
palm	palm	palm	palm
bald cypress	bald cypress	slash pine	sweetgum
pond cypress	pond cypress	longleaf pine	water oak
sweetgum	tupelo gum	pond cypress	sycamore
tupelo gum	red cedar	loblolly pine	bald cypress
mimosa	sweetgum	red cedar	pond cypress
dogwood	sycamore	tupelo gum	southern red oak
magnolia	longleaf pine	bald cypress	magnolia
sweet bay	mimosa	sweetgum	tupelo gum
southern red oak	southern red oak	water oak	sweet bay
water oak	magnolia	sycamore	hickory
sycamore	slash pine	sweet bay	pecan
longleaf pine	loblolly pine	southern red oak	red cedar
slash pine	sweet bay	hickory	red maple
loblolly pine	water oak	mimosa	mimosa
red cedar	red maple	pecan	dogwood
hickory	dogwood	magnolia	longleaf pine
red maple	hickory	red maple	slash pine
pecan	pecan	dogwood	loblolly pine

