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Assessing Hurricane-Damaged Trees and Deciding What to Do[1]

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Setting Priorities Immediately After the Storm

After a storm, evaluating trees for damage should occur as soon as possible. Ranking trees into priority groups, those that require immediate attention as well as those that can be treated later is an important step to recovery. What follows are recommendations for setting priorities and guidelines for decision making.

The most important priority is to determine if the tree poses an unacceptable safety risk (e.g., high risk, hazard) to humans or animals or is endangering property. Trees become a potential risk when a target—a structure, vehicle or person—could be struck by a falling tree or any of its parts. Therefore, a tree can be considered an unacceptable risk if any part that falls would result in damage to property, people, or other valuable trees.

Immediate Attention

The situation depicted in these photos pose a direct threat and should be taken care of immediately. The trees shown in Figures 1 and 2 need to be removed, while the tree in Figure 3 needs to be pruned as soon as possible.

In these situations, the work should be performed by a certified arborist or properly trained professional.

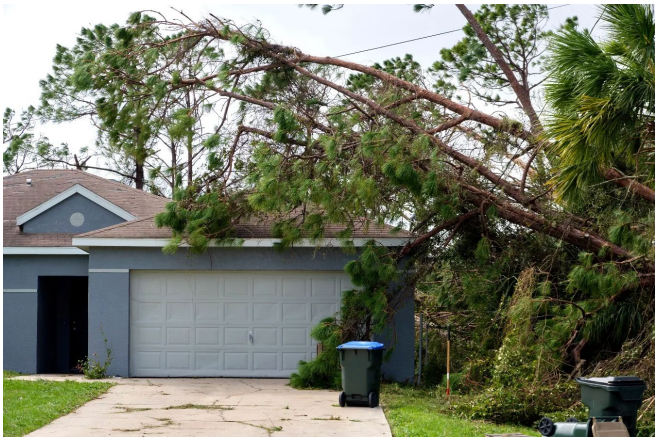

Figure 1. This tree should be removed by a certified arborist immediately.
Credit: Adobe Stock, bilanol

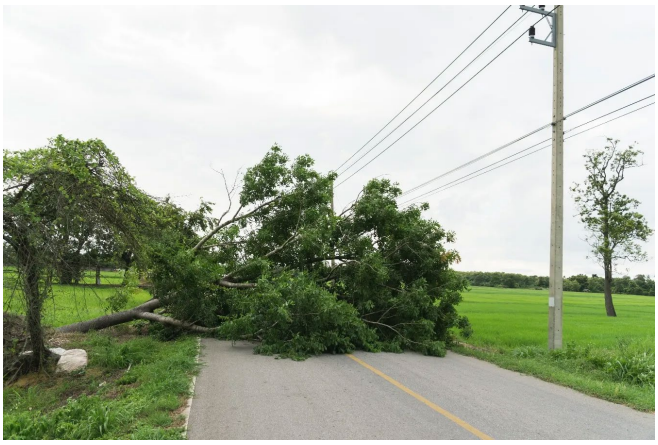

Figure 2. Trees or parts of trees that are blocking driveways or roads need to be taken care of as quickly as possible.
Credit: Adobe Stock, bonnontawat

Figure 3. Damaged trees in public places and highly trafficked areas are of immediate concern. The broken limbs hanging above the ground are high risk to cars and pedestrians.
Credit: Adobe Stock, butus

Trees That Do Not Require Immediate Attention

Keep in mind that many trees can be saved with appropriate treatment. There is no need to rush out and remove trees that do not pose an immediate safety hazard. Trees can recover from substantial damage, and what looks awful at first may be judged as less serious by an experienced professional.

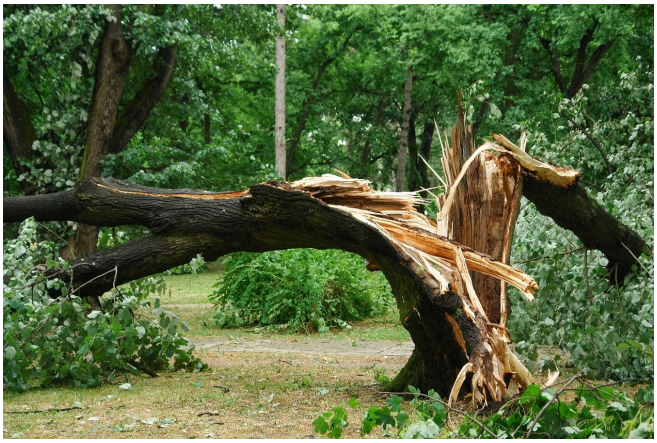

Figure 4. This tree can be removed later since it is not blocking any thoroughfare.
Credit: Adobe Stock, RenegadeStudio

Who Should Clean Up After the Storm?

Now that we have discussed setting up priorities, it is important to get the right tree care professional for the job. Homeowners should not attempt to do all the work themselves.

Certain situations require advanced training and are best handled by arborists certified by the International Society of Arboriculture (ISA). These include removing a leaning tree or broken limb near a house or other target, restoring a damaged tree that could be saved, evaluating tree risk potential, and reaching limbs that require climbing and pruning. Likewise, only qualified line-clearance arborists should work near electrical utilities. Call the electrical company to report tree limbs that have fallen on or are hanging over a power line.

Keep in mind that storm damage cleanup is extremely dangerous, even for professionals. Numerous injuries and deaths occur during cleanup after storms. When working with trees in the aftermath of a hurricane, it is essential to look up, down, and around. Beware of dangerous broken limbs that are hanging or caught in other branches overhead and may fall. Safety should be a priority. If in doubt, stay safe and find the right person to do the job.

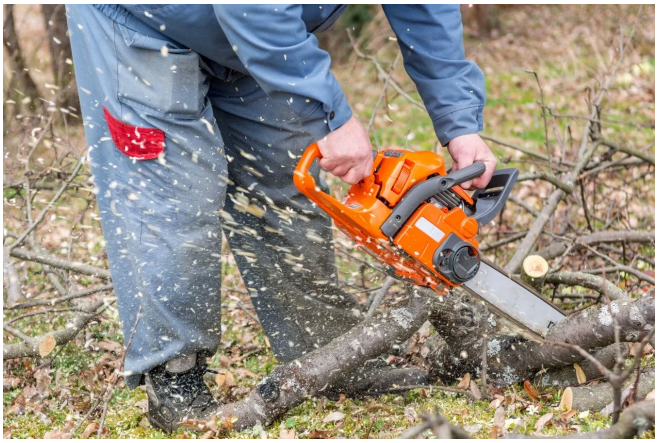

Figure 5. Chain saw use should be left to the professionals. If homeowners decide to use a chain saw, they should only work on the ground and with proper protective equipment—a hard hat with face shield, leg protection chaps, gloves, and hearing protection. This individual is lacking gloves and leg protection chaps.
Credit: Adobe Stock, anzebizjan

Not All Trees Need to Be Cut Down!

A common reaction after a windstorm is to remove all trees to avoid future problems, especially if a tree has fallen on a home or other valued property. However, not every tree poses a high risk. Unfortunately, few communities and decision-makers realize that the benefits of trees in the urban forest in the long term far outweigh the costs needed to pay arborists to care for trees.

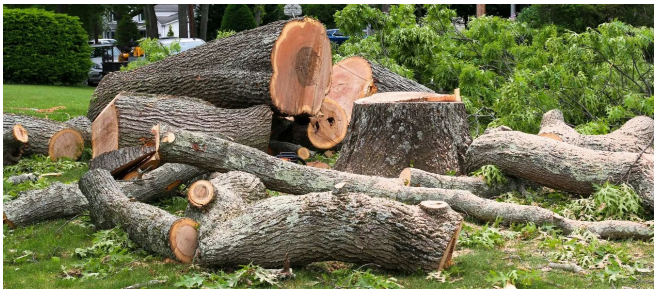

Figure 6. A common reaction after hurricanes is the removal of all the trees to avoid future problems.
Credit: Adobe Stock, coachwood

It has been observed that a grouping of well-placed, healthy trees may help redirect winds and serve as a protective barrier for homes (Figure 7). Communities with a well-maintained urban forest may suffer less tree damage from hurricanes than those without maintenance. Having an active management program reduces the losses from winds and establishes a restoration plan when damage does occur.

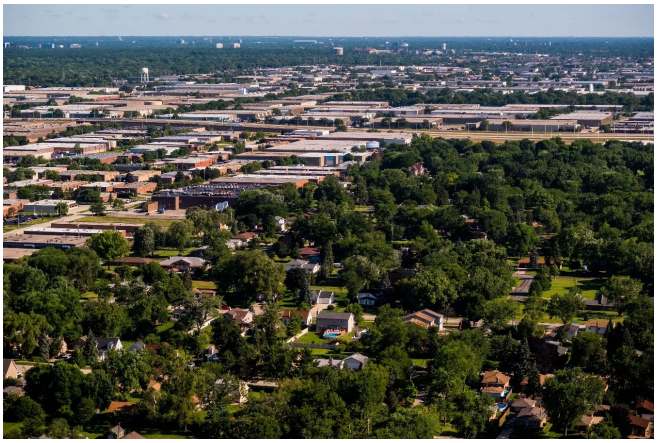

Figure 7. A healthy urban forest with well-placed and well-maintained trees may provide resilience to wind.
Credit: Adobe Stock, CK

Factors to Consider When Deciding Whether to Remove or Restore a Tree

After all the safety concerns have been addressed, the most difficult part of responding to a storm is deciding which damaged trees should be pruned and which trees should be removed. The eight items below are interrelated and together will help you determine the amount of care a tree will need after a storm. They will guide the decision of what trees should be removed and which ones can be restored.

Amount of Damage: Trees with more damage will require more work than those with less damage.

What parts of the tree are affected, how much of the canopy is gone, and how big the wounds are will determine the amount of care needed. The larger the wound is in relation to the size of the limb, the more vulnerable the tree is to decay, diseases, and pests. Generally, gymnosperm trees such as pines with 30 to 50% of the canopy damaged and angiosperms such as live oak with 50 to 70% canopy damage might be beyond recovery due to the severity of canopy loss.

Figure 8. This tree only has a few broken branches. The only action that needs to be taken is to prune its broken branches.
Credit: UF/IFAS Communications

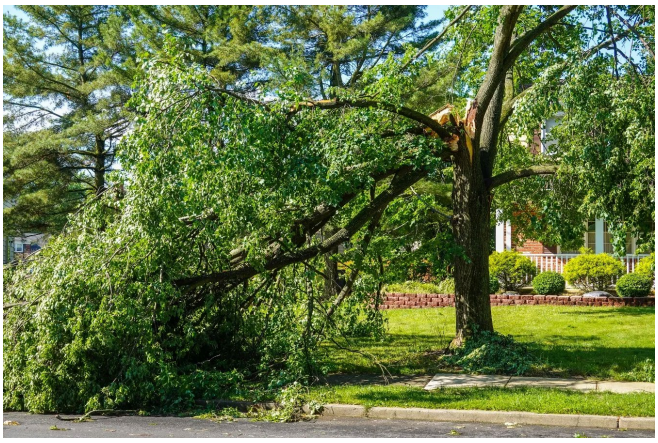

Figure 9. If over half of the canopy is gone (including the main leader) with several broken stems, the tree should be cut down.
Credit: Adobe Stock, ALAN

Tree Size and Age: Younger and smaller trees will take less time to restore than more mature and larger trees.

Younger and smaller trees survive winds better and suffer less damage than older trees, making them better candidates for restoration pruning (Figure 10).

Additionally, older, more mature trees may have accumulated multiple defects (e.g., bark inclusions, cracks, and extensive decay) over the years, often making them very susceptible to damage in storms.

Figure 10. This small tree sustained damage but because it is young it can be pruned over the next few years to help it recover and restore a future canopy.
Credit: Ed Gilman, UF/IFAS

Tree Species: Trees that resist decay are better candidates for restoration than those prone to decay.

Trees that resist the spread of decay into their wood are called good compartmentalizers and are more easily restorable. Examples include live oak (*Quercus virginiana*), mahogany (*Swietenia mahogani*), false tamarind (*Lysiloma latisiliquum*), winged elm (*Ulmus alata*), and buttonwood (*Conocarpus erectus*) (Figure 11).

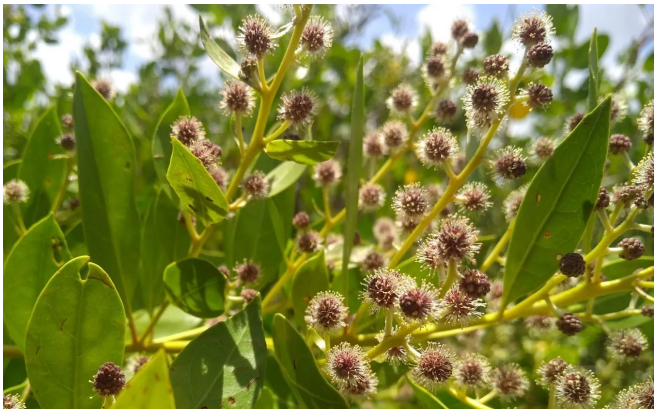

Figure 11. Buttonwood (*Conocarpus erectus*) is an example of a good compartmentalizer
Credit: Alyssa Vinson, UF/IFAS

On the other hand, poor compartmentalizers are trees prone to decay, such as African tuliptree (*Spathodea campanulata*), Hong-Kong orchid (*Bauhinia blakeana),* redbay (*Persea borbonia*), laurel oak (*Quercus laurifolia*), and water oak (*Quercus nigra*) (Figure 12). These species may become problematic urban trees since large pruning cuts, trunk injuries, and root damage can result in hollows and extensive internal decay in their roots and trunks.

Figure 12. Water oak is an example of a poor compartmentalizer.
Credit: Adobe Stock, Melinda Fawver

Short-lived species may not be worth restoring.

Every tree species has an inherent life span, and some tree species live longer than others do (Table 1). Longevity should be considered when evaluating whether a tree is worth restoring or should be removed (Figure 13). Usually, short-lived trees do not compartmentalize decay well. Keep in mind that the risk of failure increases with age.

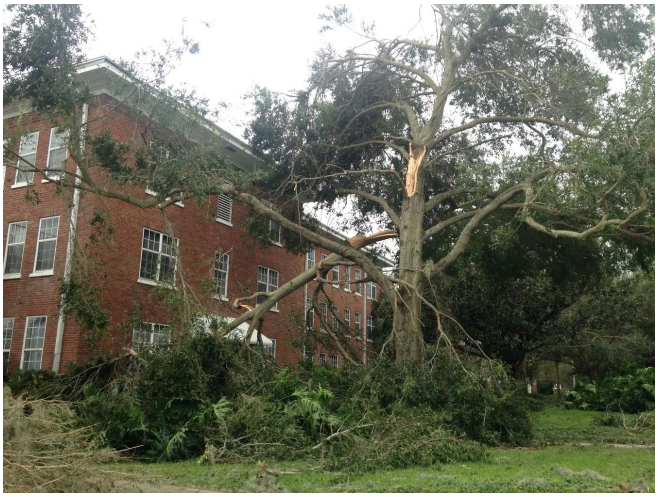

Figure 13. Laurel oaks live up to about 70 years and decay becomes more prevalent as they reach 40 years old. When a mature laurel oak is damaged after a hurricane, it can be more cost-effective to plant another species in its place.
Credit: Ed Gilman, UF/IFAS

Tree Health: Healthy trees will recover better after storms than unhealthy ones.

Decay, a major cause of tree failure, is caused by fungi that weaken wood as they grow. Cracks, seams, abnormal swelling, cankers, dead branch stubs, and large, older wounds suggest internal decay and increase the likelihood of tree failure in wind. Decay is often present without obvious signs (Figure 14).

Figure 14. A tree with a seemingly intact trunk may turn out to be hollow following a storm.
Credit: Adobe Stock, Joachim Heller

Mushrooms at the base of the tree trunk can be the sign of Armillaria or other fungi that can decay roots and create unstable trees (Figure 15). Root rot can be identified with careful, regular inspections by qualified arborists.

Figure 15. The presence of fungus around the base of tree trunks can indicate root rot.
Credit: Alyssa Vinson, UF/IFAS

Tree Structure: Trees with good remaining structure are worth saving and will be more easily restored.

Signs of desirable tree structure include one trunk up through the canopy, branches considerably smaller in diameter than the trunk, evenly spaced branches, balanced canopies, absence of codominant stems, and bark inclusions. These characteristics make trees better able to resist storms. Certified arborists are able to create and maintain such strong structure by appropriate pruning techniques, especially if they begin early in the tree's life.

Previous Cultural Practices: Poor pruning practices make trees susceptible to failure and breakage.

Removing large branches results in large pruning cuts that can serve as entry points for fungi that begin the decay process (Figure 16). Topping is a poor pruning practice that should be avoided. Sprouts that grow from topped trees are poorly connected to the cut stub, making them susceptible to breakage in storms (Figure 17).

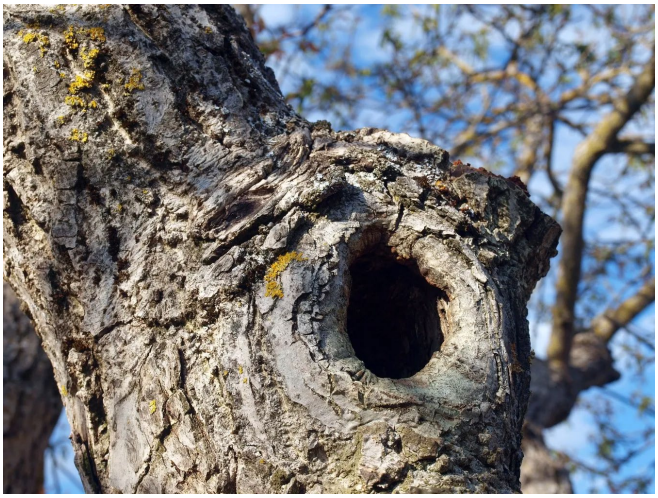

Figure 16. Large pruning cuts can be entry points for decay.
Credit: Ed Gilman, UF/IFAS

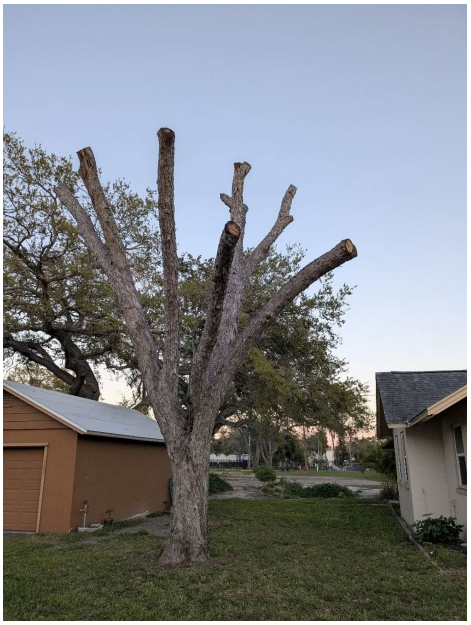

Figure 17. Topping trees is an inappropriate pruning practice. Sprout growth from this type of pruning results in poor structure.
Credit: Alyssa Vinson, UF/IFAS

Poor root management practices will affect tree stability

The importance of root integrity and health cannot be overemphasized. In addition to absorbing water and essential elements, roots anchor the tree. If roots are damaged in any way, the likelihood of failure increases (Figure 18). Construction activities that damage structural roots and trunks can result in decay and be the reason a tree blows over more than a decade later.

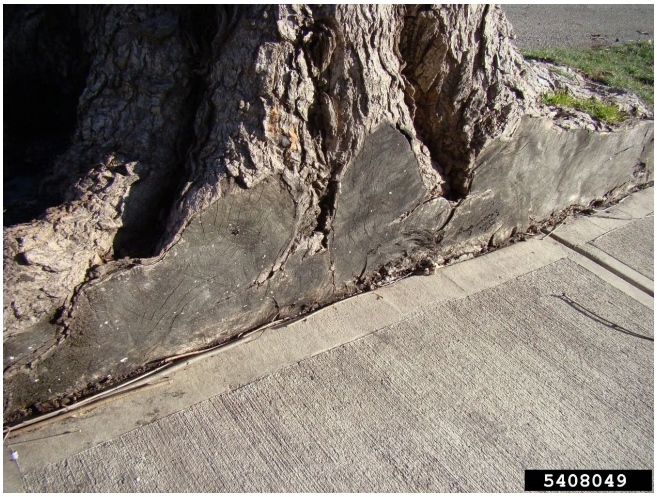

Figure 18. Construction is especially damaging to roots, such as these roots cut during sidewalk and curb repair.
Credit: Ed Gilman, UF/IFAS

Site Conditions: Tree need adequate soil space and good soil properties to be stable.

Trees with root systems confined to relatively small soil spaces are not as stable as trees allowed to develop more extensive root systems. Soil compaction, shallow soils, hardpans, and a high water table restrict roots to shallow depths and can result in unstable trees (Figure 19).

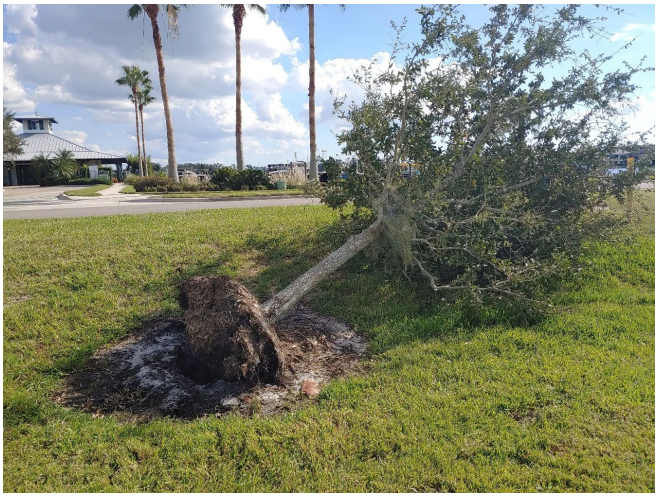

Figure 19. These roots were restricted by the compacted soil, making them very susceptible to blowing over.
Credit: Alyssa Vinson, UF/IFAS

Poorly located and/or chosen tree species may not be worth restoring.

The importance of selecting the right tree for the right location has been greatly stressed, and yet selection of inappropriate trees is one of the most common mistakes observed. For example, white oaks (*Quercus alba*) can grow to 100 feet and develop wide-spreading crowns and numerous horizontal branches and consequently are a poor choice for planting near utility lines.

If a tree is in the wrong place, such as a tall tree under a power line, or if it is an undesirable species for the site, significant damage may justify removal.

Cultural Value: How valuable the tree is to you and the community will determine the amount of restoration effort needed.

In addition to the economic and ecological values that trees provide to the owner and community, the tree in question might be a memorial tree, or it may have a historical significance, or some other cultural attribute associated with it (Figure 20).

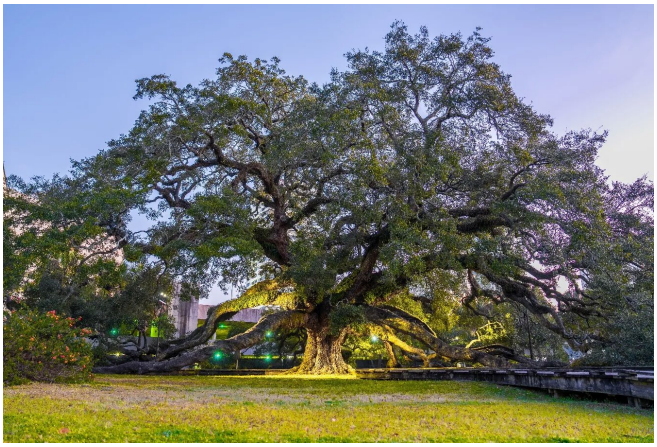

Figure 20. The Treaty Oak is a southern live oak in Jacksonville, Florida. It is estimated to be over 250 years old and is a historic landmark.
Credit: Adobe Stock, Red Lemon

When to Remove a Tree

There are situations when a tree requires removal after safety concerns have been identified. Remember, the priority is to remove trees that represent an unacceptable risk to people and property. A qualified person knows what to look for at the root level, along the trunk, and the condition of branches.

A. **The lower main trunk is cracked or broken**

Trees with cracks in the main trunk and branches are very dangerous, since limbs with this type of damage are not well-secured to the tree. Cracks that go well into the trunk (Figure 21) will not close and represent a severe defect that makes such trees a high risk in the landscape.

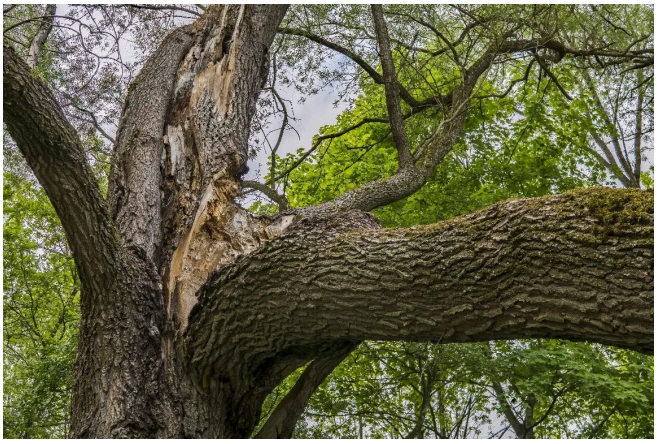

Figure 21. This tree should be removed since its broken stem is very large and the trunk is cracked.
Credit: Ed Gilman, UF/IFAS

B. **A large stem has split from the tree**

Figure 22 shows a tree that requires the split stem to be removed. The remaining stem might need to be removed because of the large trunk wound. Notice the dark area at the top of the split—it is a bark inclusion where the two codominant stems joined. Bark inclusions are weak unions between branches and are very susceptible to breakage.

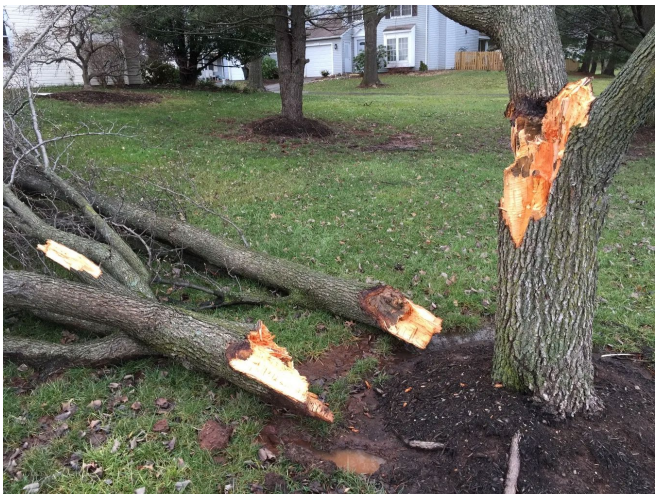

Figure 22. Notice the bark inclusion, which broke during a tropical storm. The tree should be removed.
Credit: Ed Gilman, UF/IFAS

C. **The tree is leaning towards a target**

If a leaning tree is likely to fall on a person, building, power line, roadway, or other valuable target, it should be removed immediately after the storm. However, all leaning trees should have their roots carefully examined for breakage, exposure, or lifting out of the soil (Figure 23). Pay close attention to leaning trees with unbalanced canopies, cracks in the trunk, and bark inclusions.

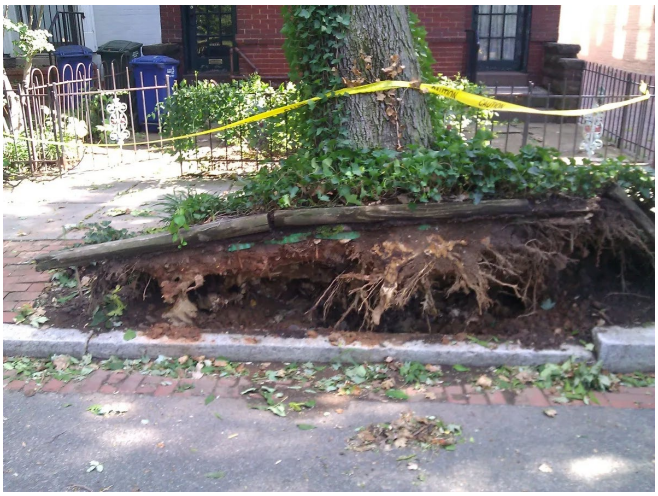

Figure 23. This leaning tree needs to be removed since major structural roots were broken and lifted, and the tree is leaning towards a target.
Credit: Ed Gilman, UF/IFAS

D. **The remaining tree structure is highly susceptible to breakage**

The tree shown in Figure 24 should be removed! It suffered major structural damage, and the remaining tree structure is compromised. All the mass is on one side of the tree, and the trunk is very weak because of the splitting.

Figure 24. This tree has trunk damage from an old split in addition to a more recent branch failure. The tree should be removed.
Credit: Ed Gilman, UF/IFAS

E. The major roots are severed or broken

Fallen or leaning medium-aged and mature trees might indicate a severed root or major root breakage. Once cut or broken, these roots will not reconnect well into the soil and are unlikely to develop the root structure needed to keep the tree erect. The reason for that seems to be that severed large-diameter roots do not regenerate new roots as well as small-diameter roots (one-inch diameter or less).

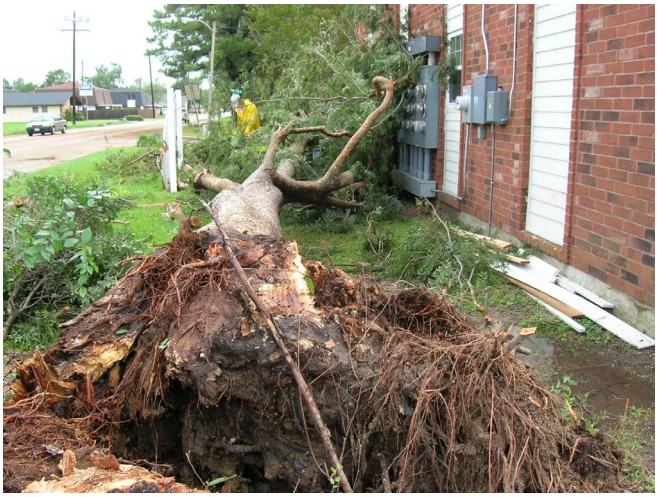

Figure 25. Rotted tree roots contributed to tree failure.
Credit: Ed Gilman, UF/IFAS

F. Large limbs are broken

Remove trees with most of the canopy damaged due to large-diameter (greater than 8 inches) branch breakage. Trees with small-diameter broken branches have a better likelihood of responding well to restoration (Figure 26).

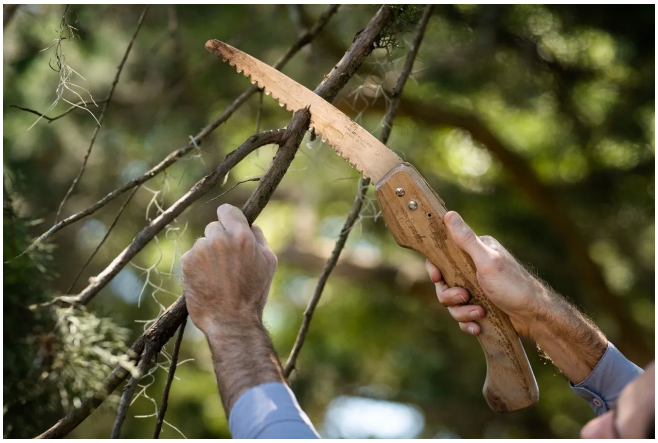

Figure 26. Small diameter branches like this are ideal for restoration pruning after storm damage.
Credit: Ed Gilman, UF/IFAS

G. Stem girdling roots are causing dead spots and cracks in the trunk

Roots circling and compressing the trunk are often referred to as stem girdling roots (SGR's), and tree death could occur when the root encircles most of the trunk (Figure 27). Trees with SGR's and cracks in the trunk will be less stable than trees without these characteristics and should be removed.

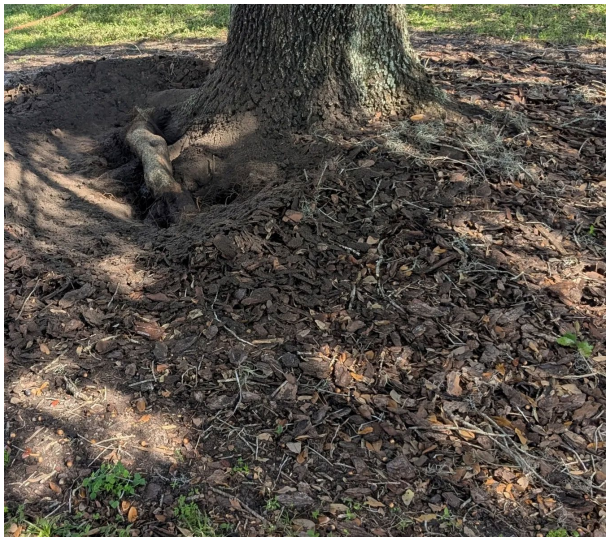

Figure 27. Notice the large root circling around the trunk and crossing other major roots, which can eventually lead to tree death.
Credit: Alyssa Vinson, UF/IFAS

When to Restore a Tree

Even after experiencing high winds, many trees can be restored. However, only restore trees with major limbs, trunk/s, and roots intact (Figure 28). To be a good candidate for restoration, a tree should have no cracks in major limbs or the trunk, no decayed wood, and no bark inclusions. Roots should not be exposed, lifted out of the soil, or girdling the trunk. Make sure the branch and trunk structures were good prior to the storms.

The following are general guidelines that can be considered when evaluating a tree for restoration pruning.

Figure 28. This is an example of a tree that could be a good candidate for restoration after a storm. It has a generally good structure and is healthy.
Credit: Ed Gilman, UF/IFAS

A. **Trees are young**

Young trees less than 10 inches in diameter make good candidates to restore because there are fewer branches to prune, the canopy is closer to the ground, and they can tolerate having more of their canopy removed than older trees (Figure 29).

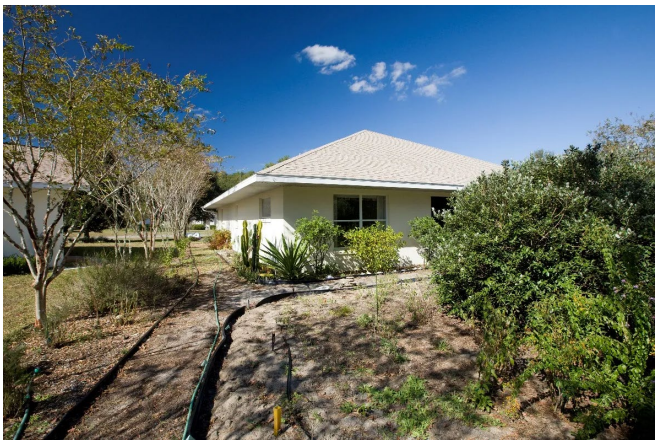

Figure 29. Young trees are more resilient to defoliation and small branch damage and are good candidates for restoration.
Credit: UF/IFAS Communications

B. **The canopy is defoliated**

Trees that lose their leaves in a hurricane usually are not dead. Many trees generate new foliage in the weeks following the storm*. Research has shown that for some species, such as gumbo limbo and live oak (Figure 30), defoliation is usually a strategy for survival since it reduces wind resistance. Defoliated trees that were healthy before the storm with no major branch breakage require no special treatment. Waiting and giving time is the best treatment for this type of damage. Avoid applying fertilizer or other chemicals, except for an identified reason.

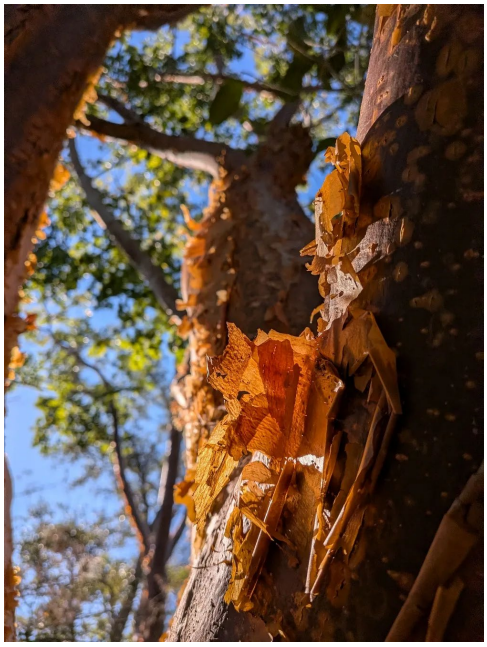

Figure 30. Gumbo limbo trees are deciduous and have the ability to photosynthesize in their bark, making them ideally suited for resilience to storm defoliation.
Credit: Alyssa Vinson, UF/IFAS

C. **Trees and palms that were inundated with salt water often lose leaves due to root damage. In this case, trees need to be irrigated to wash salt through the soil.**

Many new sprouts will eventually emerge on hurricane-damaged trees. Some trees wait to produce new foliage the following spring. Sprouts should be allowed to grow because they provide the energy the tree will need to recover (Figure 31), and they can be pruned later.

*Note: Some species, such as pines, may not recover their foliage after hurricanes.

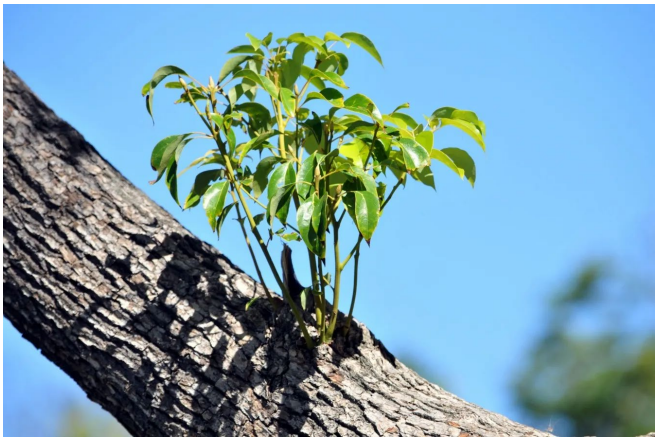

Figure 31. New sprouts arise from dormant buds after branch damage. Managing sprouts over time can create reasonably good structure and a nice-looking tree canopy. Sprout management should be carried out by professional arborists.
Credit: Ed Gilman, UF/IFAS

D. **Small branches are broken or dead**

Trees with small broken or dead branches (less than 4 inches in diameter) can easily be pruned from the canopy and have a good chance of recovering. Trees with small branches have a better chance of recovering than large-diameter branches (greater than 8 inches in diameter). If small, codominant stems are broken in the upper canopy without damage to the main trunk, the tree can also be restored.

E. **Most of the canopy is damaged in a decay-resistant species**

Trees that resist decay well can lose much of their canopy and still recover from a storm. Even with ¾ of their small branches (less than 4 inches diameter) broken or removed by a hurricane, many decay-resistant trees can be restored.

F. **Some major limbs are broken in decay-resistant species**

Many species good at resisting decay after they are wounded can be restored even with some major branch breakage.

G. **Leaning or fallen trees are small or recently planted**

Trees that have a trunk diameter smaller than 4 inches should be stood up as quickly as possible to prevent roots from drying out (Table 2.). Such small trees have a better chance of developing the proper root structure to keep them firm in the soil than bigger trees.

Recently planted trees can be uprighted at any size because they usually do not have large broken roots (Table 2). These trees should be treated as new plantings and staked with the help of a professional.

Assessing Pines

Pines are very sensitive to wind damage. Pines can snap, uproot, or lean after storms. A pine still standing after a hurricane may have internal damage that is not visible. Before deciding to remove or restore, wait and see if the tree lives, considering these points:

- Pines often die over a period of 6 months to 2 years after windstorms.
- Some may remain green for a year or even longer, then suddenly turn yellow (Figure 34) and progress to brown needles in a very short period.
- Pines with all brown needles are dead and should be removed.
- Monitor pines carefully for insects. Weakened pines may be more susceptible to beetles and diseases.

Figure 33. Damage to pines may manifest as yellowing several months after a hurricane. Credit: UF/IFAS

What causes yellowing of the needles and pine death?

The causes are not completely understood, but it is likely due to hidden damage produced by bending and twisting the trunk during hurricane-force winds. Prolonged winds may also rupture smaller roots without breaking the larger support roots. The injured stems and roots are unable to supply the water and nutrients needed in the crown, resulting in yellow needles and decline.

Assessing Palms

Palms grow differently from other trees. The growing point of a palm is at the top of each trunk, surrounded by leaves (fronds). All fronds originate from this one point (bud). If the bud is severely damaged or killed, new leaves fail to develop, and single-stemmed palms will die. On multi-stemmed palms, the undamaged trunks could recover if their buds were not damaged. If the trunk is snapped in half, the palm is dead. However, for palms left standing, the bud is often not accessible, making it difficult to determine whether it is damaged. For these palms, follow these guidelines:

- Allow at least 6 months for palms to put out new growth. New leaves may be stunted, discolored, or abnormally shaped.
- It may take 1 to 2 years or more before palms appear normal with a full canopy.
- Irrigate 3 times a week for 6 weeks if there is not sufficient rainfall; longer if drought persists.

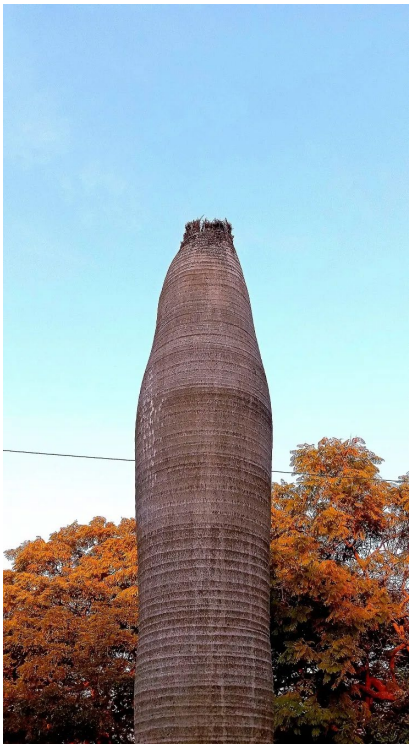

Figure 34. This royal palm (*Roystonea elata*) has lost its bud and won't recover from the damage. Credit: Ed Gilman, UF/IFAS

Final Considerations

Right after a storm, it is important to sort trees into priority groups, acting immediately in situations that require urgent attention and selecting trees to be monitored and treated later. Remember that even though hurricanes can be devastating to communities and urban forests, not all storm-damaged trees need to be removed, and many trees can be treated and saved.

When assessing damage, think about it in terms of tree function and your objectives. Management actions will depend on observing the interrelated points below when deciding what trees to remove or restore:

- Soil space and soil properties

- Tree health, size, and age
- Previous cultural practices
- Previous tree structure
- Amount of damage

Always observe safety procedures. Storm damage cleanups are extremely dangerous, even for professionals. Hire a qualified professional such as a certified arborist to help with post-hurricane recovery and to implement a restoration pruning program.

Table 1. Life span of some species in the forest.*

Short-lived (< 50 years old)	Medium-lived (50–100 years old)	Long-lived (> 100 years old)
laurel oak (*Quercus laurifolia*)	African tuliptree (*Spathodea campanulata*)	live oak (*Quercus virginiana*)
red bud (*Cercis canadensis*)	paradise tree (*Simarouba glauca*)	sweetgum (*Liquidambar styraciflua*)
bottle brush (*Callistemon* spp.)	red maple (*Acer rubrum*)	southern magnolia (*Magnolia grandifolia*)
Hong-Kong orchid tree (*Bauhinia blakeana*)	gumbo limbo (*Bursera simarouba*)	bald cypress (*Taxodium distichum*)
jacaranda (*Jacaranda mimosifolia*)	sea grape (*Coccoloba uvifera*)	Mahogany (*Swietenia mahogani*)

Table 2. Guidelines for standing up trees based on trunk diameter.

Trunk Diameter	Action
Less than 4 inches	Stand up and stake.
From 4 inches to 8 inches	Maybe stand up and stake. Could be a hazard later.
More than 8 inches	Not recommended; likely to be a hazard later.

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