Trying to Reason with Hurricane Season

a look at post-storm tree damage on Sanibel Island, Florida

by Amy Ferriter, Tony Pernas and Jim Burch • photos by Patrick Lynch

Hurricane Charley's wobble became a turn, and then a nightmare for Florida's southwest Gulf coast on the afternoon of Friday, August 13, 2004. The storm went wide right at the last minute–causing Bowdenesque cringes from forecasters as it made landfall 150 miles south of well-prepared Tampa.

Sanibel Island was the first to feel the brunt of the storm. It is a low-lying barrier island and residents were wisely ordered to evacuate on the one in/out island road (Periwinkle Drive). This "scenic" drive was lined with mature Australian pine (*Casuarina equisetifolia*) trees that threatened to topple in high winds. And indeed, after the storm, residents anxiously waited to return to their homes to survey damage. But streets littered with downed Australian pine and resulting downed powerlines prevented them from returning for several days. Crews worked around the clock clearing the pick-up-sticks-like debris on the roadways. Unfortunately, no amount of meteorological warning could have prevented much of this extensive damage - mature Australian pine trees topple no matter how well you batten down the hatches.

Tree Damage Assessment

Post storm National Oceanic and Atmospheric Administration (NOAA) wind field data revealed that Sanibel Island was battered by winds that ranged from Category 1 Hurricane force (74-95 mph) on the easternmost tip to Category 4 Hurricane force (131-155 mph) on the western tip (see Table 1). This wind gradient offered a unique opportunity to assess the effects of varying wind speeds on mature Australian pine stands in a coastal urban setting.

Aerial Observations: One week post-storm, three low-level transects were flown along the island. Observers recorded Australian pine damage and recorded damage categories. Categories were:

- **Severe:** More than 50% of trees exhibited tip up (Crown on ground, roots snapped) and/or snap off (trunk snapped below crown and above roots). Remaining trees exhibit splitting, leaning and/or severe branch loss.
- **Moderate:** 10-50% of trees exhibited severe damage (tip-ups and snap offs). Major leaning (more than 45 degrees from vertical). Severe branch loss (more than 50%) common on remainder of trees.
- **Minimal:** Less than 10% of trees exhibited severe damage such as tip-ups and snap-offs. Majority of trees standing, with major "needle" loss and minor leaning and branch loss.

Ground Observations: The aerial data was complemented by ground observations. Trees were surveyed at .2-mile increments along major roads.

Mature Casuarina trees reach heights in excess of 100 feet. This means that when they do topple, their massive surface area tends to have a greater impact on surrounding vegetation and structures.

Information collected on the ground included:

- Tree species
- Type of damage – branches broken, trunk snapped, or tipped up (uprooted)
- Sizes of branches broken (usually 5 to 10 if available at each location)

Some native plants have survival mechanisms for high winds. Gumbo limbo, buttonwood and Jamaican dogwood are quick to lose branches and leaves when hurricane force winds hit. This results in less wind resistance, and the trees tend to survive.

- Sizes of trunks (Diameter at breast height (DBH)) for snapped or uprooted trees
- Height above ground of snapped trunks
- Type of habitat
- Natural or landscaped habitat
- Estimated damage to canopy where canopy removal was apparent.

Sanibel Island's Australian pine trees suffered extensive damage as the result of Hurricane Charley. This in itself is not surprising since Australian pines dominated much of the island before the hurricane. Aerial and ground estimates of damage reveal that the eastern side of the island, which experienced Category 1 Hurricane force winds, had minimal Australian pine damage. Aerially observed damage was estimated at less than 10% while ground estimates show damage to be at 34.3%. This variance in damage estimates can be attributed to the abundance of Australian pines lining roadways where the ground surveys were concentrated.

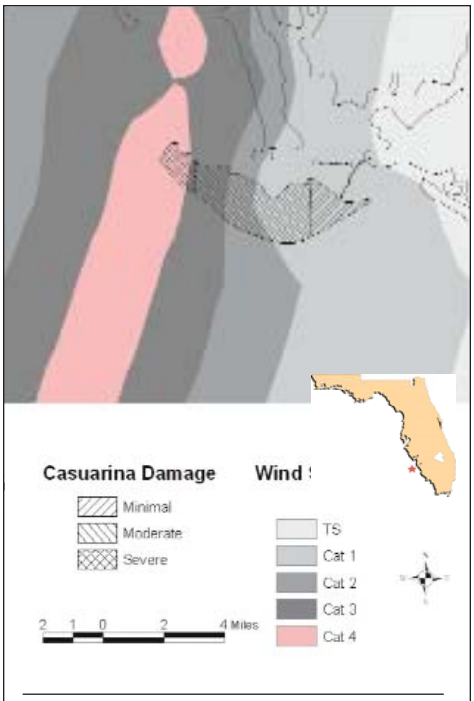
The western side of the island was exposed to a stronger gradient of hurricane force winds. Aerial estimates show moderate (10%-50%) to severe (greater than 50%) damage along the gradient. Ground observations show that 73.2% of the Australian pines on the western side of the island were either uprooted or snapped at 10' to 20' above ground. Australian pine trees that grew gregariously (mostly inland) on the island commonly had broken trunks; those that grew as solitary trees or grew near the coast were commonly uprooted.

Native tree species also experienced extensive damage in hurricane force winds. Much of the damage to native trees occurred when Australian pine trees fell into them or uprooted them as the shallow Australian pine roots were pulled from the ground. On the southwestern part of the island, many seagrape (*Coccoloba uvifera*), buttonwood (*Conocarpus erectus*) and gumbo limbo (*Bursera simaruba*) trees were damaged, but the damage was primarily the loss of branches. These native trees were often not uprooted or otherwise mortally damaged. Palms – coconut (*Cocos nucifera*), royal (*Roystonea regia*) and sabal (*Sabal palmetto*) – in general had little damage.

Ficus species (native and exotic) that were supported and stabilized by a thick base of aerial roots were often upright and virtually unscathed, even in the highest winds. However, *Ficus* species that had been trimmed into single-trunk trees or hedges often toppled and/or were uprooted in lower wind gradients. Throughout the island, *Ficus* trunks and branches were the second most common component (after Australian pine) in the roadside debris piles. Also common in these piles were mahogany (*Sweitenia mahogani*), Norfolk Island pine (*Araucaria heterophylla*) and seagrape branches, and gumbo limbo trunks and branches.

After the Storm

The 2004 hurricane season is one for the record books. The above observations were made one week post-Charley when most of us (reasonably) thought that it would be the Storm of the Decade. Little did we know that we would soon have more post-storm tree damage data opportunities than we could handle. Windshield surveys of other storm ravaged areas in Palm Beach and Martin Counties concur with the results found on Sanibel Island.



National Oceanic and Atmospheric Administration (NOAA) Hurricane Charley wind field data was obtained for Sanibel Island. A simple kriging method was used to convert the point data to polygon coverage. (Kriging is a way of spatially interpolating data between points.) The aerially observed Casuarina tree damage data is shown here with the wind field data. Damage classes correspond well with the wind gradient.

Palms (foreground) had little damage. Ficus species survived well when allowed to put down a thick base of stabilizing aerial roots. They survived very poorly when trimmed into a single trunk or hedge (background)..

Plants Not Recommended for Hurricane-prone Areas in Florida

- Australian pine (*Casuarina spp.*)
- Earleaf acacia (*Acacia auriculiformis*)
- *Ficus* spp. (when hedged or limbed up)
- Java plum (*Syzigium cumini*)
- Norfolk Island pine (*Araucaria heterophylla*)
- Queen palm (*Arecastrum romanzoffianum*)
- Washingtonia palm (*Washingtonia robusta*)
- Yellow tabebuia (*Tabebuia caraiba*)

As for what to replant, the following list provides some recommendations for more wind-resistant, coastal-adapted native species.

Crews worked around the clock to clear Casuarina debris from Sanibel and Captiva Islands

Other common landscape species like Norfolk Island Pine and yellow tabebuia offer interesting post-storm photo opportunities, but should be discouraged in storm-prone areas.

Plant Recommendations

The proper selection and placement of trees in south Florida is vital to maintain a healthy landscape. Native coastal species have evolved through centuries of hurricanes. The following is a list of recommended trees/shrubs/groundcovers for South Florida:

Trees

- Sabal Palm (*Sabal palmetto*)
- Royal Palm (*Roystonea regia*)
- Buccaneer Palm (*Pseudophoenix sargentti*)
- Florida Thatch (*Thrinax radiate*)
- Silver Palm (*Cocothrinax argentea*)
- Buttonwood (*Conocarpus erectus*)
- Seagrape (*Coccoloba uvifera*)
- Gumbo Limbo (*Bursera simaruba*)
- Shortleaf Fig (*Ficus citrifolia*)
- Jamaican Dogwood (*Piscida piscipula*)
- Lignum Vitae (*Guaiacum sanctum*)
- Geiger Tree (*Cordia sebestena*)
- Strong Bark (*Bourreria ovata*)
- Wild Tamarind (*Lysiloma bahamense*)

CATEGORY	WINDS	EFFECTS
One	74-95 mph	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal road flooding and minor pier damage
Two	96-110 mph	Some roofing material, door, and window damage to buildings. Considerable damage to vegetation, mobile homes, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of center. Small craft in unprotected anchorages break moorings.
Three	111-130 mph	Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain continuously lower than 5 feet ASL* may be flooded inland 8 miles or more.
Four	131-155 mph	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach. Major damage to lower floors of structures near the shore. Terrain continuously lower than 10 feet ASL may be flooded requiring massive evacuation of residential areas inland as far as 6 miles.
Five	greater than 155 mph	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Major damage to lower floors of all structures located less than 15 feet ASL and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5 to 10 miles of the shoreline may be required.

TABLE 1 The Saffir Simpson Scale was formulated in 1969 by Herbert Saffir, a consulting engineer, and Dr. Bob Simpson, director of the National Hurricane Center. The World Meteorological Organization was preparing a report on structural damage to dwellings due to windstorms, and Dr. Simpson added information about storm surge heights that accompany hurricanes in each category. *ASL = Above sea level. Source: NOAA

Shrubs

- Saw Palmetto (*Seronoa repens*)
- Jamaican Caper (*Capparis cynophallophora*)
- Joewood (*Jacquina keyensis*)
- Black Torch (*Erithalis fruticosa*)
- Florida Privet (*Forestiera segregate*)
- Cocoplum (*Chrysobalanus icao*)
- Bay Cedar (*Suriana maritima*)
- Inkberry (*Scaevola plumieri*)
- Bay Lavender (*Argusia gnaphalodes*)
- Schillings Dwarf Holly (*Ilex vomitoria*)
- Florida Boxwood (*Scheeffaria frutescens*)
- Seven Year Apple (*Casasia clusifolia*)

Ground Covers

- Golden Creeper (*Ernodea litoralis*)
- Beach Sunflower (*Helianthus debilis*)
- Beach Morning Glory (*Ipomoea imperati*)
- Railroad Vine (*Ipomoea pes-carpe*)

Seagrape is well adapted to coastal winds if allowed to grow in mounds with multiple branches acting as a support system. These trees rarely completely tip up, unless they are trimmed into a single-trunked tree.

This line of Seagrape was virtually unscathed on the Gulf side of Sanibel Island. When allowed to grow in its natural mounded form, it has a very high wind tolerance.

For more information, contact Amy Ferriter at the South Florida Water Management District, aferrite@sfwmd.gov, 561/687-6097.

Paul C. Myers
1948 - 2004

Mr. Paul Charles Myers of Winter Haven passed away in his home September 19, 2004 after a 27-year battle with a rare cancer. He was 55.

Paul worked for the Florida Department of Pollution Control from 1971-1977, then served as director of Polk County's Environmental Services Aquatic Plant Management Department until 1983. He founded Applied Aquatic Management, Inc. in 1981 and served as Executive Vice President until his passing. He was president of the Florida Aquatic Plant Management Society in 1984 and was a past editor of *Aquatics* magazine.

Paul developed and perfected many of the invasive weed management techniques currently in widespread use in Florida. Around 1990, while working with the South Florida Water Management District, he evaluated various "hack and squirt" combinations for melaleuca control and was the first to use contract labor for this work. Paul also was a willing educator and assisted and taught many applicators. His ready smile and laid-back style endeared him to everyone who met him. In recognition of his friendly nature, the Aquatic Plant Management Society awarded the "Max C. McCowen Friendship Award" to Paul in 2000. Paul's professional contributions on behalf of invasive weed management were numerous and his expertise and friendship will be missed.

Paul was a devoted husband, father and grandfather. He was an avid outdoorsman who enjoyed hunting, fishing and traveling. He was a member of the First Baptist Church of Lake Alfred. Paul is survived by his wife of 34 years, Linda Webster Myers; daughter Robin Myers, Gainesville, FL; son, Paul C. Myers, Jr., daughter-in-law, Jennifer Myers, and two grandchildren, Jake and Jordan Myers, Winter Haven.

As a tribute to Paul, memorial contributions may be made to the Florida Aquatic Plant Management Society Scholarship and Research Foundation for the newly formed "Paul C. Myers Applicator Dependent Scholarship," c/o Don Doggett, PO Box 60005, Ft. Myers, FL 33906, or to the First Baptist Church of Lake Alfred Building Fund, 280 East Pierce St., Lake Alfred, FL 33850.