BoatU.S. hurricane preparation guide

The next big named storm to make landfall is a question of when, not if. Coastal boaters should prepare because hurricane season is here. In this special section, our editors have created a comprehensive guide to help you, step-by-step, protect your boat

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NOAA

GETTY IMAGES/FELIXMIZIOZNIKOV

Top: The eye of Hurricane Floyd. Above: Hurricanes combine high winds, heavy rains, and several feet of surge. Your hurricane plan needs to take all of this into consideration.

In an average year, two hurricanes will come ashore somewhere along the Gulf or Atlantic coast, destroying homes, sinking boats, and turning people's lives topsy-turvy for weeks or months. Since 2016, the U.S. has been hit by four powerful Category 4 hurricanes of 130-mph-plus – Harvey, Irma, Maria, and Michael, which strengthened to a Cat 5 storm, the most powerful ever to hit the Florida Panhandle, and demolished 150 years of records. Florida is struck most often, but every coastal state is a potential target.

Experts predict that tropical storms will be stronger and contain even more rainfall in the future, coupled with higher water levels. Experts also warn that after a number of storm-free years, people in some of the vulnerable areas may become less wary of a storm's potential fury. But to residents of the Carolinas crippled by Florence, and people in Florida ravaged by Michael in 2018, the hurricane threat won't soon be forgotten.

Our BoatU.S. editors, working with our hurricane experts at BoatU.S. Marine Insurance, have created this comprehensive guide, plus clear, how-to videos, to help you prepare if a major storm is headed your way. These articles and videos are available on our website for reference. The more you know and plan ahead, the better your chances of protecting your boat and property.

CHAPTER 1

WHAT TO EXPECT

Preparing a boat for a hurricane means defending against wind, rain, waves, and high water – all in proportions rarely experienced by boaters

The BoatU.S. CAT Team

Created way back in 1983 after Hurricane Alicia devastated much of the Texas Gulf Coast, the BoatU.S. Catastrophe Team was formed to help our insureds get their boats salvaged and their claims processed as quickly as possible. In the 36 years since then, this boots-on-the-ground crew has grown to include as many as 50 professional surveyors, claims processors, transportation providers, and professional TowBoatU.S. towers and salvage experts. As soon as a hurricane area is accessible, the CAT Team is typically the first marine insurance representatives to arrive and they quickly get to work assessing salvage needs and damages to our insureds' boats, working to promptly settle claims. Much of their time is spent arranging for cranes and other equipment to salvage damaged boats. Says our CAT Team field operations manager, Mike McCook, "Generally speaking, if you can find a difficult predicament, we have a boat there."

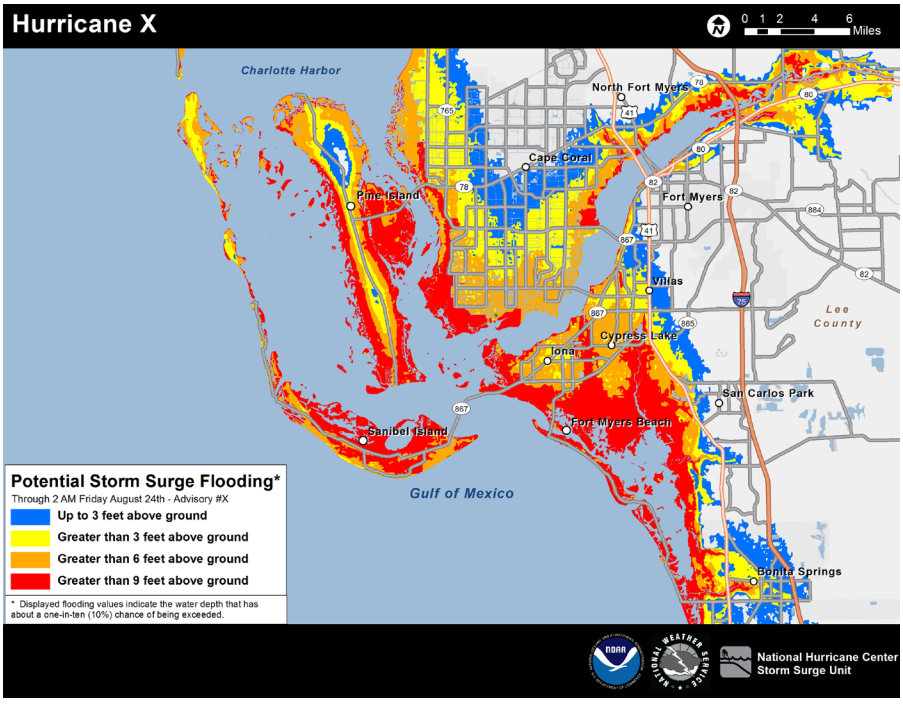
With so much time in the trenches, CAT Team members have become experts on what works and what doesn't when it comes to securing a boat for a hurricane. We've drawn on their extensive knowledge here to help you prepare your boat so it has the best chances of surviving a storm. **– C.F.**

Surge

The damaging influence of high water, or storm surge, is often underestimated in preparing a boat for a storm. Storm surge raises the water level far above normal high tide, cutting off roads, forcing evacuation, and lifting boats above their docks and pilings. Surge accounts for major damage to boats because it puts docks and dockline arrangements underwater as the boat tries to float above.

Surge is the result of several factors. Due to low barometric pressure, the ocean surface is drawn upward, forming a mound about 1 foot higher than the surrounding ocean. Large swells generated by the storm reach land first, while storm winds drive water toward the coast. As the storm makes landfall, water levels 10 to 20 feet above normal high tide are possible. In 2005, Hurricane Katrina generated a surge of nearly 28 feet in Pass Christian, Mississippi.

Surge is responsible for extensive flooding and much of the loss of life that accompanies a hurricane. Dangerously high water can reach outward 20 to 50 miles from the storm's center. Surge makes extra length and positioning of docklines critical.



Wind

A hurricane, of course, brings high winds. Wind speeds of 70 to 130 mph are common, and much higher speeds have been recorded. In 2018, Hurricane Michael had the strongest sustained winds (155 mph) of any hurricane to hit the U.S. when it battered Florida. What may be less understood is the force created by such winds. When wind speed doubles, the wind pressure quadruples. To put it in practical terms, when the wind speed increases, the damage it causes increases at a much greater rate. This illustrates the importance of reducing the boat's windage, which is the amount of area your boat presents to the wind, by removing as much rigging, canvas, and deck gear as possible, and facing the bow toward the greatest exposure.

Waves

Waves in the ocean have tremendous energy and can reach mountainous heights. But even in relatively small harbors, bays, and lakes, waves can build

Storm surge is often underestimated and one of the factors that determines how you need to prep your boat.

to surprising heights. In a hurricane, it is not unusual for steep, breaking waves 3 to 6 feet high to pound normally peaceful harbors. Seawalls, barrier beaches, and other structures that normally protect docks and moorings are often submerged by the storm surge. This has the effect of greatly extending the "fetch," or distance, over which the wind can generate waves.

Rainfall

Rainfall of 6 to 12 inches within 24 hours is normal during a hurricane, with well over of 24 inches having been recorded. In 1979, Hurricane Claudette caused massive flooding in southeast Texas after dropping 42 inches of rain in just 24 hours. The all-time record, though, was Hurricane Harvey in 2017, which totaled a record 60 inches of rain, also in Texas.

Torrential rain can sink boats that are spared the worst high water and wind. Cockpit decks are seldom 100% watertight, and the ability of a bilge pump and battery to handle rain accumulation is often overestimated. Deck drains and pump discharges located near the waterline can backflow when waves and the weight of rainwater put drains underwater.

Tornadoes

Tornadoes are sometimes spawned by hurricanes. In 2017, Hurricane Harvey created 54 tornadoes, and several people have died as the result of hurricane-spawned tornadoes. Little can be done to protect a boat from a tornado. The possibility of a twister, however, is a strong reason for you, your family, and your boat, if it is trailerable, to be far from the coast when a hurricane makes landfall.

The time to take action

U.S. Navy Admiral Chester W. Nimitz, who commanded allied air, land, and sea forces during World War II, said it best: "The time for taking all measures for a ship's safety is while still able to do so. Nothing is more dangerous than for a seaman to be grudging in taking precautions lest they turn out to have been unnecessary. Safety at sea for a thousand years has depended on exactly the opposite philosophy."

So prepare or move your boat when a hurricane is a substantial possibility, before a watch is even issued. If you wait longer and your plan includes relocating the boat, bridges may be locked down and the hurricane hole you choose may be inaccessible. Or if you plan to have your boat weather the storm ashore, you may find the marina is too busy to haul your boat.

A hurricane watch is posted when hurricane conditions pose a threat to a specified coastal area, usually within 48 hours. Waiting for a watch to be posted may be too late to head for the marina or to move the boat to a safer location.

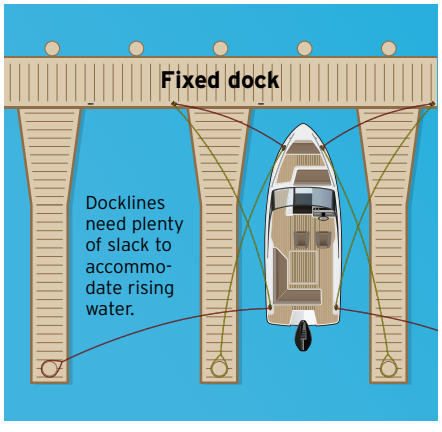
A hurricane warning advisory is posted when sustained winds of 74 mph or higher are expected within 36 hours or fewer – too late in most situations to head for the boat. Securing the house, gathering emergency provisions, and evacuating the family will need attention at this point. **– C.F.**

CHAPTER 2

WHERE TO KEEP YOUR BOAT

The best predictor of whether your boat will survive a hurricane is where it's kept. Just as in real estate, the three most important considerations should be location, location, location

Left: Boats that are hauled out are far less likely to be damaged during a storm than those left in the water. Using straps is effective at keeping boats from toppling over or floating away. Below: Lines should be extra long to allow for surge. Double up lines where possible.



ERICH STEVENS

Going back as far as Hurricane Alicia in 1983, our BoatU.S. Hurricane Catastrophe Team (CAT) professionals have spent thousands of hours working to identify and recover damaged boats. They've seen firsthand what works and what doesn't when a boat is prepared for a hurricane. When asked where CAT Team members would take their own boats if a hurricane warning were posted, most agreed: They'd have it hauled ashore. For many boat owners and marinas, hauling boats is the foundation of their hurricane plan. Some farsighted marinas and yacht clubs have evacuation plans to pull as many boats out of the water as possible whenever a storm is approaching and secure the rest in the largest available slips.

Securing a boat ashore

Some types of boats must be pulled if they're to have any chance of surviving. For instance, smaller open boats and high-performance powerboats with low freeboard will almost always be overcome by waves, spray, and rain. This is true even if the boats have self-bailing cockpits. Fortunately, most of these boats can be placed on trailers and transported inland.

Boats ashore should be stored well above the anticipated storm surge, but even when boats are tipped off jackstands and cradles by rising water, the damage they sustain in a storm tends to be much less severe than the damage to boats left in the water. Windage is also a consideration. If nothing else, reduce windage as much as possible (see "Find and fix potential breaking points" on page 8). Make sure your boat has extra jackstands, at least three or four on each side for boats under 30 feet, and five or six for larger boats. Jackstands must be supported by plywood and chained together to stop them from spreading. To reduce windage, some ambitious boat owners on the Gulf Coast have dug holes for their sailboat keels so the boats present less windage. Smaller sailboats are sometimes laid on their sides.

One technique that has proven very effective involves strapping boats down to eyes embedded in concrete. At least two marinas in Florida and one in Puerto Rico have used straps with excellent results. One of the Florida marinas strapped the boats to eyes embedded in its concrete storage lot. The other Florida marina and the one in Puerto Rico built heavy concrete runners (similar to long, narrow concrete deadweight moorings) beneath the boats to anchor the straps. (Straps made from polyester work better than nylon, which has more stretch). Even when the wind has been on the beam and water has come into the storage area, the straps held and boats stayed upright. An alternative tried at other marinas has been to use earth augers screwed into the ground to secure the straps. Results with the latter technique have been mixed; some have held while others have been pulled out. All things considered, any attempt to anchor a boat on shore is worth the effort.

Securing a boat in the water

Any boat in the water should be secured in a "hurricane hole," which means a snug harbor protected on all sides from open fetch and unrestricted storm surge. (Don't even think about riding out the storm at sea unless you're the skipper of an aircraft carrier!) The trick is deciding which harbors will still be safer if a hurricane comes ashore and which ones will be vulnerable. Storm surge – high water – is a major consideration. A storm surge of 10 feet or more is common in a hurricane, so a seawall or sandy spit that normally protects a harbor may not offer enough protection in a hurricane.

Another consideration is rocks. Crowded, rock-strewn harbors are picturesque but not a good place to keep your boat in a storm, particularly if your boat breaks loose. If you plan to anchor, choose your bottom well for holding your type of boat with your type of anchors. Also, water can sometimes be blown out of the harbor, leaving boats stranded briefly. If this happens, your boat would rather settle onto anything but rocks.

At a fixed dock

Members of our BoatU.S. CAT Team estimate that as many as 50 percent of the boats damaged at fixed docks during hurricanes could've been saved by using better docklines – lines that are

longer, larger, arranged better, and protected against chafing. If you decide to leave your boat at a dock, you'll need to devise a docking plan that's liable to be far different than your normal docking arrangement. By the time preparations are completed, your boat should resemble a spider suspended in the center of a large web. This web will allow the boat to rise on the surge, be bounced around by the storm, and still remain in position.

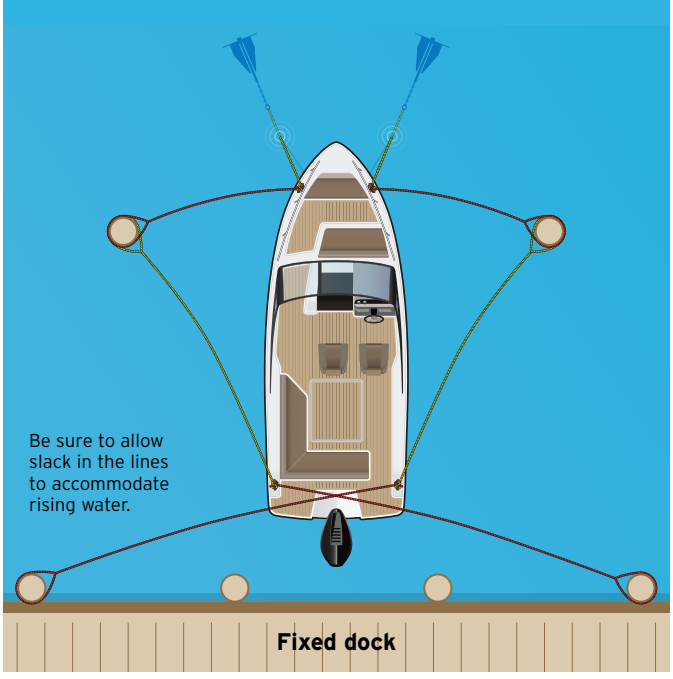
Take a look at your boat slip and its relation to the rest of the harbor. For most boats, you'll want to arrange the bow toward open water or, lacking that, toward the least protected direction. This reduces windage and keeps the strongest part of the boat – the bow – facing the storm. If your boat has a swim platform, especially one that is integral to the hull, you'll need to take extra care that the platform can't strike anything. Boats have been sunk when their platforms were bashed against a bulkhead.

Next, look for pilings, dock cleats, trees – anything sturdy – that could be used for securing docklines. Avoid cleats that do not have sufficient backing. Just bolting them through dock planks will probably not suffice. Not all pilings are sturdy, though. Old wood pilings that are badly deteriorated should obviously not be relied on in a storm. The same is true of older concrete pilings, which seem to be more susceptible to snapping in half (and sometimes landing on boats) than their more pliant wood counterparts. Many of the boats that were wrecked in Hurricane Charley had been secured to concrete pilings that couldn't stand up to the lateral stress and twisting. And at least one marina in Pensacola had almost all its concrete pilings fail. All things being equal, wood is a better choice unless the concrete pilings are relatively new.

YOUR BOAT SHOULD RESEMBLE A SPIDER SUSPENDED IN A LARGE WEB

With most docking arrangements, lines will have to be fairly taut if the boat is going to be kept away from pilings. The key to your docking arrangement is to use long lines, the longer the better, to accommodate the surge. (A good rule of thumb: Storm dock lines should be at least as long as the boat itself.) You'll probably want to use other boat owners' pilings (and vice versa), which calls for some planning and cooperation with slip neighbors and marina management.

Lines should also be a larger diameter to resist chafe and excessive stretching. On most cases, you should use ½-inch line for boats up to 25 feet; ⅝-inch line for boats 25 feet to 34 feet, and ¾- to 1-inch lines for larger boats. Chafe protectors (see "Find and fix potential breaking points," page 8) must be on any portion of the line that could be chafed by chocks, pulpits, pilings, and so on. To secure lines to hard-to-reach outer pilings, put the eye on the piling so that lines can be adjusted from the boat. For other lines, put the eye on the boat to allow for final adjustment from the dock.



ERICH STEVENS

If you don't have a slip, tie extra-long lines to pilings or cleats to allow for the surge, which could be 10 feet or more. Use anchors or long spring lines to keep the boat from striking the dock.

At a floating dock

Because they rise with the surge, floating docks allow boats to be secured more readily than boats at fixed docks. There's no need to run lines to distant pilings because the boats and docks rise in tandem. Floating docks only offer protection from the surge, however, if – a HUGE if – the pilings are tall enough to accommodate the surge. In almost every major hurricane, there have been instances where the surge has lifted floating docks up and over pilings. When that happens, the docks and boats, still tied together, are usually washed ashore in battered clumps.

If you plan to leave your boat at a floating dock, it's critical that you measure the height of the pilings. Will they remain above the predicted storm surge? Pilings that are only 6 or 7 feet above the normal high tide probably won't be safe. When floating docks have been rebuilt after hurricanes, the new pilings have almost always been much taller, up to 18 feet tall, and are far less likely to be overcome by surge than the 6- to 8-foot pilings that they replaced. Taller pilings are much more "stormproof."

Canals, rivers, and waterways

Whenever canals, rivers, or waterways are available, they serve as shelters – hurricane holes – and may offer an alternative to crowded harbors and marinas if you have no alternative. Your mooring arrangement will depend on the nature of the hurricane hole. In a narrow residential canal, a boat should be secured in the center with several sturdy lines ashore (the "spider web") to both sides of the canal. This technique was common to most of the boats in canals that survived recent hurricanes. Conversely, boats that were left at docks without the benefit of lines to both sides of the canal didn't fare any better than boats at marina docks.

The boat should be facing the canal's entrance and be as far back from open water as possible. Besides sheltering the boat, being away from the entrance should help with another consideration, which is the need to maintain a navigable waterway. Securing boats in resi-

dential canals is possible only if you make arrangements with the homeowners whose trees and pilings you'll be using to secure your boat. This can be difficult if your boat isn't normally moored in the canal. If your boat is already in the canal, getting other homeowners involved in planning for a hurricane increases the chances that your boat (and theirs) will survive. This is important because all it takes to wreak havoc in a narrow canal is one or two neglected boats coming loose.

In wider canals and waterways, boats should be secured using a combination of anchors and lines tied to trees ashore. More lines and anchors are always better. Try to find a spot that is well away from open water and that has tall banks, sturdy trees, and few homes. Moor your boat away from the main channel. Other considerations: A hurricane hole that ordinarily takes an hour to reach may take two hours or more to reach when winds and seas are building, bridges will likely not open as frequently once a hurricane warning has been posted, the bridges may be locked down for evacuation by vehicle, or the hurricane hole may be crowded when you get there. Plan on moving your boat early.

Helix moorings were found to hold better than other types of moorings, withstanding more than 12,000 pounds of strain.

At a mooring or at anchor

Mooring in a sheltered location can also be a good alternative to exposed harbors and/or crowded marinas. A boat on a mooring can swing to face the wind, which reduces windage, and can't be slammed into a dock unless the mooring or anchor drags. The first question, then, is, will your mooring hold? As a result of numerous moorings being dragged during hurricanes and northeasters, a study by the BoatU.S. Foundation, *Cruising World* magazine, and the Massachusetts Institute of Technology found that a 500-pound mushroom buried in mud could be pulled out with 1,200 pounds of pull (supplied by a 900-hp tug); an 8,000-pound deadweight (concrete) anchor could be pulled out with 4,000 pounds of pull. A helix mooring, however, could not be pulled out by the tug, and the strain gauge recorded 12,000 pounds of pull – its maximum – before a shackle burst apart from the strain. Scope in each case was slightly less than 3:1.

The holding power of a mushroom or deadweight mooring anchor can be increased by extending the pennant's scope, which has as much to do with the holding power of a mooring as it does the anchor itself. (Additional scope, while always advantageous, appears to be less critical with helix anchors.) Studies have found that when the angle of pull increases to 25 degrees, a mooring's holding power begins to weaken precipitously. So in shallow harbors, where a scope of 3:1 can be had with, say, 20 to 30 feet of chain, the advantage of scope is all but eliminated in a storm by a combination of a large tidal surge and the high, pumping motion of waves. Note that in a crowded harbor, scope must be increased uniformly on all boats.

Finally, when was the last time your mooring's chain was inspected? Chain that is marginal in the spring won't be sufficiently strong at summer's end to stand up to a hurricane. A harbormaster should know how long your chain has been in use and whether its condition could be iffy. If you have any doubts about your mooring, the chances of it failing can be reduced significantly by using one or two additional storm anchors to enhance its holding power and to decrease the room your boat will need to swing.

As with moorings, conventional storm anchors rely on scope – at least 10:1 if possible – to increase holding power. Heavy, oversize chain is also recommended; 50/50 is probably the optimum chain-to-line ratio. In theory, a riding weight, or sentinel, placed at the chain/line juncture will lower the angle of pull on the anchor and reduce jerking and strain on the boat. During a hurricane, however, its value will be diminished by the extreme pressure of wind and waves, and a sentinel (and the weight of the chain) should never be relied on to compensate for lack of scope. To absorb shock, an all-chain rode must have a snubber (usually nylon line) that is 30 percent of the rode's length. Without the nylon line, the surging waves and intense gusts are much more likely to yank the anchor out of the bottom.

TIP

BoatU.S. Marine Insurance policies include named-storm haulout coverage, which reimburses 50% of the cost (up to $1,000) to professionally haul or protect your boat in preparation for a NOAA named storm in your area.

BoatU.S. CAT Team members have consistently found that boats using single working anchors were much more likely to have been washed ashore. Conversely, more and larger anchors (suited for the type of bottom) increased a boat's chances of staying put. One CAT Team member says he's impressed with the number of boats that ride out storms successfully using two large anchors with lines set 90 degrees apart. With this technique, one rode should be slightly longer than the other so they won't become tangled should they drag. Even more staying power can be had using the tandem anchoring technique – backing each anchor with a second anchor. Using tandem anchors allows the first anchor to dig a furrow so that the second can dig in even deeper. A study done by the U.S. Navy found that the use of tandem anchors yields a 30% improvement over the sum of their individual holding powers.

One more important note: Chafe gear is essential on any line, but it's especially important on mooring and anchor

lines. Recent storms have given dramatic evidence that a boat anchored or moored is especially vulnerable to chafing through its pennants. Unlike a boat at a dock, which is usually more sheltered and secured with multiple lines, a boat on a mooring is more exposed to wind and waves and will typically be secured with only two lines. Lines on the latter will be under tremendous loads and will chafe through quickly if they aren't protected.

Trailerable boats

A trailer is, or should be, a ticket to take your boat inland to a more sheltered location away from tidal surge. But your boat won't get far on a neglected trailer that has two flat tires and rusted wheel bearings. Inspect your trailer regularly to make sure it will be operable when it's needed.

If you take your boat home, you may want to leave it, and not your car, in the garage. A boat is lighter and more vulnerable to high winds than a car. If this isn't practical, put the boat and trailer where they'll get the best protection from wind, falling branches, and other hazards. Let some air out of the trailer tires and block the wheels.

Increase the weight of lighter outboard boats by leaving the drain plug in and using a garden hose to add water. (Rain will add a lot more water later.) This has the added advantage of giving you emergency water (not potable) if the main water supply gets knocked out by the hurricane. Place wood blocks between the trailer's frame and springs to support the added weight. On a boat with an inboard or sterndrive, remove the drain plug so the engine won't be damaged by flooding.

Secure the trailer to trees or with anchors or augers. Strip all loose gear, bimini tops, canvas covers, electronics, and other items and then lash the boat to the trailer.

Boats on lifts

When asked, "Where wouldn't you want your boat to be in a hurricane?" just about all of the BoatU.S. CAT Team members consistently say they wouldn't want their boat to be on a hoist or lift. Damage to boats on lifts has been high and has included boats being blown off cradles, bunk boards breaking (and spilling the boats), boats grinding against lift motors and pilings, boats being overcome by the storm surge, and boats filling with rainwater and collapsing lifts. The boats that do survive were typically subjected to only a slight surge, and the lift had been secured so that the boat and its cradle couldn't be tossed around by the wind, and the boat was covered to reduce the weight of rainwater.

Whenever possible, boats on lifts or davits should be stored ashore. If the boat must be left on its lift, remove the drain plug so the weight of accumulated rainwater won't collapse the lift. If the tidal surge reaches the boat, it will be flooded, but leaving the plug in place is likely to result in more serious structural damage. Tie the boat securely to its lifting machinery to prevent the boat from swinging or drifting away. Some boats survived on their lifts when their owners used heavy straps to attach them to well-secured cleats on the dock. Plug the engine's exhaust outlet and strip the boat. Make sure cockpit drains are free of debris.

Boats on high-rise storage racks

In Hurricane Wilma alone, three large steel storage racks with thousands of boats collapsed. Typically, older storage racks are more vulnerable than ones that were constructed in the past few years. On newer buildings, the supports will be free of rust and the "loosening" effect of previous storms. Newer ones are also more likely to have been built to a higher standard with more and heavier structural supports to withstand higher winds. A marina owner should know how much wind a steel building was designed to withstand. If not, or if there is any doubt about the structure's ability to stand up to an approaching storm, boats on storage racks should be placed on trailers and taken elsewhere.

Is your marina stormproof?

Here are eight things to look for when it comes to selecting a hurricane-safe marina.

1. A PLAN. A marina should have a comprehensive hurricane plan that outlines who does what when a storm approaches. Slipholders may have to sign a pledge to secure their boats properly, whether ashore on in the water, which can prevent your boat from being damaged by someone else's. A "hurricane club" (often with a deposit) can guarantee you'll be among those hauled out first.

2. PROTECTION FROM WIND AND WAVES. Open water is the biggest enemy of boats in a marina during a storm. Look for tall breakwaters and small openings to the big water outside. Smaller breakwaters may be underwater during a surge. Bulkheads should be tall and sturdy and not in need of immediate repair. High banks around the marina can help keep the worst of the wind at bay.

3. FLOATING DOCKS. These should have pilings tall enough to keep the docks from floating away during a high surge (even a Category 2 will have surge of 6 to 8 feet or more). Cleats should be heavy and well-attached.

4. FIXED DOCKS. These should be sturdy without loose pilings or rotting wood. Taller pilings make it easier to attach longer lines to help with surge. Cleats need to be thru-bolted through substantial structure in wood docks. Loose planks can be carried away in the surge, making accessing your boat after the storm harder and more dangerous. For all docks, larger slips allow more room for movement without banging into the dock.

5. HAULOUT FACILITIES. If your marina can't haul your boat (boats are nearly always safer ashore), you'll need to move your boat to another one, which may be hard to do when a storm threatens.

6. ASHORE. Higher ground for hauled boats mean less likelihood of being toppled by high water or even washed away. The best marinas have anchors in the ground that boats can be strapped to.

7. HIGH-RISE STORAGE. Only those built fairly recently are designed to withstand real hurricane force winds. Most built in the last few years are, but ask your facility.

8. MARINA OFFICE. Buildings should be on high enough ground to survive the surge, otherwise management may take months to clean up, access records, and operate again. **– C.F.**

CHAPTER 3

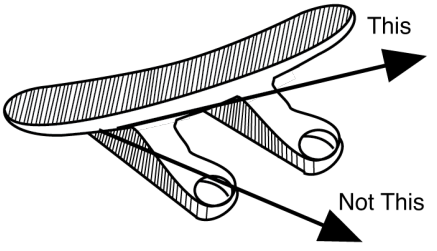
FIND AND FIX POTENTIAL BREAKING POINTS

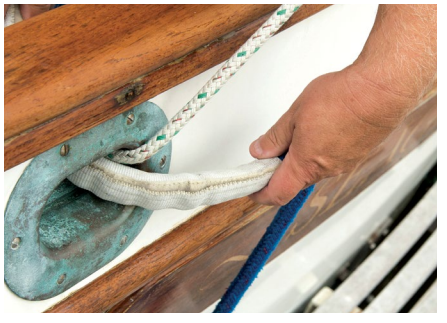
The fate of your boat's security in a storm comes down to these essential and critical points in your defense strategy. Addressing them early could mean the difference between your boat surviving a serious storm, or breaking free, hitting hard objects, filling with water, and sustaining catastrophic damage

Chafe gear

Nylon stretches and absorbs shock, which is good, but this stretching under tremendous loads also works the line against chocks and other contact points. Chafe protectors are essential on all lines – at a dock, mooring, or at anchor. At a dock, lines are liable to abrade against chocks, pilings, and the dock itself. Wise use of proper chafing gear is critical. Commercially available chafing gear such as Chafe-Pro is a good choice.

On moorings or at anchor, the line stretched over the edge of the rail can create sufficient heat to melt the line internally. Using hose to protect the line during a storm can encourage heat-related failure by not allowing water to cool the nylon fibers. Also, the plastic can melt, causing abrasion to the line. One solution is to mount the cleats directly at the rail so the line won't be worked against a chock. Another is to use polyester (Dacron) line, which has much less stretch but is far more chafe-resistant than nylon. By using a polyester line from the cleat through the chock and then joining it with a nylon line (use two eyes) to the piling or mooring, you can get the best of both types of line – the chafe-resistance of polyester and the stretch of nylon. An alternative is to use polyester sleeves, available at chandleries, to protect the nylon lines from chafe while also allowing water to reach the heated fibers.





STACEY NEDROW-WIGMORE

Top: Lines led perpendicular from a cleat can wrench the cleat out of the deck. Two-hole cleats are more vulnerable than four-hole cleats. Above: Chafe protection is essential on all lines where they rub against chocks, pilings, or the dock itself.

Cleats

Many boats have cleats and chocks that are woefully inadequate. This problem becomes critical when more and larger-diameter storm lines are used during a storm. If necessary, add more and larger cleats and chocks now; they'll make securing the boat easier all year.

Assess the ability of cleats to carry heavy loads. This means making sure all are backed properly with stainless steel or aluminum plates. On sailboats, winches (if backed properly and designed for the job) and even keel-stepped masts can also be used to secure lines at a dock. Note that anchor lines should not be secured to the mast, as it creates that much more stretch on the line at the chock, which further increases the chances of chafe failure.

Don't put too many eggs in one basket by leading numerous lines to a single cleat, even if it's backed properly. Two lines per cleat is usually the maximum. Also, a cleat is not reliable when lines are led perpendicular to the base and the cleat can be wrenched out by the tremendous loads (see diagram at left).

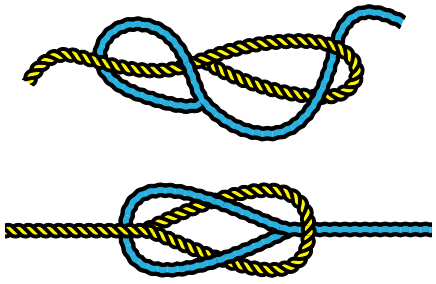
Reduce windage

Strip all loose gear that creates windage: canvas covers, bimini tops, outriggers, antennas, anchors, running rigging, booms, life rings, dinghies, portable davits, and so on. Anything on deck that can't be taken off should be lashed securely. Unstepping masts on sailboats is strongly advised. If this is impractical, sails (particularly roller-furling headsails) must be removed. Roller-furling headsails create a lot of windage, especially when they come unfurled, which is almost guaranteed to happen no matter how carefully they're secured. All halyards should be run to the masthead and secured with a single line led to the rail. This reduces windage and minimizes flogging damage to the mast. The line can be used to retrieve the halyards.

ONLINE EXTRA

Visit BoatUS.com/Boat-Chafe-Protection learn ways to protect your lines from chafe.

Fenders and fender boards won't compensate for a poor docking arrangement in a hurricane. When the boat has been well secured, however, they may offer some additional protection. When asked about fender boards, BoatU.S. CAT Team members said they were effective at preventing "dock rash," but only if heavy boards were used with several large fenders. Using only two fenders at either end of a long board wasn't effective; the fenders were either bounced out or the boards broke in the middle. One example of a system that worked: A member in Punta Gorda said he used several 12- by 32-inch fenders and a 16-foot fender



© ERICH STEVENS

By joining a polyester line from the cleat through the chock to nylon line from the piling or mooring, you can get the best of both types of line – the chafe resistance of polyester and the stretch of nylon.

board made from a 2-by-10 at his dock to keep his 50-foot Sea Ray from banging against a piling during a hurricane. The member credits the fender board for helping minimize damage to his boat.

Preventing theft

Electronics and other valuable gear should be taken home for safekeeping. Not only are electronics vulnerable when vandals comb through boatyards after the storm, they can also be wrecked by all of the water. Personal belongings and other loose gear should be taken home and the cabinets and cabin doors secured. All ship's documents should be taken off the boat.

Preventing water damage

Remove cowl ventilators and seal the openings. Use duct tape to cover instrument gauges. Duct tape should also be used around hatches, ports, lockers, and so on, to prevent water damage below. Note that some types of duct tape leave less gummy residue than others.

Close all but the cockpit drain seacocks and shove a plug into the engine's exhaust ports. If the boat does take on water, it will sit lower, and water could back up into the engine. Remember to remove the plug before starting the engine when the storm has passed.

CHAPTER 4

DEVELOP A PLAN

It's said that every minute you spend planning saves 10 minutes in execution. When a hurricane threatens, you'll be glad your plan is ready to go

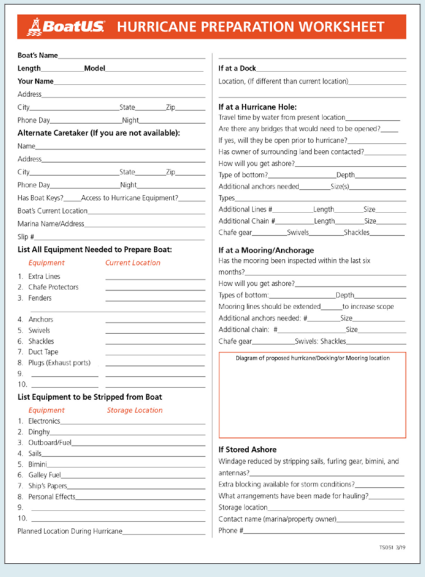
The first step in developing a preparation plan is to review your dock contract for language that may require you to take certain steps or to leave the marina when a hurricane threatens. Some marinas require boat owners to have and present a hurricane plan of their own. Ask the marina manager what hurricane plan the marina has in place. Planning where your boat will best survive a storm and what protective steps you need to take should begin before hurricane season.

Our BoatU.S. Marine Insurance claim files show that the probability of damage can be reduced considerably by choosing the most stormworthy location possible and having your plan ready long before a hurricane warning is posted. You may be able to join a "Hurricane Club," which would allow you to have your boat hauled whenever a hurricane warning is posted. These usually require signing up long before the first hurricanes and sometimes require a nonrefundable deposit, but you'll be among the first to be hauled.

Note that BoatU.S. Marine Insurance will pay half the cost, up to $1,000, to have your boat hauled prior to a hurricane, moved by a professional to a safer location, or for the professional execution of a hurricane plan. BoatU.S. will also lower the named-storm deductible for boat owners who can show they have properly prepared their boats (photos are a good idea). Also, call your insurance company to verify you have the right coverage and that you're in the right coverage area. Once a hurricane is threatening, it's too late to get or change coverage. Now is the time to check.

ONLINE EXTRA

Visit YouTube.com/BoatUS for a playlist of our hurricane-preparation videos.



BoatUS HURRICANE PREPARATION WORKSHEET

Boat's Name
Length Model
Your Name
Address
City State Zip
Phone Day Night
Alternate Caretaker (If you are not available):
Name
Address
City State Zip
Phone Day Night
Has Boat Keys? Access to Hurricane Equipment?
Boat's Current Location
Marina Name/Address
Slip #
List All Equipment Needed to Prepare Boat:
Equipment | Current Location
1. Extra Lines
2. Chafe Protectors
3. Fenders
4. Anchors
5. Swivels
6. Shackles
7. Duct Tape
8. Plugs (Exhaust ports)
9.
10.
List Equipment to be Stripped from Boat
Equipment | Storage Location
1. Electronics
2. Dinghy
3. Outboard/Fuel
4. Sails
5. Bimini
6. Galley Fuel
7. Ship's Papers
8. Personal Effects
9.
10.
Planned Location During Hurricane
If at a Dock
Location, (if different than current location)
If at a Hurricane Hole:
Travel time by water from present location
Are there any bridges that would need to be opened?
If yes, will they be open prior to hurricane?
Has owner of surrounding land been contacted?
How will you get ashore?
Type of bottom? Depth
Additional anchors needed Size(s)
Types
Additional Lines # Length Size
Additional Chain # Length Size
Chafe gear Swivels Shackles
If at a Mooring/Anchorage
Has the mooring been inspected within the last six months?
How will you get ashore?
Types of bottom Depth
Mooring lines should be extended to increase scope
Additional anchors needed: # Size
Additional chain: # Size
Chafe gear Swivels Shackles
Diagram of proposed hurricane/Docking/or Mooring location
If Stored Ashore
Windage reduced by stripping sails, furling gear, bimini, and antennas?
Extra blocking available for storm conditions?
What arrangements have been made for hauling?
Storage location
Contact name (marina/property owner)
Phone #
TSO19_379

Visit **BoatUS.com/Hurricane-Worksheet** to download a hurricane plan template.

BoatU.S.: Here for you 24/7

Visit **BoatUS.com/Hurricanes** to read more damage-avoidance articles to help prepare your boat for a hurricane. Our site includes up-to-date information on active hurricanes, including tracking models and NOAA forecasts. Plus, we've added a library of new videos to show you how to perform many of the tasks outlined in this article

Also, download our new BoatU.S. App (**BoatUS.com/App**), which can send you hurricane updates and even allow you to quickly file a claim using your mobile device.

CHAPTER 5

CASE STUDY: The trial of her life

These boat owners aggressively prepped their boat for survival at the dock using proven techniques as powerful Hurricane Florence zeroed in. Here's their dramatic firsthand story

BY JOHN STONE

Within seven hours of Hurricane Florence hitting the Carolinas, the water was 4 feet over the docks where John Stone's boat was tied up.

August through October is prime hurricane season in the Carolinas. Everyone who owns a boat here is aware of the risk. Our marina is on the Neuse River about 20 miles from where it empties into Pamlico Sound, a large body of water between the mainland and famous Outer Banks of North Carolina. We have 360 degrees of protection; docks are fixed (nonfloating), were rebuilt about five years ago, and are in good shape. The pilings are 9 feet above the normal high tide. The marina doesn't require evacuation because it's essentially a hurricane hole.

During a tropical storm, we know that boats are usually safer ashore, but haulout for an event like 2018's Hurricane Florence is not an option for everyone. Sometimes boats have to be moved a great distance to get to

a haulout facility, and sometimes you simply can't get hauled out if you didn't pay a nonrefundable deposit up front the previous spring to get on a hurricane haulout list (we did not). Even so, I felt most of the nearby marinas where we'd normally take our boat to haul out were not well protected. Turns out, I was right.

Every June, my wife Gayle and I discuss our plan for the upcoming hurricane season. This year we planned to keep *Far Reach*, our highly modified Cape Dory 36, which I'd spent six years rebuilding, in the marina. We aimed to enjoy our boat close to home during September and October, partly so we could be present and prepare if a hurricane threatened our area. Before the hurricane season began, we made one of the most important decisions we could have made – we chose to put *Far Reach* in one of two empty 26-foot-wide catamaran slips. While others saw the wide slip and contrary current as inconvenient, I saw it as room for *Far Reach* to survive should our luck avoiding hurricanes run out.

Creating an action plan

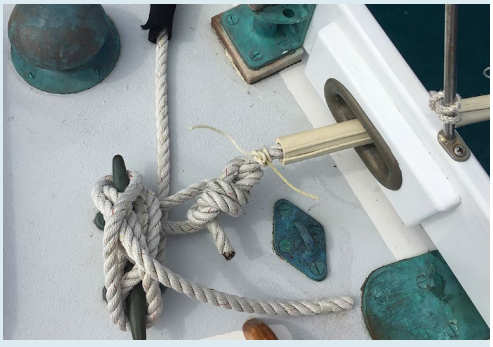
SEPT. 9, 2018 We'd begun to read about Hurricane Florence, and now there were early projections for landfall on the southeast coast of the U.S. We set our plan in motion. First, we turned *Far Reach* around in her slip so her bow faced out toward the northeast, from where we expected the strongest wind to come, and which presented the longest fetch in the marina. We removed all canvas, spinnaker pole, hard dinghy, dinghy sailing rig, pram hood, outboard engine, and solar panel to reduce windage. We removed as much gear on board as possible, even the cushions. By the time we finished, *Far Reach* was practically empty.

SEPT. 10 The forecast became dire. The exact point of landfall was unknown, but all indicators were that landfall would be in three days – and close. Pamlico Sound is 70 miles long and 30 miles wide, and our area was forecasted to be on the hurricane's "bad" side – the right front quadrant. It would pass to the south of us, the most powerful winds, the ones in the right front quadrant, coming from the northeast and east. Hurricane-force winds were predicted to drive the water into Pamlico Sound and up the Neuse River. Early surge forecasts would prove to be accurate: 9 to 13 feet, with 30 inches of rain.

SEPT. 11 We expected the roads would become blocked by downed trees, so we made a reservation at the hotel on the Marine Corps base where our marina was located. I spent six years and 6,000 hours rebuilding *Far Reach* from a bare hull and, other than my family, it's the love of my life. She was insured, but the amount was barely enough for the material I had into her. Our house, on the other hand, was insured for its full value, and my sister, a retired fire captain, agreed to stay there. By staying in that nearby hotel, we could eliminate blocked roads as obstacles to getting to the boat to check lines during the surge and address any concerns until the last

How to survive a hurricane in a marina

- **Develop a comprehensive storm-action plan** and be ready to implement it. Your marina should have a written, posted, storm-action plan available to every boat owner. (Our marina didn't have one.) It should be on the marina's website and emailed to all boat owners. The marina should be proactive and open an email dialogue with boat owners as soon as a storm looks like a threat.
- **A proactive dockmaster is critical.** Again, we didn't have one. A system must be in place for them to alert owners and management if boats aren't prepared so preemptive action can be taken. The dockmaster ideally should have a bosun's locker with extra ropes, chafe guards, sail ties, and so on, to secure unprepared boats.
- **Docklines should be of the right size**, doubled, with chafe protection. Your boat must have good thru-bolted backing plates for the cleats, preferably well tied in to deck structure. Lines should have enough slack for the forecasted surge. Ensure they can be adjusted from the dock if there's any chance you or someone else can safely visit the boat. Cleat them properly, and half hitch them if they're going to be underwater so they don't untie.



- **Reduce windage.** Remove the dodger, bimini, solar panels, wind generator, kayaks, cooking grills, and all sails, especially furling headsails
- **Use the best slips** available, even if you have to move.
- **Analyze how the wind and surge will affect your marina.** Position your boat accordingly.
- **Use new high-quality nylon dock lines and chafe protection**
- **Reach out to adjacent boat owners.** Share contact info and formulate plans together. They may not know what to do and be too embarrassed to ask, or they may be out of town.
- **Access your boat if safe to do so.** Adjusting lines before and after a storm can be the difference between no damage and a lot of damage. But remember, your life is more important than your boat. No unnecessary risks! **– J.S.**

possible moment. After the hurricane passed and the surge dropped, we wanted to be able to take in the slack in the dock lines so the boat would be protected from hitting the dock.

Painstaking preparation

SEPT. 12 Like any boater, I'm loathe to cut up a line, but we had to have as strong a dockline system as possible. So we cut a 250-foot-long ¾-inch double-braid nylon anchor line into four lines of about 50 feet, and two of 25 feet. We had a half-dozen old-style rubber Taylor Made Chafe Guards and another half dozen Chafe-Pro line protectors. The dockline plan proved crucial. The fixed docks are normally about 4 to 5 feet above the water. But with a 9- to 13-foot surge forecasted, we could have anywhere from 5 to 9 feet of water over the top of the dock. Docklines had to accommodate our boat rising the same amount of height.

This is where the wide slip was of such great value. We centered *Far Reach* in the slip and created as much slack as we could in the lines – not so much that she could make contact with either side, yet enough slack that she could float up without breaking the lines. The forward spring lines were the linchpin for the rest of the lines because winds were expected from the bow and would push her back toward the dock behind her. As the water rose, she'd be pulled forward as the relative length of the line shortened. Aft spring lines would keep her centered fore and aft. We also added bow and stern lines but not breast lines, as they wouldn't, by their geometry, be long enough to accommodate the surge.

Above: Preparations begin. The author cuts up his anchor line to use for extra docklines and adds chafe protection. Right:* Far Reach *is centered in a wide slip with slack lines to accommodate storm surge.

ONLINE EXTRA

Visit BoatUS.com/Hurricanes for more resources and to watch all our new hurricane-prep videos.

Our everyday docklines for the 16,000-pound *Far Reach* are high-quality New England Ropes ½-inch three-strand nylon, essential for their stretch, which reduces dynamic shock loading on the boat's cleats. Also, you can inspect three-strand lines; there's nothing hidden under an outer cover as with double-braided. As an added precaution, we doubled all docklines for added strength and to provide redundancy should a line break or chafe through. To our normal eight bow, stern, and spring lines, we added eight more for a total of 16 dock lines, all long enough to accommodate the surge expected in the marina. Then, we added chafe protection to the lines.

WE CENTERED *FAR REACH* IN THE SLIP AND CREATED AS MUCH SLACK AS WE COULD IN THE LINES

We also developed a cleating plan. We wouldn't be able to get on the boat to adjust the lines once the surge began, so we decided to terminate the lines on the boat and make them adjustable on the dock. We also avoided putting too many lines on the horns of the boat's cleats and decided to limit it to one line through the center hole and over the top of the cleat and the other secured to the cleats in the traditional manner. I tied off the tails with half hitches to assure they wouldn't come lose in the high wind.

The dock has fixed pilings on each outboard end where we secured the bow lines and aft spring lines. Pilings are great because, unlike cleats, they likely won't tear out. Another advantage is that you can position the lines high on the pilings, which allows more room for the lines to accommodate the surge. We secured all the lines to the pilings with rolling hitches, then took the tails around the piling one more time and tied the ends off to the standing part with half hitches.

This is where long lines can really

be of great value. The stern lines and forward springs had to be terminated on cleats on the dock as that was all that was available. We secured them in the normal manner, but tied all the tails off with half hitches because as the surge rose above the dock, the cleated lines would be underwater, and we were concerned the tails could come loose in fast-moving current. There was nothing more to be done, so we loaded up our truck with a cooler, ice, food, water, flashlights, rain gear, life jackets, coils of lines, tools, and handheld VHF radio, and moved into our hotel.

Florence hits, and it's a big one!

SEPT. 13 By 11 a.m., water was just over the dock, and all marina power had been shut off. This is important because energized shore power can be deadly to anyone on the docks when the rising water nears the shore-power pedestals. By 2 p.m., the water was about 18 inches over the dock. I added slack to the lines. We left for a few hours and returned at 6 p.m., hoping to have one last chance to adjust the lines. There was 4 feet of water over the dock and the wind was strong.

Never stay aboard in a hurricane

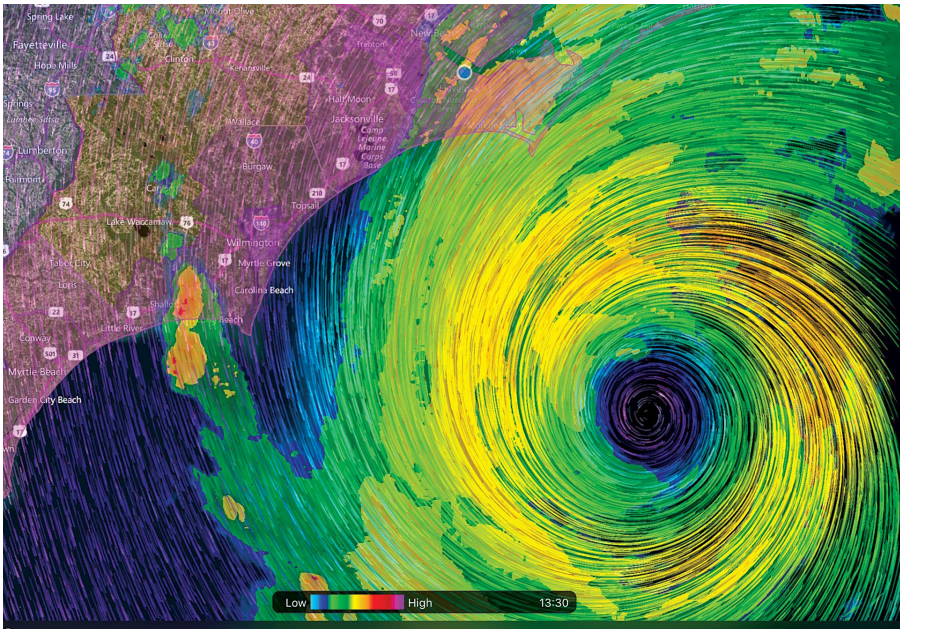
One of the most dangerous mistakes a skipper can make is to stay aboard his or her boat during a hurricane. Several accounts given in our BoatU.S. Marine Insurance claims files indicate that there is little, if anything, a skipper can do to save a boat when winds are blowing over 100 mph, tides are surging, and visibility is only a few feet.

What can happen? Consider the case of a 68-year-old skipper in Charleston, South Carolina, who together with his grown nephew, took his trawler up the Wando River to ride out Hurricane Hugo in what they thought would be a "sheltered" hurricane hole. He reported that the boat seemed to be doing fairly well initially, but later that night the wind picked up to over 100 mph and 15-foot seas sent the boat crashing completely over.

The two men were trapped briefly in a pocket of air underwater when another wave rolled the boat upright. They then scrambled onto the deck and were eventually rescued, but not before almost drowning and being overcome by exposure.

Another skipper who stayed aboard his motorsailer at a marina during Hurricane Gloria had to jump overboard and swim through breaking waves, drifting boats, and debris after another boat broke free and rammed its mast (the boat was on its beam ends) through his boat's pilothouse window. He was lucky to reach shore alive.

Two Miami men who stayed aboard a sportfisherman (not insured by BoatU.S.) during Hurricane Andrew were not so lucky. They both drowned while trying to escape their battered and sinking boat. When a hurricane is approaching, secure extra lines, set out anchors, add chafe protection, strip the boat above and belowdecks, and so on. Do whatever it takes. Then head inland. Your boat can be replaced. You can't. **– CHARLES FORT**



Above: The hard work paid off. Far Reach had emerged unscathed, but other boats nearby weren't so lucky. Right: A satellite image of Hurricane Florence's path

It was no longer safe to venture out onto the dock to check the boat. All we could do was say a prayer for *Far Reach* and return to the hotel. It was a long night knowing the boat I'd spent years building, and which had safely carried me to and from the West Indies, was having the trial of her life.

SEPT. 14 By 10:30 a.m. I felt it was safe to go to the marina. The first thing we saw through the wind-whipped tree limbs was complete destruction – at least four boats sunk, all more than 34 feet. Five had been driven up on land; one was missing entirely. Suddenly I saw *Far Reach*'s mast through the wind-driven rain. She was afloat! We made our way to the parking lot, still under a foot of water. I donned my life jacket and very cautiously worked my way out along the dock. Before the storm, we'd rigged a hand line between the pilings for this possible situation. There can be many dangers wading in receding floodwaters, including displaced snakes.

The destruction was shocking. Every boat on B Dock was damaged. An Islander 37 a slip away from *Far Reach* was sunk. But our hard work had paid off; *Far Reach* was undamaged. We estimate the marina had 10 to 12 feet of surge and winds of 80 knots. With the surge rapidly falling, I reduced line slack to ensure the boat wouldn't contact the dock.

Looking back, we didn't learn anything that hasn't been written about before. We were lucky, yes, but also aggressively followed proven techniques, and credit those for *Far Reach* surviving without damage. This was a large, powerful hurricane with enormous long-duration surge. With forethought, an understanding of how the storm will affect your marina, advance planning, hard work, active marina staff, and a little luck, your boat could survive one, too.

John Stone, a retired Marine Corps colonel who served 26 years, is a lifelong sailor. After he retired, he rebuilt Far Reach *and is now sailing with his wife, Gayle, in the eastern Caribbean. His twin children started college this fall.*

CHAPTER 6

What to do after the storm

When the worst is over, here's what you need to do

FROM THE *BOATU.S. MAGAZINE* EDITORS

After a storm has passed and authorities are allowing travel, get to your boat quickly. It's your responsibility to protect your boat from further damage, and its equipment from theft, regardless of its condition. An important task is calling your insurance company. The company will need to know the exact location and condition of the boat and will assist you in what steps to take. The BoatU.S. Emergency Dispatch phones are manned 24 hours a day and are heavily staffed after a storm to assist those with BoatU.S. Marine Insurance. Start the claim process online at **BoatUS.com/Account** to save time. You can also use the BoatU.S. App (download at **BoatUS.com/App**) to file a claim.

Don't take chances

A marina can be a hostile environment after a storm. Leave children, pets, and sightseers at home. Be cautious of leaking fuel, exposed electrical lines (make sure the dockside power is off if there is any chance of dangerous leaking current), sewage backups, missing dock boards, and other dangers. For example, often snakes will come to higher ground if their normal habitat is flooded. Don't venture out onto docks until it is safe to do so. And don't mind if you are challenged to show proof of ownership or asked to keep out of damaged areas. Marina management and authorities should restrict access to damaged and undamaged boats.

Some things to initially take to the boat include duct tape to secure broken rigging or railings and to seal cracks or holes, some basic tools, extra line; pencil and paper along with a camera to inventory damage; and lots of cleaning gear and anticorrosion spray. Removing salt, mud, and moisture should begin as soon as it can be done safely. Take trash bags to remove debris that could clog bilges and pumps. Don't forget bug spray, boots, and gloves.

If the boat appears undamaged or has only minor scrapes, inspect for chafed lines and broken ports or hatches where rain can enter. Monitor the water level in the bilge in the event there is underwater damage. Make sure the galley and engine fuel systems are undamaged and the bilge pump is working. Report damage right away to the insurance company.

If the boat is sunk, beached, or otherwise in need of salvage, contact your insurance representative for instructions on how to proceed. While you have the right to salvage your boat, contracting with salvors can be tricky business and is best left to insurance professionals. Inexperienced, poorly equipped, or overpriced crews can cause delays and additional damage that may keep you ashore longer than necessary. If the marina wants to act as a contractor, it should have your permission and the agreement of your insurance company before moving or salvaging your boat.

Boat owners insured with BoatU.S. should call the 24-hour Emergency Dispatch Center at 800-937-1937 before contracting for salvage or removal work. If communications are impaired, look for BoatU.S. Catastrophe Team field people who will be in the area immediately after a major hurricane. Whoever raises a sunken boat should begin cleaning the boat and "pickling" and preserving the engine and machinery immediately. Flush everything with freshwater, remove cushions and clothing to dry, and dry out the interior. Your yacht policy should cover the reasonable cost of any steps you take to reduce further damage.

STACEY NEDROW-WIGMORE

Your policy should also reimburse for any reasonable costs incurred for security you may hire if the boat is exposed. After the storm passes, boats thrown onto beaches or parking lots can fall victim to looters. In one sad case, a classic yawl cast onto a New England beach by a storm was dismembered by souvenir hunters with chain saws. After Wilma, boats stranded in marshes were stripped clean before salvors could reach them. After Andrew, someone painted a claim on a large yacht, mistakenly thinking that an "abandoned" boat was up for grabs. Police will be occupied with higher priorities; it's up to you to protect your damaged boat and its equipment.

BoatU.S.: Here for you 24/7

Visit **BoatUS.com/Hurricanes** to read more damage-avoidance articles to help prepare your boat for a hurricane. Our site includes up-to-date information on active hurricanes, including tracking models and NOAA forecasts. Plus, we've added a library of new videos to show you how to perform many of the tasks outlined in this article

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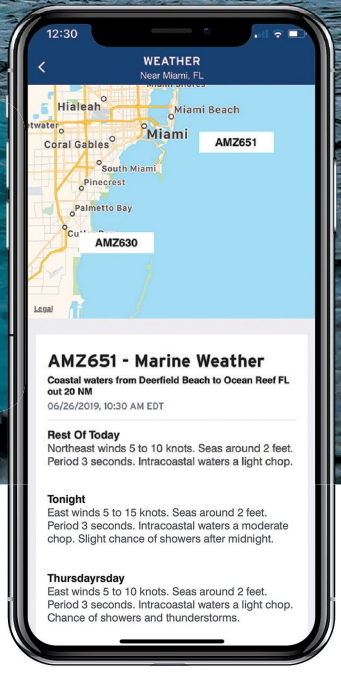

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