Within sight of New York City, an old-growth forest faces storms and sea-level rise

December 4 2019, by Kevin Krajick

Researchers make their way through a rare old-growth coastal forest on New Jersey's Sandy Hook peninsula, a onetime military base. Most of the trees seen here are red cedars; many were killed by Hurricane Sandy in 2012. Credit: Kevin Krajick/Earth Institute

Bounding the southern approach to New York harbor, New Jersey's low,

narrow Sandy Hook peninsula is home to an extremely rare forest: a 65-acre patch of eastern holly and red cedar trees, some of which date to the early 1800s. Close to sea level, rooted in nutrient-poor sand and exposed to wind from all directions, such forests once covered much of the East Coast. These few trees have survived the development that has swallowed nearly everything around them, along with countless storms, and—so far—rising sea levels. In 2012, Hurricane Sandy tore through, killing many trees with saltwater inundation and wind. The skeletons of the dead now whiten in the sun. With the slow inland march of rising ocean waters, and the increasing climate-driven potential for future powerful storms like Sandy, how much longer the rest may exist is an open question.

Tree-ring scientist Nicole Davi and several colleagues visited the forest one recent fall day. Davi, a professor at William Paterson University and researcher at Columbia University's Lamont-Doherty Earth Observatory, is interested in the relatively new field of paleotempestology—the study of past storms. In particular, she wants to know if she can use the old trees to establish the frequency and power of coastal storms preceding the roughly 100 years of modern meteorological records. Such knowledge would be valuable not only in understanding past events, but could help scientists project how this and other coastal ecosystems will respond to the stressors projected for coming decades.

Recent studies from the coasts of Virginia and Mississippi suggest that trees suffer trauma from saltwater and wind brought by big storms, in the form of reduced growth in their rings for several years following; some trees may die outright. And many East Coast woodlands along the East Coast are gradually turning to ghost forests, as saltwater rises up to 5 millimeters a year in some places, killing tree roots. Davi wants to know if she can spot the storm signal in coastal trees here. "How are trees responding to climate in real time?" she said. "Can we collate that with recorded weather and see how they react, and then extend that back

before the record? These trees may capture the history of storms that we can't capture otherwise."

Rare holly trees, some dating to the early 1800s, are highly resistant to saltwater. Such forests once existed along much of the U.S. East Coast, but are now almost all gone. Credit: Kevin Krajick/Earth Institute

Sandy Hook is seven miles long and in parts only 500 feet across. The old-growth forest has survived for a perhaps counterintuitive reason: the peninsula has mainly been a military base since the British occupied it during the Revolutionary War. American forces later used it to guard the harbor and test weaponry, erecting elaborate fortifications, gun batteries, and eventually, Cold War launching pads for nuclear missiles. Areas not

needed were left untouched, spared from the civilian development that has eaten almost every other bit of the coastline. The Coast Guard still occupies a small bit of Sandy Hook, but the majority was turned over to the National Park Service in 1974, and now serves as a combination recreation area and historic park featuring now largely ruined military structures.

The forest is fenced off from the public, but armed with an official research permit, Davi, Lamont Tree Ring Lab technician Troy Nixon, and two colleagues from William Paterson climbed over a locked gate and descended into the woods where mostly open, marshy areas separated hummocks thickly populated by trees. A few trees stuck out of the marsh grass, but most were dead—likely victims of Sandy, or maybe rising sea level, measured at a steady 4 millimeters per year here since the 1930s.

Navigating a scant, unmarked trail, the crew tangled with clinging underbrush and barbed-wire-like masses of catbrier, keeping an eye out for prolific ticks and poison ivy. At one point, they passed an apparent bomb crater, about six feet deep and 20 feet wide. Visitors sometimes still run across unexploded ordinances around here.

Tree-ring researcher Nicole Davi samples a cherry tree using an augur that removes a small cross section of growth rings. Credit: Kevin Krajick/Earth Institute

Davi took the first tree-ring sample from a gnarly, heavily leaning red cedar about a foot-and-a-half across. "I like trees that are leaning—the oldest ones are always leaning," she said. Sampling is done with a corer—a hollow augur that one twists by hand into the tree, filling its interior with a straw-like cross section of the tree's rings. The process produces a dry, croaking sound. Getting it both in and out requires plenty of muscle; Davi, who has done this hundreds of times, grimaced as she worked it in. When she hit what she figured was dead center a few minutes later, she backed the augur off a bit, and pulled out the core. Inspecting it briefly, she estimated that the tree was about 150 years old.

Its exact age and whatever storm events or other disturbances the rings might reveal would have to await lab analysis.

Further on, the crew arrived at a stand of hollies, with trunks as thick as three feet. Widely spaced and with elaborate crowns as much as 50 feet in the sky, they created a cathedral-like effect. Some specimens may be as old as 200 years, and they are the ultimate survivors in this kind of environment. Many tree species die quickly when their roots or branches are exposed to saltwater, but hollies have a high resistance. So do the cedars, but not as much; most of the dead trees scattered about seemed to be the cedars.

A couple of hours later, the crew had two cores each from a dozen hollies and a dozen cedars, along with a few old cherry trees. (The latter are mostly dead or dying; they seem to do less well with salt.) Davi and William Paterson lab technician Mike DaSilva also took advantage of a few downed tree trunks to saw out entire cross sections—a destructive technique never used on living specimens. In addition to inspecting rings for irregularities that could signal storm damage, Davi also intends to use a newly emerging technique to measure changes in oxygen isotopes in the rings, which may reflect the composition of storm source water, and could be used to identify big tropical-cyclone events.

A core from a red cedar tree, at first glance estimated to be 150 years old. Variations in the rings may signal past storms or other disturbances. Credit: Kevin Krajick/Earth Institute

Tree-ring technician Troy Nixon samples an ancient holly. Credit: Kevin Krajick/Earth Institute

On the dunes facing open water, big storms and gradually rising sea level are killing off trees. In the background, an abandoned missile silo. The peninsula was occupied by military forces for centuries, which saved the forest until now. Further in the background: the highly developed New Jersey mainland. Credit: Kevin Krajick/Earth Institute

Other natural archives can produce paleotempestology records, including layers of shells periodically washed ashore by big storms onto beaches or into ponds or lagoons. Some of these proxies may produce records going back as far as 6,000 years, but tree rings are Davi's favorite. "The great thing about tree-ring science is that it's very exact," said Davi. "The rings will tell you the absolute year when something happened." In one broad marsh, three metal pipes stuck out of the grass—monitoring wells installed by the U.S. Geological Survey, to measure the salinity of

groundwater at various levels. It may be difficult to measure the gradual intrusion of seawater using tree rings, said Davi, but the wells provide a direct record.

Only two other similar old-growth maritime forests remain in this region: a 50-acre tract on Fire Island, off Long Island, protected by the National Park Service; and a larger forest near Montauk, at the very tip of Long Island, on state land. Both contain trees that go back to the early 1700s. Davi intends to work there as well. She has also studied trees in Mongolia, Peru, Alaska, the Yukon, and other places, but says the ones closer to home are special to her. "It's amazing that they're here, considering all the pressures," she said. "They're remarkable recorders of climate, and we don't realize, some of them are just a couple hundred feet from a parking lot."

Provided by Columbia University

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