

Rising sea levels could kill off 500-year-old trees in New Jersey forest

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Dark water formed an eddy around Steve Eisenhower's boots as they sank into the muck at the base of a 90-foot black gum tree so old, its roots were deep in this ground when the Pilgrims landed.

Scientists estimate the age of black gums in an old-growth forest surrounded by Bear Swamp in Cumberland County, N.J., ranges from 400 to 500 years, making it among the [oldest trees](#) in the oldest forest of its kind in the Northeast.

But [sea-level rise](#) fueled by warmer oceans and sinking land is pushing saltwater ever closer to the trees, with the potential to kill them in the not-so-distant future.

Less than half a mile away, hundreds of trees separate from the old-growth forest are already dead from rising salt levels in what once was mostly a freshwater stream. Those [dead trees](#) jutted gray and naked into the late-fall sky during a recent hike with Eisenhower through the remote part of an old-growth forest, which is in the 6,765-acre Glades Wildlife Refuge owned by Natural Lands.

Eisenhower, regional director for Natural Lands, is cautious about proclaiming an immediate demise for the trees, *Nyssa sylvatica*, also known as black gum, black tupelo, or pepperidge.

"The old-growth trees are potentially threatened," Eisenhower said. "But we tend to be cautious in saying so."

Clearly, though, he is taken with the trees.

"Cornell came and did test borings years ago. The oldest sour gums were more than 500 years old," Eisenhower said, still marveling at that fact.

But it's not just black gums that are threatened. The forest is so remote, it lacks both people and trash, a rare thing in the region. It also is home to a grove of American hollies estimated to be at least 200 years old. Nearby are tulip poplar, beech, sweet gum, maple, white cedars, and other species. The few people who venture into the woods tend to be

hunters stalking white-tailed deer. Eagles nest nearby. Foxes, robins, and other wildlife feed on the black gum's fruit, while bees gather the nectar.

It takes a good hour—if you know the way—to reach these time-tested black gums. The only way to get to them is by foot, through deep, marshy woods protected by Natural Lands.

Sea-level rise in New Jersey is, in some ways, as old as the black gums. As far back as the 1700s, colonists noted saltwater intrusion. The state's coastal areas have been sinking slowly for thousands of years, as the Laurentide Ice Sheet retreated. Pumping out groundwater for human use accelerates this subsidence.

But since the 1700s, development, industry, and other human interventions have led to a 40 percent increase in carbon dioxide in the atmosphere. In recent decades sea rise has accelerated as oceans have warmed because of carbon dioxide emissions from burning fossil fuels. Glades Wildlife Refuge, where Bear Swamp is located, is among the most vulnerable areas of the state to this combination of rising seas and sinking lands. Add to all that another consequence of a changing climate—bigger storm surges that drive saltwater into areas once fed only by fresh water.

Though climate and other scientists generally agree that seas are rising, they don't always agree on how much. An archived U.S. Environmental Protection Agency fact sheet estimates that the sea is rising about 1 inch every six years because of climate change. By the next century, the Jersey Shore will face sea rise of 18 inches to 4 feet, the fact sheet states.

Separately, a Rutgers map of a sea-level rise of 1 foot, the lowest estimate using 2000 as a base level, shows much of Glades Wildlife Refuge, which spans from the Delaware Bay to the old-growth forest,

would become mostly water. Already, trees that once were upland are dying along the marshes as salinity pushes in. Pockets of Atlantic White Cedar have already died giving rise to ghost forests.

Bear Swamp is far enough inland that it's been protected so far. And the black gums weren't valued for timber because so many are hollow because of their natural aging process, though they are still very much alive. But the core of Bear Swamp was hollowed out decades ago by sand mining, which left vast, man-made pits now full of both groundwater and water that flows in from Oranoaken Creek.

Joseph Smith, an environmental scientist with L.J. Niles Associates, has measured salt-marsh encroachment that amounts to about a loss of about 5 feet of forest every year in the area.

Five years ago he tested the water in Oranoaken Creek and the lake formed from a mining pit about 200 feet from several black gums. He detected salinity of 3.5 parts per thousand. Closer to the bay, streams and creeks hit 10 to 12.

In November, he tested the water again and the results stunned him: up to 8.4 parts per thousand in the pit about 200 feet from the black gum trees.

"A forest can't move itself out of sea-level rise," Smith said. "Once you get saltwater into these pits, the ecosystem just flips."

The surrounding water-filled old mining pits, once the true "swamp" of Bear Swamp, can span 1,000 acres, helping accelerate saltwater intrusion. If the original land had remained unmined, it would act as a large buffer, slowly draining water back toward the bay. Eisenhower describes the pits as an unnatural "water highway" for saltwater to travel through.

Neil Pederson, now of Harvard Forest, a department of Harvard University, was one of those who came out for a coring of the black gum trees in 2002 in an attempt to date them.

"The black gum was really massive and I hadn't seen any of that size at all before," Pederson said. "They were definitely unusual-looking black gum, and that made them very different."

But Pederson said it was hard to determine their true age, which could be older than even half a millennium because they are hollow. The deepest part of cores dated to about the 1790s. But that was only halfway to the diameter of some trees, meaning they were probably much older.

"Some people were thinking they were ridiculously old," Pederson said. "I don't even want to say the number."

He estimates that most were in the range of 350 to 550 years old. He said he's seen black gum trees that date to the 1490s and aren't as tall as the ones in Bear Swamp.

"So it really is a special forest just for the size of the trees of that species," Pederson said. "It is a really, really cool forest regardless of how old the trees might be."

Gerry Moore, a botanist with the U.S. Department of Agriculture in North Carolina, grew up in nearby Millville and began cataloging flora as a young student. He's seen the damage saltwater intrusion has inflicted on the region over the decades.

"That's always been a very special area," Moore said of Bear Swamp, noting that naturalists as far back as the 1800s commented on the age and size of the trees. "It's a different kind of habitat with those trees that are that large and old. You're hard-pressed to find them anywhere

anymore. In most areas if you want to find old trees, you find them in cemeteries because they're protected. But when you're so close to a saltwater line, that's a real challenge. Saltwater and those trees don't mix."

Brian Johnson, who oversees Natural Lands' South Jersey properties, including Glades, stood recently at the edge of the patch of dying [trees](#) where Oranoaken Creek spills into the big mining pit near the black gums.

"Everything is dying where the stream comes in," Johnson said. "All of it is dying, 100 percent. And every year is more dramatic than the year before. If you ever have an unbeliever in climate change, bring him here."

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