

ENVIRONMENT



Flat and sinking, Delaware's coast battered by rising seas

The state faces higher tides and more frequent storms caused by climate change

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by **Natasja Sheriff**

MILFORD, Delaware — Emerging from the forests and wetlands that border Delaware Bay, Bennett's Pier Road comes to an abrupt and dramatic halt. Heading northeast toward the shore, the road gives way first to sand, then to sea. Fractured slabs like stepping-stones mark a broken path to the shoreline before disappearing beneath the encroaching waves.

The farthest reach of the road is now underwater. The broken pieces that remain are a stark reminder that Delaware's coastline is fighting — and in many places losing — a battle with the sea.

Kate Hackett, the director of Delaware Wild Lands, a private nonprofit conservation organization, went there eight years ago, as part of a Nature Conservancy initiative to monitor the state's famed horseshoe crab aggregations. "We came out here, to this very spot," she said. "The dunes were probably 20 feet high, all along here, this beautiful coastal dune system, and it's all gone now."

A few miles south of Bennett's Pier, the handful of residents that live on Big Stone Beach find themselves ever closer to the shore. Some homes, although elevated, now sit below the high tide line, which is fast approaching other houses on this stretch of the beach. One home on the southernmost end of the row was destroyed during Hurricane Sandy. The house next to it, closest to the shoreline, could be on increasingly uncertain ground as beach erosion continues.

Delaware, like other states on the mid-Atlantic coast, is on the front line of climate change in the U.S. Low-lying, flat and, since the loss of the last ice sheets, sinking, Delaware is vulnerable; its residents face a potent combination of rising seas, higher tides and more frequent storms that will erode and inundate the coastline.

Climate change is affecting coastlines in a number of ways: Sea levels are rising as water in the world's oceans heats up and expands and ice sheets and glaciers are melting, further raising sea levels. Meanwhile, scientists [cautiously point](#) to links between climate change and extreme weather events, and [evidence shows](#) that winter storms have increased in frequency and intensity in the northern U.S. since 1950. Those storms are meeting higher seas, driving bigger tides and storm surges onshore, flooding communities and eroding the coast.

Delaware's beaches attract millions of visitors each year. In 2013 the state's tourism industry generated about \$451 million for state and local government and employed close to 40,000 people. Delaware's Atlantic coast beaches — Lewes, Rehoboth, Fenwick and Bethany — are [eroding](#) at a rate of almost 1 meter per year. Preserving them attracts the largest share of state and federal funding for beach replenishment and coastal protection. But residents on the Delaware Bay shore — where erosion rates of up to 10 meters per year [have been recorded](#) — argue that their vulnerable beaches and the wetlands behind them, which provide protection for the state's valuable inland areas, should also be a priority for preservation.

Unlike some of its neighbors, Delaware's state government has taken a progressive stance on climate change and sea level rise. In 2010, the state's Department of Natural Resources and Environmental Control (DNREC) launched a study to assess Delaware's vulnerability to sea level rise. The findings, published in 2012, were startling.

According to the report, [projected](#) increases in sea level of 1.6 to 4.9 feet along Delaware's coast by 2100 could inundate up to 11 percent of the state's land area. The assessment also predicts a loss of all but a tiny fraction of Delaware's tidal wetlands by 2100. Elsewhere on the mid-Atlantic coast, estimates suggest that New Jersey will [likely see](#) a rise in sea level of 2.5 to 7 feet by 2100 and [Maryland](#), 2.7 to 3.4 feet.

Coastal communities have always borne the brunt of whatever extreme weather the Atlantic whips up, and they may now face a more challenging future. Flooding on the Atlantic coast has risen by almost a foot since the start of the last century, about 8 inches more than the global average, according to the [National Climate Assessment](#). Extreme rainfall events on the East Coast have increased more than 70 percent since 1958.

Slaughter Beach sits on a narrow spit of land, south of Bennett's Pier, caught between Delaware Bay and wetlands behind. Cottages and multistory homes run either side of Bay Avenue, the main route through the town, a stone's throw from the beach. On a still, sunny day in June, the quiet is broken only by the sound of birds on the marshland and waves breaking on the nearby shore. But in winter, the town experiences severe storms, the powerful nor'easters that slam into the Atlantic coast.

"The storms come in for three days, four days with sustained winds and just blow all the water from the bay and the ocean into the marshlands and fill those up," said Kathy Lock, a Slaughter Beach resident and the treasurer of the town's civic council. "The wind stays so long that the water can't recede at low tide. So it just builds up in the back marshes, tide after tide, and eventually that water has to go someplace, and it floods the town."

The main road into the village, from the north, floods a few days every year, making access to work and schools difficult. On Oct. 6, Hurricane Joaquin continued to affect coastal communities on the bay shore. At Slaughter Beach, the town's route north remained closed because of floods, and the southern access road was flooded but passable by some vehicles at low tide.

Residents like Lock know that this is only the beginning — the mid-Atlantic coast is likely to see some of the greatest increases in flood frequency in the next decade, according to the [Union of Concerned Scientists](#), a nonprofit advocacy group that promotes the use of science in government policy, meaning residents will have to navigate floodwaters more often. The group estimates that the coastal town of Lewes, on Delaware's Atlantic coast, which currently experiences about 30 tidal floods a year, will see that number rise to 90 in 15 years. By 2045, the group predicts that will increase to more than 200 tidal floods annually.

Lock says she started noticing a change about 10 years ago.

Looking out across the marsh in the summer from the back door of her home, she wouldn't see any water. "The marsh was dry, and it was green, and it was beautiful. Certainly at this point you could see puddles, and you could see where it was wet. So it's staying wet longer. And then about 10 years ago, I think, I noticed that the marsh was filling up more in the wintertime," said Lock.

"We never used to be an island. We are now," she added. "A little barrier island that protects the inland from sea level rise and from inundation."



Work began to shore up Broadkill Beach's sands this summer. **Natasja Sheriff**



A warning to drivers in Prime Hook.

Coastlines are dynamic. They are vulnerable to the ebb and flow of the tide and the currents that flow along the coast, moving and dropping sand as they go. Beaches grow and recede naturally. The environmental change associated with climate change intensifies those processes.

Residents of Broadkill Beach — a beachfront community to the south of Slaughter Beach stretching almost 5 miles along the coast, with few amenities — were facing an uncertain future as their beach receded and tides that reached beneath the beachfront's elevated homes

became the norm. A large-scale project to reconstruct the beach would likely not have gone ahead without federal assistance. Then a channel dredging project to deepen the Delaware River, paid for with federal disaster relief funding, brought a reprieve. This summer, work began to replenish Broadkill's diminishing sands.

"To be perfectly honest, the main crux of what you see happening at Broadkill is really the channel-deepening project," said Jim Bailey, head of Broadkill civic council. "It's just that we happen to be standing here smiling as they put the sand that they dig out of the channel on our beach, making a big berm and incredibly large beach."

Before the replenishment, the beach extended just a few feet below the high water mark. Now it stretches some 100 feet beyond a 16-foot-high sand dune that almost obscures the beachfront houses from view.

About 100 families live in Broadkill year round, and the population mushrooms in summer, said Pat Crabb. Her grandfather built a cottage on a small patch of land here 92 years ago. He was a country doctor in Milton who spent summers on Broadkill with his wife and four children. Crabb has spent summer there since she was a child. She built a summer home 25 years ago next to her grandfather's cottage, right on the beachfront. It's a three-story property, so she still has views of the sea, despite the new berm. The house is raised above the water, to protect it from floods.

Crabb believes her grandparents' house would eventually have been lost if the beach hadn't been replenished.

"The berm starts just about where the waterline was before they put [the berm] in," she. "In a storm, man, it would crash against those blocks there. It's a mighty force, the wind and the water."

Just 30 miles wide at its widest point, there is nowhere in Delaware that is far from the coast. The ocean influences the lives of tens of thousands of people who live within easy reach of the shore, as well as making a significant contribution to the state's economy. But as demand for coastal protection rises, Delaware Bay's shore communities may have to compete harder for funds.

"One of the things we've been trying to do and what we have been doing a little bit is turning the conversation around. It's not about us. It's about where we live ... This connotation that you know, 'Oh, you live at the beach. You shouldn't have bought it. You shouldn't have built there' — well, [Slaughter Beach] has been around since the 1800s," said resident Bill McSpadden. "It's critically important to protect the habitat, the wildlife that's around here."

The wetlands behind Slaughter Beach are part of the Marvel Salt Marsh Preserve. Beyond them to the west lies the Milford Neck Wildlife Area, and to the south is the Prime Hook Wildlife Refuge — all forming part of Delaware's extensive wetland habitat, which plays a key role in protecting the land and infrastructure that lies behind them.

"The wetlands are the first line of defense against coastal storms, and when we lose the wetlands, we lose a huge tract of land that can store water and buffer the waves," said Chris Sommerfield, a professor of oceanography at the University of Delaware.

Although the wetlands, too, are threatened by rising seas, under the right conditions, they stand a good chance of surviving the encroaching tides.

The DNREC's predictions are based on a "bathtub" model, which shows what the state would look like if everything lying below 3 to 5 feet flooded. That doesn't take into account the ability of the land to absorb and retain water or to grow.

"Unlike many other types of land, wetlands have a natural capacity to build themselves up, and over time, sediment is added to the wetland surface," said Susan Love, the leader of the DNREC's climate and sustainability division and a former project manager of the state's sea level rise initiative. "It's happening right now. The wetlands are flooded, and sediment is dropping out. Over time, wetlands can and are in many cases keeping pace with sea level rise. So they're building themselves up at the same time as sea levels are rising." Still, there are limits. If sea level rises at an accelerated rate, it's likely the wetlands won't be able to keep up, she said.

McSpadden worries for the future of the wetlands. "Besides the diversity of wildlife that's out here, [the wetland] helps to recharge groundwater. It also stops the flooding further inland," he said. "It might flood us, but if we go and it goes, it's just going to creep further and further inland."

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