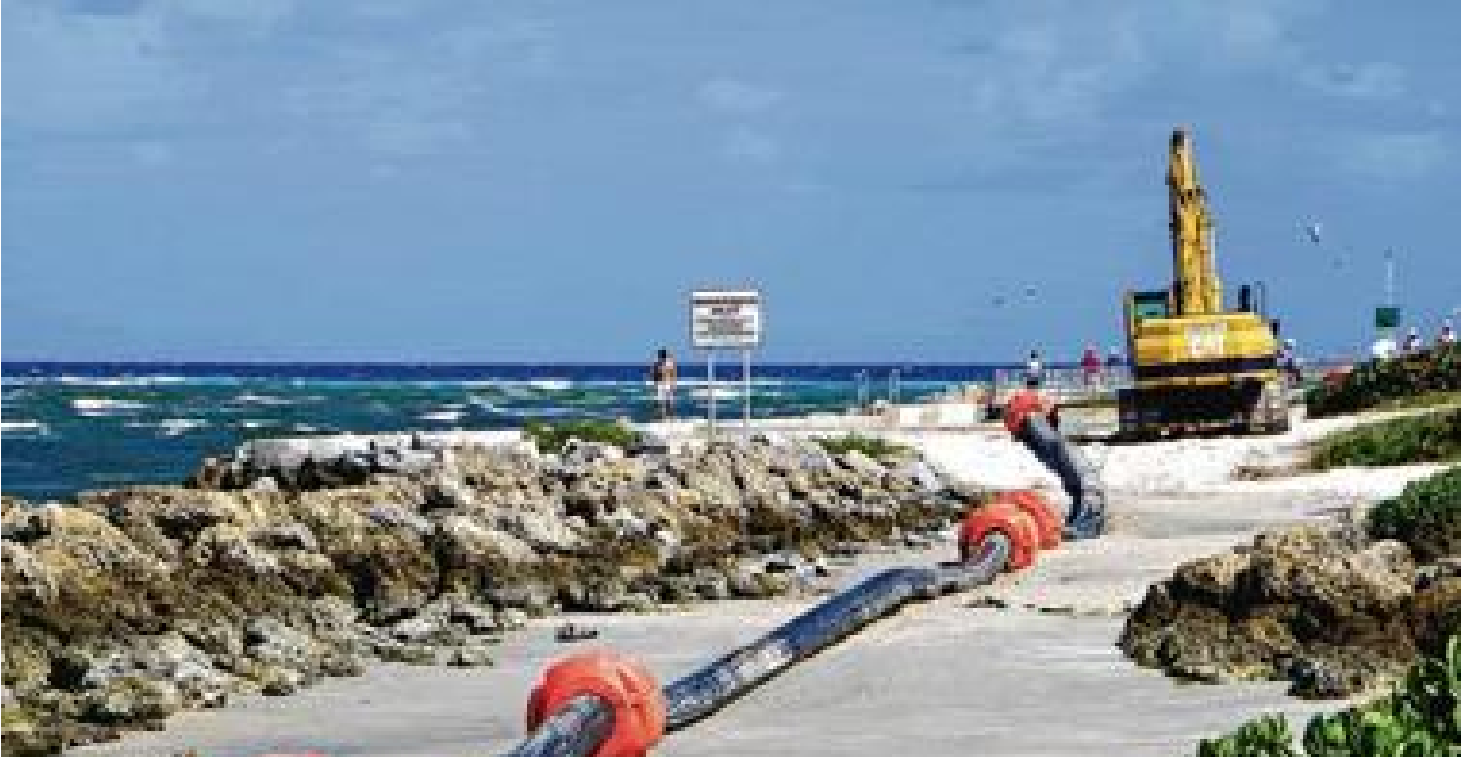


FROM TOP: RICHARD GRAULICH/THE PALM BEACH POST/ZUMA PRESS; CHRISTINA MENDENHALL/BLOOMBERG NEWS

A 2016 dredging project in Palm Beach, Florida, brings 70,000 cubic yards of sand from the bottom of the ocean to the shore.

The Battle for Our Beaches

Development and industrial demand are stripping shorelines of sand, and replenishing them is ever more costly.

By Vince Beiser

FOR A PLACE that depends on sun-and-sand-seeking tourists, Fort Lauderdale has a big problem: Its beaches are disappearing.

The Florida city has been fighting a defensive battle against nature for decades. The sand that lines its shores is constantly being swept out to sea by wind, waves and tides. In the natural course of things, that sand would be replenished by grains carried by the Atlantic's southward-moving currents. That's what used to happen. Today, however, so many marinas, jetties and breakwaters have been built along the Atlantic coast that the flow of incoming sand has been blocked. The natural erosion continues, but the natural replenishment does not.

For many years, Broward County, in which Fort Lauderdale sits, solved its vanishing-beach problem by replacing the sand with grains dredged up from the nearby ocean floor. Nearly 12 million cubic yards of underwater grains have been stripped off the sea bottom and thrown onto the county's shores. But by now, virtually all of the accessible undersea sand has been used up.

The same goes for Miami Beach, Palm Beach and many other beach-dependent Florida towns. In fact, according to the state Department of Environmental Protection, nearly half of the state's beaches have suffered "critical erosion."

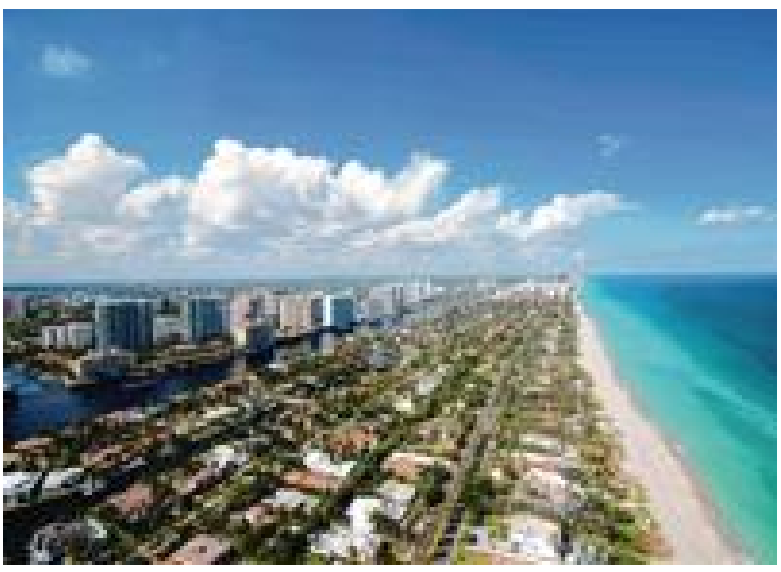
Florida isn't an anomaly. Beaches are disappearing all across America and around the world, from South Africa to Japan to Western Europe. A 2017 study by the U.S. Geological Survey warned that unless something is done, as much as two-thirds of Southern California's beaches may be completely eroded by 2100.

This is mostly our own fault. Sand gets to beaches from a combination of sources that vary depending on the local geography. In places with steep mountains close to the coast, like much of the American West, rivers carry sand straight to the shore. In other places, waves push sand from the ocean bed ashore. And all beaches are fed at least in part by currents traveling along the coast, bringing sand from other areas.

Human beings are interfering with all of those processes. Massive coastal development blocks the flow of ocean-borne sand. In many countries, including the U.S., river dams also cut off sand that used to feed beaches. The widespread practice of dredging up river sand to use for making concrete makes the problem worse. Researchers at the South African Institute of International Affairs believe that sand mining has slashed by one-third the flow of river sand that feeds the beaches of Durban, South Africa; and in the San Francisco Bay, environmentalists warn that massive sand dredging may be starving nearby beaches.

In some places, outlaw sand miners are hauling away the beach itself. In Morocco, Algeria, Russian-occupied Crimea and elsewhere, illegal miners have stripped entire beaches for construction sand, leaving behind rocky moonscapes. Smugglers in Malaysia, Indonesia and Cambodia load beach sand onto small barges in the night to sell in Singapore.

Having thwarted the natural processes that used to feed beaches, people are now replacing them with artificial ones. The easiest and cheapest method is to suck up grains from offshore and blast them onto the beach through massive pipes. But having run out of offshore sand, many towns in southern Florida are left with no choice but to dig their sand from inland quarries and haul it to the coast one roaring, diesel-spewing truck at a time. Tourists and locals hate the noise and traffic, and county officials hate the extra cost, which can be easily double that of dredged sand. Desperate officials are even talking about importing sand from the Bahamas.



In Miami Beach, seen here in 2014, construction extends almost to the shoreline.

The costs add up fast. The price of renourishing a beach can reach $10 million per mile. Broward County alone has spent more than $100 million replenishing its beaches in a multiyear project launched in 2015. More than a few places, such as Atlantic City, have already racked up tabs of well over $100 million by themselves. All told, nearly $9 billion has been spent in the U.S. in recent decades on artificially rebuilding hundreds of miles of beach, according to researchers at Western Carolina University. Florida accounted for about a quarter of the total. Almost all of the costs are covered by taxpayers.

Advocates of beach nourishment argue that the process more than pays for itself, considering what tourism brings in to local, state and regional economies. As a straight financial proposition, this is irrefutable. But there are other costs involved that can't always be priced in dollars.

Dredging up ocean sand clouds the water with stirred-up grains and muck. Suspended in the water, those particles can block life-giving sunlight from reaching coral reefs. And when the grains settle, they can suffocate the reefs and whatever creatures are living on them.

Moreover, beach sands are themselves home to a multitude of creatures. Besides the obvious ones—clams, crabs, birds, plants—they shelter all kinds of nematodes, flatworms, bacteria and other organisms so small that they live on the surface of individual sand grains. Despite their tiny size, these creatures play an important role in the ecosystem, breaking down organic matter and providing food for other creatures. Dumping thousands of tons of imported sand on top of these organisms can obliterate whole colonies of them.

Though concerns about tourism motivate much of the effort to preserve and replenish beaches, local authorities are increasingly taking action for another urgent reason: Beaches are bulwarks that can protect lives and property from storms and rising seas in our climatically imperiled world.

Between 1990 and 2010, a recent analysis by Reuters found, about 2.2 million new housing units were built near American shores, many of them in areas considered the most imperiled by rising sea levels. All told, an estimated $1.4 trillion worth of real estate lies along the country's shores. All of it—along with countless billions more in coastal communities in other countries—is endangered by the rising seas and powerful storms spawned by the changing climate.

The U.S.'s densely populated eastern seaboard is already getting a taste of what that means. When Hurricane Sandy hit in 2012, it killed 159 people and damaged or destroyed at least 650,000 homes. The storm struck hardest in areas where beaches had eroded, leaving little or no buffer between cities and the raging wind and waves. On the other hand, according to the U.S. Army Corps of Engineers, renourished beaches in New York and New Jersey prevented an estimated $1.3 billion in damages that Sandy otherwise would have inflicted.

Renourishment is not a cure for beach erosion, however. It's just a treatment—one that must be repeated regularly. Few replenished beaches last longer than five years or so before they have to be fattened up again. Dozens of Florida beaches have been bolstered repeatedly in the last few decades, some as many as 18 times. New Jersey's Ocean City Beach has been replenished 37 times; Virginia Beach, Virginia, more than 50 times.

In retrospect, it obviously wasn't such a great idea to develop so much property so close to the ocean's edge. But now there are millions of people and billions of dollars worth of buildings in place. How could we undo all that?

No one knows, and few are asking. Which leaves us more or less obliged to keep rebuilding beaches, both as defenses against the ocean and as magnets for tourists. From Fort Lauderdale to Malibu, the question now is: How long can we keep it up before the money runs out—or the sand does?

This essay is adapted from Mr. Beiser's new book, "The World in a Grain: The Story of Sand and How It Transformed Civilization," which will be published on Aug. 7 by Riverhead Books.