

Mangroves vs. seawalls? Mix may be 'best of both worlds' to take on South Florida sea rise

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Along most of the historic South Florida coast, mangroves were nature's way of protecting the coast from waves and hurricanes. As development inched closer to the water, seawalls became the method of choice to

separate land and sea.

With 2 feet of sea level rise on the horizon by 2060, which is the right choice for extending the life span of cities like Miami?

The science—at least for pure flood control—suggests the man-made answer wins out over nature's solution, with some caveats.

Peter Sheng, a University of Florida researcher who's studied the protective value of [mangroves](#) in Florida, said they're an incredible tool when used correctly. In places like Cutler Bay, huge swaths of mangroves provide a barrier between the 10-foot-plus waves from hurricanes and populated areas.

"If you have a narrow urban [mangrove](#) planter, it doesn't cut it," he said. "Three meters of mangrove does nothing. It's a token for the look. If you want to dissipate waves, you need at least 100 meters."

This math was evident in the federal government's decision that the best method to protect Miami-Dade's coast from the punishing hurricanes of the future was a 20-foot wall stretching for miles along the coast, and not the dense mangroves and short seawall combination many residents brought up in public meetings.

Ultimately, the county and its residents rejected the wall, sending the U.S. Army Corps of Engineers back to the [drawing board](#) for a new solution that Miami-Dade residents will actually like, and one that is intended to protect them for decades to come.

How do mangroves stack up?

It's not that seawalls are better than mangroves 100% of the time, said Rik Gijnsman, a coastal engineer and researcher at the University of

Twente in the Netherlands. In a 2021 paper, he and other authors analyzed a decade's worth of research on how well mangroves work at reducing flooding compared to a seawall.

"It's not an 'or' question. It's different systems and they can both be useful depending on the conditions locally," he said. "I think we need both and it depends on the local conditions, how to integrate the two."

Rod Braun, climate strategy director for The Nature Conservancy, said mangroves have a long list of benefits, including erosion control, providing a habitat for the fish and other organisms that inhabit the bay, improving water quality and storing carbon dioxide, a greenhouse gas that causes global warming. And unlike a concrete wall, they actually form a stronger and higher barrier over time.

"I think it makes it just a nicer place to live," he said.

And seawalls have issues. When waves crash against the hard concrete, it carves away at the sand below, making it a less friendly place for sea creatures or plants.

Combining the two, known as a hybrid approach, solves a lot of those issues. It's what the city of Miami suggested for the new coastline of Morningside Park, a 6-foot seawall in combination with mangroves and other landscaping. Then some residents complained that mangroves would ruin their view and they were removed from the project.

But in the case of the Army Corps plan, which was designed to protect the county from the punishingly high waves associated with hurricanes and not just occasional flooding, the data show that even a hybrid approach might not be enough.

Gijsman said studies consistently show that to cut huge waves down to

size takes a lot of mangroves, an Everglades-sized amount of mangroves.

"Mangroves will never provide full safety for real storm surges," he said. "To really attenuate the waves you need kilometers of them."

The science is still out

Yuepeng Li, a Florida International University researcher who's published multiple papers attempting to quantify exactly how much protection mangroves offer, said there are a lot of factors when it comes to figuring that out. It matters what species of mangrove you're talking about, and even the ratio of roots to branches makes a difference.

Accounting for those variables, he said, it takes about half a mile worth of mangroves to lop off even one foot of storm surge.

"Even one mile of mangroves, I don't think it will significantly decrease the surge," Li said.

One of the reasons builders stick with seawalls over mangroves, Gijnsman said, is that you can build a concrete structure exactly the same way every time and all but guarantee the same performance.

"We've realized for a long time already that natural area contributes to flood protection, but it's not that simple to work with because nature is unpredictable, and as an engineer, you want to be on the safe side," he said.

For instance, engineers can calculate what it would take to make a seawall crack and fail. When it comes to mangroves, they aren't as sure. That makes it difficult to provide the "return on investment" numbers agencies like the Corps rely on to make decisions.

And as the world gets hotter, wetter and saltier, mangroves could perform worse.

Best of both worlds

When armoring the coasts, seawalls and mangroves aren't mutually exclusive solutions. Increasingly, planners are looking to combine both strategies.

Landolf Rhode-Barbarigos, an assistant professor with the University of Miami's college of engineering, said he's "all about the hybrid" of the two—using a seawall to protect against flooding and plants like mangroves to bring in the environmental benefits.

But calculating those eco-friendly additions is much harder than simply seeing how much less flood damage a city faces with or without a [seawall](#). Not everyone agrees on the value of having a few dozen fish around or a few pounds of carbon dioxide sucked out of the atmosphere.

Rhode-Barbarigos said if planners change the question they ask at the beginning from "what offers the best [flood protection](#)?" to "what does the most good for this space?" then a hybrid solution is the clear winner.

"What you're getting with the hybrid, I want to believe, is the best of both worlds and not the opposite," he said.

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