

Coastal wetlands dramatically reduce property losses during hurricanes

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Flooding in New Jersey caused by Hurricane Sandy, which made landfall in New Jersey and devastated the East Coast. A new study estimates that coastal wetlands reduced property damages from Sandy by an average of 22 percent in affected areas. Credit: Bridget Besaw

With the Atlantic hurricane season well under way and Tropical Storm Harvey causing devastation in Texas, a new scientific study reports that coastal wetlands significantly reduce annual flood losses and catastrophic damages from storms. Led by a team of scientists from the engineering, insurance, and conservation sectors, including researchers at UC Santa Cruz, the study found that coastal wetlands in the northeast United States

prevented \$625 million in direct flood damages during Hurricane Sandy, reducing damages by more than 22 percent in half of the affected areas and by as much as 30 percent in some states.

The study, published August 31 in *Scientific Reports*, quantified the flood reduction benefits provided by [coastal wetlands](#) across the northeastern United States during Hurricane Sandy, as well as the benefits provided annually in Barnegat Bay in Ocean County, New Jersey. It used the risk industry's latest and most rigorous high-resolution flood and loss models and an extensive database of property exposure to show the correlations between property value and wetland presence, and between wetland extent and avoided flood damages.

The vast majority of public and private funding for coastal infrastructure goes toward built structures (e.g., concrete), with only about 3 percent going to restoration of natural infrastructure (e.g., wetlands), according to a [recent analysis](#) by UC Santa Cruz researchers. The authors of the new study said their findings make a clear case for reallocation of this coastal investment portfolio, particularly after disasters such as Hurricane Sandy.

"Wetlands can be incredibly effective at reducing property damages from catastrophic storms, and these effects can be clearly understood by combining state-of-art engineering models with coastal ecology and economic analysis," said lead author Siddharth Narayan, a coastal engineer at UC Santa Cruz. "Coastal habitats provide benefits that represent hundreds of millions of dollars in annual savings along the U.S. East Coast."



The study shows that conserved wetlands provided risk reduction benefits during Hurricane Sandy even in highly urban environments like this urban salt-marsh in New York. Credit: Kevin Arnold

Clear correlation

The study showed a clear correlation between wetland cover and avoided property damages: the greater the extent of the wetland, the more protection it provides. Even relatively degraded wetlands in highly urban areas like New York City provided hundreds of millions of dollars in flood protection during Hurricane Sandy, preventing \$140 million in flood damages in New York and \$425 million in New Jersey.

In addition, the study demonstrated that coastal wetlands provide important coastal protection services year-round. Annual flood losses in Barnegat Bay, New Jersey, were 16 percent lower in places that had conserved their marshes than where the marshes were gone. In places that were 1.5 meters or less above sea level, the relative annual risk reduction benefits from wetlands were as high as 70 percent.

The study was led by UC Santa Cruz, The Nature Conservancy and the Wildlife Conservation Society in association with Risk Management Solutions and Guy Carpenter & Company, with funding from Lloyd's Tercentenary Research Foundation. This partnership between the conservation, engineering, insurance, and risk management sectors was born out of the realization that coastal development and climate change will continue to increase the risks to people and property from flooding and storm surge, and that protecting coastal habitats can mitigate some of these risks. Coastal habitats are natural defenses that can help reduce risk in a cost-effective way, adapting to changes in the environment and providing multiple benefits to society.



Marsh wetland provides a first line of defense in coastal New Jersey. The study shows that properties fronted by salt-marshes experience 16 percent lower annual flood losses from storms than ones that have lost their fronting marshes. Credit: Jim Wright/LightHawk

Conservation and restoration

In a connected [report from Lloyd's](#), the partners identified how the findings in the *Scientific Reports* paper can be used to fund wetland

conservation and restoration. Before a disaster strikes, investments in habitat conservation that reduce coastal risk could reduce premiums on insurance and insurance-linked securities (such as resilience bonds). In this way, habitat restoration could pay for itself in savings. After a disaster strikes, private insurance and public recovery funds can support wetland conservation, with the benefits of further reducing insurance premiums and building coastal resilience against future disasters. The risk and insurance industry can play a critical role in wetland restoration for disaster prevention and recovery.

The magnitude of the benefits was surprising given how many coastal wetlands already have been lost throughout the region. For example, wetlands did not reduce as much damage in New York in part because of their extensive loss in past decades. At the same time, even relatively small, thin bands of wetlands serve as an effective first line of defense, and they can be restored to build coastal resilience.

"Our models traditionally focus on man-made coastal defense structures, or on other gray architecture solutions, like elevating properties above sea level," said coauthor Paul Wilson, vice president of model development at RMS and an expert in hurricane and storm surge. "This study is pioneering because it applies cutting-edge modeling science to natural defenses, and it allows us to put a financial value on the role wetlands play in protecting our coastal communities against storm surges."

Quantifying the economic value of natural defenses will increase their relevance and inclusion in coastal management priorities. Although the risk-reduction role of coastal wetlands is often included in risk models, it is not clearly recognized by risk modelers, insurers, brokers, and clients. The risk-reduction role of wetlands can be straightforwardly included in the products of the risk and engineering sectors, and thus more readily considered in [coastal development](#) and habitat restoration decisions.

"Although these might be strange bedfellows, engineers, insurers, and conservationists can come together to save people, property, and nature," said coauthor and project lead Michael Beck, lead marine scientist for the Nature Conservancy and a research associate at UC Santa Cruz. "Our work together shows where we can find innovative solutions for reducing flood risk and conserving [wetlands](#)."

"Lloyd's Tercentenary Research Foundation aims to fund cutting-edge scientific research that contributes positively to society; this principle is embodied in the ongoing project led by the University of California at Santa Cruz," said Jean-Bernard Crozet, trustee of Lloyd's Tercentenary Research Foundation and head of underwriting modeling at MS Amlin. "Coastal ecosystems such as coral reefs, mangroves, and salt marshes play a fundamental role in reducing the risk of storm surge. The LTRF believes that improved quantification of these benefits will, in turn, lead to better management and conservation of these natural ecosystems, contributing not only to risk reduction along our coasts but to our planet's sustainability in the long run."

More information: Siddharth Narayan et al. The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA, *Scientific Reports* (2017). [DOI: 10.1038/s41598-017-09269-z](https://doi.org/10.1038/s41598-017-09269-z)

Provided by University of California - Santa Cruz

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