Lo Que el Huracán Nos Enseñó

What the Hurricane Taught Us

A companion essay to a watercolor series

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On September 20, 2017, Hurricane Maria made landfall on the southeastern coast of Puerto Rico with maximum sustained winds of 155 mph. In less than a day, it moved northwest across the entire island, stripping leaves from every tree, collapsing roads, knocking out power to all 3.4 million residents, and killing nearly 3,000 people (George Washington University, 2018). The official death count released by the federal government was 64. The true toll, documented months later by independent researchers, was closer to 2,975, with some estimates running even higher (Kishore et al., 2018).

This essay accompanies a series of four watercolor paintings that trace this story. But the paintings are only part of what needs to be said, because Hurricane Maria was not simply a natural disaster. It was the collision of a warming climate, decades of ecological degradation, political neglect, and colonial inequality, all of which made an already catastrophic storm devastatingly worse.

To understand Maria's impact, you must understand what Puerto Rico's coastline looked before it. Mangrove forests once wrapped around much of the island's shore: dense, salt-tolerant trees whose tangled root systems rise above the waterline. Mangroves are among the most effective natural storm barriers on Earth. Their root networks absorb wave energy and reduce

storm surge. Research shows that surge can be cut by more than 50 percent as it passes through a healthy mangrove forest (Manggear, 2022). They stabilize sediment, prevent coastal erosion, and provide nursery habitat for fish and marine life. They also store enormous quantities of carbon, making them critical buffers against the very climate change that intensifies the storms threatening them.

"Antes | Before" (Barkman, 2026)

By the time Maria arrived, much of that protection was already gone. Puerto Rico's mangrove cover had declined by 35 percent between the 1980s and 2009, a rate exceeding even the deforestation of tropical rainforests and coral reefs during that period (Martinuzzi et al., 2009, as cited in Howe et al., 2025). The losses came from dredging for agriculture and urban development, wastewater contamination, industrial pollution, and the destruction of connected barrier ecosystems like sand dunes (Mongabay, 2022). When Maria's storm surge hit a coastline already stripped of its natural defenses, there was nothing to slow it down.

The destruction of Puerto Rico's mangroves did not end when the storm passed on. On the small island of Vieques, east of the main island, coastal mangrove forests survived the initial

winds, only to die months later from a phenomenon researchers described as delayed mortality. Maria's intense rainfall had trapped enormous quantities of freshwater in the wetlands, disrupting the salinity balance that mangroves depend on. The trees, already stressed, could not recover (Eos/AGU, 2022).

The broader forest picture was equally stark. A NASA researcher described the effect of the storm from above as turning a tropical rainforest into "a New England woodland in December, because you stripped all of the leaves off almost all of the trees" (The World/PRX, 2018). El Yunque, the only tropical rainforest in the U.S. National Forest system, lost an estimated 23-31 million trees. Ecologists estimated the forests would need roughly 60 years to fully recover. The deeper concern, voiced by ecologist Ariel Lugo, was that the mangroves were unlikely to recover before the next major hurricane arrived, once again leaving the island's communities exposed with "landslides and greater floods" absorbing the energy that living ecosystems once would have taken on (The World/PRX, 2018). This is the compounding logic of ecosystem loss: degradation does not just make one storm worse; it makes every subsequent storm worse.

"La Tormenta | The Storm" (Barkman, 2026)

Hurricanes are heat engines. They form when ocean surface temperatures rise above approximately 26.5°C (80°F), drawing energy from warm water and moisture as they spin. As the planet warms, the ocean absorbs more than 90 percent of the excess heat trapped by greenhouse gases, and sea surface temperatures have risen approximately 2.8°F since the early 20th century (Woodwell Climate Research Center, 2025). The result is more fuel available for stronger storms.

The data on major hurricanes is unambiguous. Research suggests that the proportion of Category 3 or above storms in the Atlantic has doubled since 1980 (Environmental Defense Fund, 2025). Storms are also intensifying more rapidly. A phenomenon called rapid intensification, defined as a 35 mph increase in wind speed within 24 hours, and the number of storms that quickly strengthen from Category 1 into a major hurricane more than doubled in 2001-2020 compared to 1971-1990 (Climate Central, 2024). Hurricane Maria itself underwent dramatic rapid intensification in the days before landfall.

Climate change also makes hurricanes wetter. Warmer air holds more moisture; more moisture means more rainfall. Scientists project that hurricane rainfall rates in the Atlantic will increase by almost 30 percent by the end of the 21st century (Yale Climate Connections, 2019). For a mountainous island like Puerto Rico, where Maria's rainfall triggered catastrophic flooding and landslides, this is not an abstract projection, but an amplification of what happened.

The ecological story of Hurricane Maria cannot be separated from its political one. Puerto Rico is a U.S. territory, its residents are American citizens, and yet the federal response to Maria was dramatically different from the response to the storms that struck the continental United States the same hurricane season.

"El Después \| The Aftermath" (Barkman, 2026)

Hurricane Harvey struck Texas in late August 2017. Hurricane Irma hit Florida a few weeks later. Maria, which was by most measures the most devastating of the three, hit Puerto Rico on September 20. In the first nine days after Harvey made landfall, survivors in Texas received more than $100 million in FEMA disaster relief. In the same period after Maria, Puerto Rico survivors received just over $6 million (U.S. Commission on Civil Rights, 2022). The

disparity was not explained by storm severity or population size. A peer-reviewed study in BMJ Global Health concluded that the federal response to Maria did not align with the storm's severity or the needs of the affected population (Willison et al., 2019).

Six months after the storm, hundreds of thousands of residents were still without electricity. A George Washington University study eventually established the death toll at 2,975, nearly 47 times the government's initial figure of 64. One third of those deaths, researchers found, resulted from delayed or interrupted healthcare, much of it caused by hospitals and clinics operating without power (PMC, 2020). The island's pre-existing $70 billion debt burden and its status as a territory, not a state, which prevented it from filing for bankruptcy, had already weakened its infrastructure and government capacity before the storm arrived (PMC, 2022).

The United States is the world's second-largest cumulative emitter of greenhouse gases. The communities most exposed to the consequences, those in hurricane belts, on low-lying coastlines, in territories without full political representation, are among those least responsible for the warming, and often the least resourced to recover from it.

Forty percent of the U.S. population lives in coastal communities (UCAR, 2025). Globally, the loss of mangroves and coastal ecosystems continues to accelerate, and with it, the removal of the natural buffers that make storms survivable. A World Bank analysis found that the greatest factor increasing the number of people at risk from storm surge developing coastal nations was not sea level rise or storm intensification alone; it was the expected loss of mangroves (Losada et al., 2013). The ecosystems themselves are the infrastructure.

"El Renacimiento | Rebirth" (Barkman, 2026)

Puerto Rico in 2017 is a case study in what ecologists call a "compound disaster," a crisis where multiple stressors compound each other into something worse than any single factor could produce. The deforestation, warming ocean, economic vulnerability, inadequate federal response: none alone was the cause. Together, they were catastrophic.

But this story does not end with the storm. Seven years later, ecologists, restoration workers, and communities across Puerto Rico are planting mangroves, rebuilding dunes, and restoring coastlines. Young Puerto Ricans are entering conservation careers specifically because Maria showed them what was at stake (NOAA Fisheries, 2024). Resilience, in ecology as in human development, is not the absence of destruction; it is what grows in the aftermath.

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