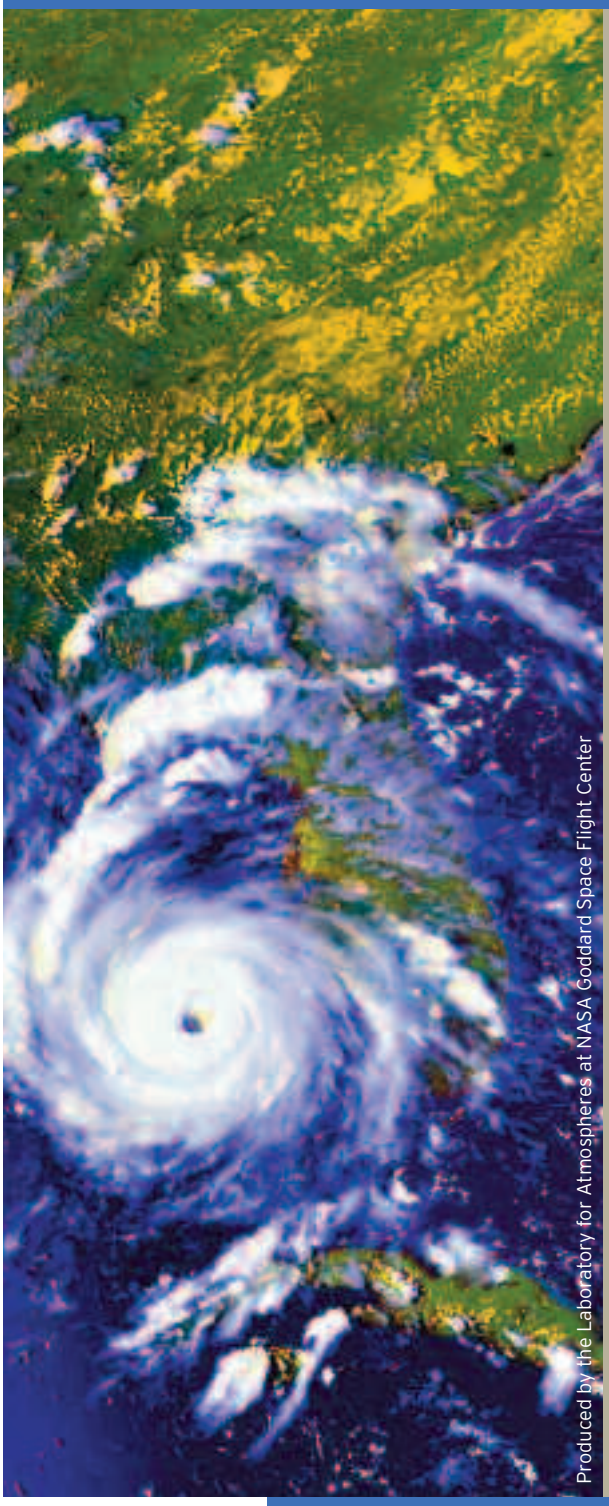
Increasing Vulnerability to Hurricanes: Global Warming's Wake-Up Call for the U.S. Gulf and Atlantic Coasts

NATIONAL WILDLIFE FEDERATION 2008



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Stronger hurricanes, heavier rainfall, and rising sea level: this is what global warming has in store for the U.S. Gulf and Atlantic coasts. The latest science indicates that hurricane wind speed will increase 2 to 13 percent and rainfall rates will increase 10 to 31 percent over this century. At the same time, sea-level rise will cause bigger storm surges and further erode the natural defenses provided by coastal wetlands that buffer storm impacts.

The rapidly expanding population and development along our coasts means that more and more people are living in harm's way. Furthermore, the current federal flood programs have exacerbated the situation by failing to discourage people from building and rebuilding in vulnerable locations and too often development occurs with inadequate environmental and safety standards.

Skyrocketing economic losses have accompanied increased hurricane activity and coastal population growth of the last few decades. For example, in the last decade, there were 12 hurricanes in the United States with damages exceeding $1 billion each, including Hurricane Katrina with losses of about $125 billion.[1]

We must take global warming into account as we prepare for future hurricanes and manage our coasts, from carefully siting new construction or reconstruction to account for rising sea level and increasing flood risks to revising building codes to account for greater wind speed. Restoring and protecting coastal wetlands, lowlands, and barrier islands—all of which provide a vital first line of defense in buffering coastal communities from hurricane-related flooding—is another cost-effective strategy for reducing vulnerability to hurricanes in many locations. At the same time, we must get at the root of the problem and reduce the global warming pollution that fuels stronger storms and leads to increasing sea level.

NATIONAL WILDLIFE FEDERATION

CONFRONTING GLOBAL WARMING Report

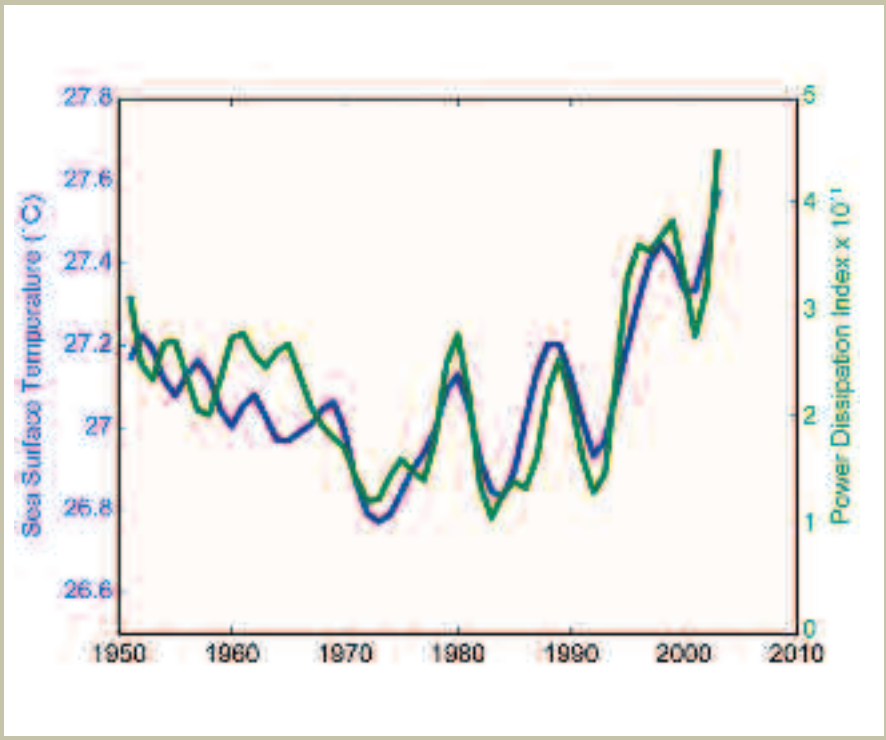
Hurricanes Getting Stronger as Oceans Warm

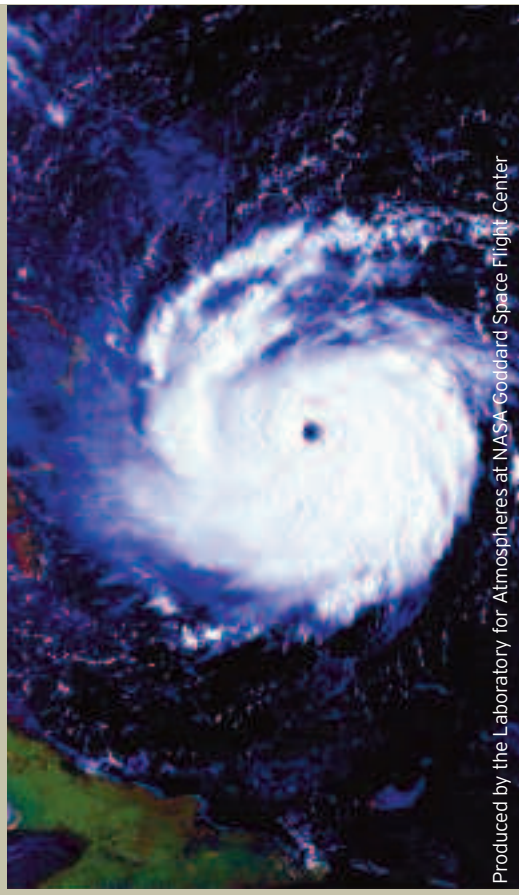

FEMA

The destructive potential of tropical storms in the North Atlantic has increased by about 50 percent since the 1970s.[2] This increase, which primarily reflects longer storm lifetimes and greater storm intensities, is correlated with an increase of 0.9 to 1.3 degrees fahrenheit in sea-surface temperatures in the main development area for tropical storms in the North Atlantic.[3] In addition, the heights of big waves—those higher than about 10 feet that are likely to be present during strong storms—have increased by 20 percent along the eastern United States during hurricane season since the late 1970s, augmenting the overall storm-related hazards for coastal communities and habitats.[4]

The frequency of North Atlantic hurricanes also appears to have increased over the last century, from an average of 3.5 per year in the early 1900s up to an average of 8.4 per year for 1995-2005.[5] This trend remains even when we account for the 1 to 3 hurricanes per year that may have been missed prior to 1965 when satellite observations became available.[6] Warming of the Atlantic Ocean is a likely explanation for this trend.[7] Natural climate oscillations may also play a role,[8] but there is good reason to expect that global warming also can modify these natural oscillations.[9]

RELATIONSHIP BETWEEN SEA SURFACE TEMPERATURES AND HURRICANE POWER IN THE NORTH ATLANTIC OCEAN

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The hurricane destructive potential as quantified through the Power Dissipation Index—a measure that combines storm intensity, duration, and frequency—is highly correlated with sea surface temperature in the tropical Atlantic, especially since 1970 when both started increasing rapidly.[10] Source: CCSP (2008a).


NOAA

More Stormy Weather Ahead

Warming of the North Atlantic along with other climate changes underway point to increasing risks associated with hurricanes. If global warming pollution continues unabated over the next century, tropical sea surface temperatures could increase another 3 degrees Fahrenheit—three times the warming to date.[11] Tropical storms are likely to bring higher wind speeds, more precipitation, and larger storm surge in the coming decades.

Surface wind speed could increase 2 to 13 percent by 2100 according to most models[12]—enough to bump a hurricane up to the next more severe category. Even small increases in wind speed have been found to cause big increases in damages. For example, a 10 percent increase in wind speed of a category 4 hurricane can increase damages by about 50 percent.[13]

Rainfall could increase 10 to 31 percent in hurricanes.[14] Because it is a law of physics that warmer air can hold more moisture, heavy rainfall events are expected to get heavier with global warming. Furthermore, changes in the broad circulation patterns of the atmosphere may cause storms to move more slowly, meaning more rainfall in a single location and a greater risk of severe flooding.[15]

Rising sea level will further compound the risk to coastal communities from hurricanes. Global warming is expected to cause 7 to 23 inches of sea-level rise by 2100,[16] and recent rapid melting of polar ice caps suggests that much more sea-level rise is possible.[17] To put this in perspective, a two-foot rise in sea level would mean regular inundation for 2,200 miles of major roads and 900 miles of railroads in Maryland,


USFWS

Virginia, North Carolina and the District of Columbia.[18] When a tropical storm hits, higher sea-level translates into bigger storm surges that can cause flooding further inland. Sea-level rise will also endanger coastal wetlands and barrier islands that form a first line of defense and help buffer coastal areas against hurricanes and storm surges.

WILDLIFE AND NATURE INCREASINGLY VULNERABLE TO HURRICANES

Hurricanes are part of the natural environment to which wildlife have adapted: species and habitats typically can rebound quickly after a storm passes through and some species even flourish in the storm aftermath. However, increasingly intense storms will likely make it more difficult for regions and wildlife to bounce back. The effects of Hurricane Agnes on the Chesapeake Bay illustrate how major flooding can devastate ecosystems. The June 1972 storm sent an enormous amount of freshwater into the bay, leading to a dramatic reduction in salinity that affected many marine fisheries for years afterward.[19] Furthermore, the 30 million tons of sediment the hurricane washed into the bay—equivalent to about seven years of deposition during normal flows[20]—increased nutrients to unhealthy levels, blocked out sunlight due to suspended particles, and buried seagrass beds that are crucial habitat for migratory waterfowl and juvenile fish.

Strong hurricane winds can wreak havoc on broad expanses of forests, causing downed trees, snapped trunks and limbs, and stripped leaves. For example, about 5 million acres of forest across Mississippi, Louisiana and Alabama were damaged by Hurricane Katrina.[21] Damaged forests increase the risk of wildfire, insect infestation, and the establishment of invasive species. Furthermore, as all the dead trees decompose, they release substantial carbon dioxide to the atmosphere, exacerbating global warming.[22]

Stronger storms combined with other factors affecting species, such as limited habitat, are expected to challenge the ability of some species to survive. Especially at risk are those species already vulnerable because of low population or reliance on isolated or limited habitats. A large storm that devastates broad expanses of ecosystem can push such species over the brink. The red-cockaded woodpeckers in South Carolina's Marion National Forest almost were an example of this when Hurricane Hugo hit the area in September 1989. About 60 percent of the 500 groups of birds perished and 87 percent of the trees containing cavities where they live were destroyed. Fortunately, other populations were not in the path of Hurricane Hugo and immediate action by the U.S. Forest Service to construct artificial cavities helped the birds recover.[23]

Jerry A. Payne, USDA Agricultural Research Service, www.forestryimages.org

Extensive Coastal Development Puts People in Harm's Way

More and more people are living along our coasts, where the impacts of hurricanes are felt the most. As of 2003, 33.1 million people lived in coastal communities along the Gulf Coast and Southeastern United States. Population in these regions is the fastest growing among coastal areas in the nation, with Florida, Texas, and North Carolina leading the way.[24] This population growth is expected to continue. For example, South Florida is projected to grow from a 1990 population of 6.3 million to a 2050 population of 15 to 30 million people.[25] This increasing coastal population is vulnerable to increasing sea level due to global warming as well as the greater risk of hurricanes.

The growing population plus increasing wealth of coastal communities is responsible for some of the increases in damages from tropical storms.[26] In addition, a significant portion of flooding losses comes from properties with repetitive flooding histories. For example, as of February 2008, Florida had 14,334 properties in coastal counties with at least two flood insurance claims paid within a 10-year period since 1978. These repetitive losses have resulted in National Flood Insurance Program (NFIP) payments of $1.12 billion.[27]

RECENT HURRICANES WITH DAMAGES EXCEEDING $1 BILLION[28]

HURRICANE NAME	WHEN	WHAT	WHERE	DAMAGES (2007 dollars)	DEATHS
Wilma	October 2005	Category 3	Florida	$17 billion	35
Rita	September 2005	Category 3	Texas and Louisiana	$17 billion	119
Katrina	August 2005	Category 3	Louisiana and Mississippi	$134 billion	1833
Dennis	July 2005	Category 3	Florida	$2.1 billion	15
Jeanne	September 2004	Category 3	Florida	$7.7 billion	28
Ivan	September 2004	Category 3	Alabama	$15 billion	57
Frances	September 2004	Category 2	Florida	$9.9 billion	48
Charley	August 2004	Category 4	Florida	$17 billion	35
Isabel	September 2003	Category 2	North Carolina	$5.6 billion	55
Floyd	September 1999	Category 2	North Carolina	$7.4 billion	77
Georges	September 1998	Category 2	Puerto Rico, Florida Keys, and Gulf coasts of Louisiana, Mississippi, Alabama, and Florida panhandle	$7.4 billion	16
Bonnie	August 1998	Category 3	North Carolina and Virginia	$1.3 billion	3

Wetlands Are the First Line of Defense Against Hurricanes


USGS

It has long been known that coastal wetlands and barrier islands serve an important role in absorbing the destructive force of hurricanes. In particular, wetlands can reduce the amplitude of storm surge by inhibiting the formation and propagation of waves.[29] Based on the experience in coastal Louisiana during Hurricanes Andrew (1992) and Rita (2005), scientists have estimated that every mile of wetlands can trim 3 to 9 inches off of a storm surge.[30] However, wetland loss has been a persistent problem along the Gulf and Atlantic coasts of the United States and will only be exacerbated by increasing sea level.

A recent study estimated that the annual value of coastal wetlands in the United States for reducing hurricane damage averages about $3300 per acre, or some $23.2 billion for the current distribution of wetlands.[31] In addition to buffering coastal communities from storms, wetlands are extremely beneficial for water purification, ground and surface water supply, and wildlife habitat. These other ecosystem services of wetlands have been valued at $4700 per acre.[32] Thus, restoring and protecting coastal wetlands is a cost-effective way to reduce the impact of storms and brings multitudes of other benefits. Strong conservation efforts will be even more crucial as sea-level rise and encroaching development squeeze coastal wetlands.

HURRICANES KATRINA AND RITA ILLUSTRATE THE VALUE OF COASTAL WETLANDS


NOAA

On August 29, 2005, Hurricane Katrina struck Greater New Orleans and the Mississippi Gulf Coast. One month later, Hurricane Rita struck the coastal plain of west Louisiana and eastern Texas. These hurricanes devastated South Louisiana, claiming 1,952 lives,[33] and destroying more than 200,000 homes and 18,700 businesses.[34]

The impacts of these hurricanes provide stark evidence that levees alone cannot protect people and communities. Levees failed in more than 50 places in Greater New Orleans, allowing storm surge to flood more than 85 percent of the city. Levee areas protected by coastal marsh and cypress forest were much less likely to breach than levee areas exposed to the full force of the storm surge.[35] Data gathered during Hurricane Rita show that storm surge is reduced by 1 foot for every 1.4 mile of coastal wetlands.[36]

Unfortunately, every day Louisiana loses an area of coastal wetlands equivalent to the size of 32 football fields. In the face of warmer climate, rising sea levels, and stronger storms, restoring our disappearing wetlands is more important than ever. Coastal wetlands and barrier islands are our first line of defense to slow down and absorb storm surge.

Preparing for Future Hurricanes and Reducing the Risk

Global warming presents new challenges for how we manage our coastal resources, especially along the Gulf of Mexico and Atlantic seaboard. We must account for increasing storm activity and rising sea level when managing our coasts, especially by discouraging development in coastal wetlands and lowlands that provide crucial natural defenses. It is paramount that sensible, science-based steps are taken to minimize risk to coastal communities and wildlife. Indeed, many strategies for managing our coasts can meet the dual objectives of increasing public safety and improving sound stewardship of our land. To achieve these goals, we must:

Reduce global warming pollution to minimize future hurricane risk. To prevent the worst impacts of climate change and limit the impacts on communities and wildlife, we must reduce global warming pollution. The National Wildlife Federation recommends that policy makers, industry, and individuals take steps to reduce global warming pollution from today's levels by at least 2 percent per year, and by 20 percent by 2020. Science tells us that this is the only way to hold warming to no more than 2 degrees Fahrenheit in the next century.[37] This target is achievable with technologies either available or under development, but we need to start taking action now.

Restore and increase protection for coastal wetlands, lowlands, and barrier islands that provide the first line of defense against hurricanes. Healthy wetlands and stronger natural barriers will reduce the dependence on seawalls, levees, and other hard structures. In certain locations with dense population, such as south Louisiana, levees close to communities can protect people while allowing wetlands to build up naturally along the coasts. In general, reliance on new levees should be discouraged and existing levees should be reviewed to consider safety levels. Restoring wetlands may bring the added benefit of improving the ability to withstand some sea-level rise.

A number of federal programs that deal with natural resources need to be updated to help keep coastal wetlands healthy. The Water Resources Development Act of 2007 authorized urgent coastal restoration projects; funding these projects should be a top priority. Other important steps include fully funding restoration programs such as the Estuaries Program and the Wetlands Reserve Program, enacting the federal Clean Water Restoration Act to reinstate protection for all wetlands and streams, and expanding the Coastal Barrier Resources System to protect more barrier islands and other coastal areas.

Take global warming into account when choosing *where* to build. With the National Flood Insurance Program (NFIP) more than $17 billion dollars in debt,[38] it is both fiscally and environmentally irresponsible to encourage development in flood prone areas. Instead, the Federal Emergency Management Administration (FEMA) should recommit to a national hazard mitigation policy that emphasizes placing homes and businesses in areas safe from flooding, leaving flood plains open to absorb flood water.

Take global warming into account when choosing *how* to build. FEMA should require shoreline building setbacks and increased building elevations to account for increasing sea level and flooding potential. Building codes and land-use regulations should be strengthened to take into account the likely increase in wind speeds and related storm impacts associated with more intense storms.

Prioritize Army Corps of Engineers projects. The Corps currently has $81 billion of congressionally authorized, but not-yet-constructed projects on the books,[39] and a construction budget of only $2 billion per year. Because of this huge project backlog, many of our nation's most pressing water infrastructure needs are not being met. We need a comprehensive prioritization system to ensure that Congress directs limited federal resources to meeting the nation's most urgent public safety and ecosystem protection and restoration needs.

Reform National Flood Insurance Program, strengthen community land-use and building standards, and update flood hazard maps to reduce unwise floodplain development, preserve open space and wildlife habitat, and improve public awareness of flooding risks. People living in floodplains—even low-risk floodplains—need to know they are at risk as global warming brings heavier rainfall, slower moving storms, and sea-level rise. Therefore, floodplain planning and maps must incorporate future conditions, including effects of urbanization and changing climate. Simply relying on past flooding histories is not enough. Although assistance should be provided to help communities at risk respond to and adapt to changing conditions, Congress should not expand flood insurance to add wind coverage or make taxpayers responsible for natural catastrophe reinsurance. Instead, Congress should

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set NFIP rates to reflect true risks and, where necessary, establish needs-based assistance to help lower-income residents obtain insurance. Overall, efforts must be expanded to improve hazard identification and public awareness, increase standards, improve land-use planning, and aggressively pursue hazard mitigation.


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Endnotes

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