

Climate change poses various threats to Florida's ecosystems and citizens

# Brace for IMPACT

“Colleagues, we are on a road to ruin. But these are not future problems. Climate change is already here,” COP29 President-elect Mukhtar Babayev said while addressing world leaders during the opening ceremony of the 29th Conference of the Parties—an important meeting on climate change.

In 2024, Florida experienced its hottest summer on record, and globally, it was the warmest year on record, according to the 2024 Annual Florida Weather and Climate Summary by the Florida Climate Center. Climate change and global warming are not only real, but pervasive, and Florida is on the front line.

“Our low-lying topography... and the fact that we’re surrounded by water make us very vulnerable to sea level rise and storms of increasing intensity,” Florida and Caribbean Director and Senior Attorney for the Center for Biological Diversity Elise Bennett said. “Our aquifer is also vulnerable to saltwater intrusion, which puts our drinking water at risk. We’re also seeing more dangerously hot days here.”

The September 2023 edition of the Florida Climate Resilience Survey by Florida Atlantic University found that 90% of respondents believe climate change is happening, and 69% support government action at the state level, and 70% support government action at the federal level to address its effects.

Many Floridians have, after all, experienced the ramifications of weather events that were undoubtedly

Sea level rise is one of the greatest threats to Florida stemming from climate change. As temperatures warm, heat causes water to expand and consequently rise. Sea level rise increases the potential for coastal flooding, which Florida is especially vulnerable to given its low elevation, long coast, flat topography and limestone bedrock.

In fact, the 2025 Climate Central report “Coastal Flood Risk Across the U.S.,” reported Florida is the state most in danger of “severe coastal flooding” by 2050. This means that Floridians and their properties are in peril; over 16 million people in Florida are coastal residents as of March 2025, according to the National Oceanic and Atmospheric Administration. This is more than half of Florida’s total population.

“According to NOAA Florida has 8,436 miles of shoreline, all of it threatened by sea level rise,” Professor and Environmental Science BS Program Manager at Broward College David Serrano said. “This includes high value properties such as resorts, hotels, national parks and private residences that generate billions for Florida in economic metrics. [We can address this via] infrastructure improvements and storm hardening/resilience projects. Programs such as Fortify Lauderdale, [FPL’s Storm Secure Underground Program] and updating city stormwater master plans are essential to mitigate Florida vulnerability. Legislators can prioritize funding for such projects.”

Even Broward County will endure the effects of coastal flooding if the county’s goals for reducing

greenhouse gas emissions remain as they are. Climate Central’s Coastal Risk Finder indicates that 1,700 people and 1,200 homes in the county will face flooding by 2050 under the current goals.

“I think it [coastal flooding] is definitely concerning,” Goldstein said. “I’ve been seeing

a bunch of visuals that a lot of Florida’s going to be under water in the next 100 years and with already a housing crisis and a whole bunch of different problems that come with that like... biodiversity loss, it’s very worrying the fact that climate change is on such a rise that this is something we genuinely have to worry about.”

Residents of coastal communities are bound to have their daily lives impacted by coastal flooding if sea levels continue to rise as they are projected to. Businesses and services, including schools and hospitals, may shut down, transportation may be impeded, power supplies may be disrupted, homes may be flooded and ultimately, peoples’ lives may be threatened, all due to climate change.

Further, in response to the increased threat of flooding, coastal communities will inevitably migrate inland. This leads to a process called secondary displacement, or the emigration of residents from receiving communities after wealthier coastal residents increase property values.

For example, a 2021 study funded by the LeRoy Collins Institute at Florida State University found that 30%, 25% and 20% of the census block groups of Duval, Miami-Dade and Pinellas Counties, respectively, face high risk of secondary displacement.

“Receiving communities are likely to be historically



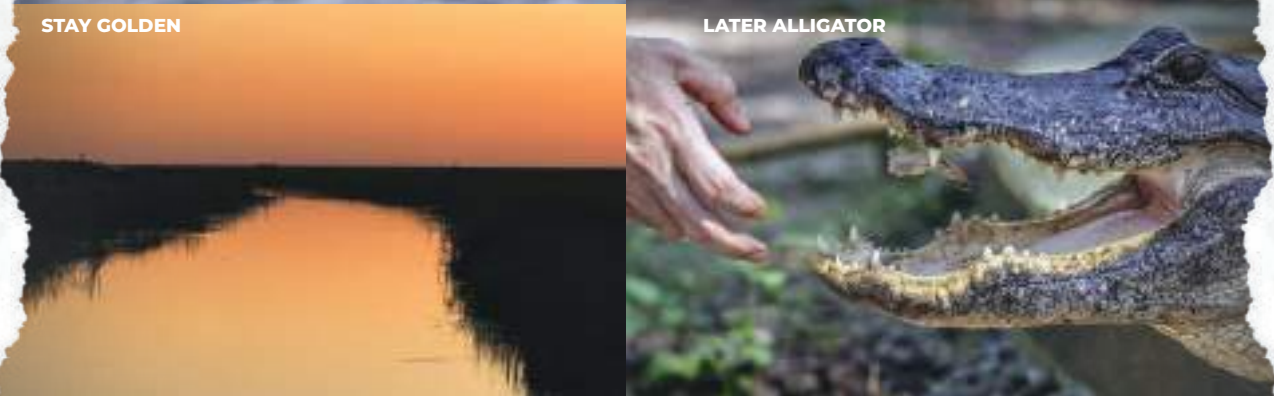
INTO THE WOODS



DARWIN'S FINCHES



PRETTY IN PINK



LATER ALLIGATOR

STAY GOLDEN

**INTO THE WOODS.** Cypress trees stand tall in Big Cypress National Preserve in Miami, Florida. **PHOTO PERMISSION FROM** Jose A. Iglesias/Tribune News Services

**DARWIN'S FINCHES.** One the most endangered birds on the planet, the Cape Sable seaside sparrow, rests in the hand of Stuart Pim, an ornithologist who is studying the birds that number about 2,500 in Everglades National Park. **PHOTO PERMISSION FROM** Tim Chapman/Miami Herald Staff/Tribune News Service

**PRETTY IN PINK.** A flock of flamingos sit on a mud flat in Florida Bay on the edge of the Florida Everglades. **PHOTO PERMISSION** from Tribune News Service

**STAY GOLDEN.** The sun sets over the Everglades on April 12, 2025. **PHOTO BY** Victoria Damaso.

**LATER ALLIGATOR.** Chris Gillette feeds an alligator named Bella a piece of shrimp at his animal sanctuary, called Bellowing Acres, in Ocala, Florida on Wednesday, Sept. 18, 2024. **PHOTO PERMISSION FROM** Al Diaz/Miami Herald Staff/Tribune News Service

underinvested and marginalized neighborhoods,” Jayson Velazquez said in a 2024 Yale Environmental Review article. “Analyzing the demographic characteristics of these receiving communities will help predict the social landscape where the bulk of migrants will settle. Therefore, policymakers and planners in receiving communities must balance serious quality of life needs for residents and newcomers, while avoiding secondary displacement.”

In neighborhoods of lower socioeconomic statuses, redevelopment projects undertaken without protections for affordable housing that attempt to remedy climate-related problems contribute to secondary displacement. The 2022 United Nations' Intergovernmental Panel on Climate Change report stated that “Miami-Dade’s efforts to raise roads and build stormwater pumps have raised property values, leading to inequality for vulnerable populations,” for instance.

## Aquifers

Saltwater intrusion in aquifers has also been exacerbated in Florida as a result of sea level rise.

Aquifers are underground layers of rock saturated with groundwater. The groundwater found in aquifers below land surfaces is typically freshwater, and the freshwater is replenished by rainwater that infiltrates the ground. Freshwater aquifers are often used to supply drinking water, as well as for agricultural, industrial and other domestic purposes.

The Floridan Aquifer System is one of the most productive aquifers in the world and serves as the primary source of drinking water for about 10 million people, according to the “Floridan Aquifer System Groundwater Availability Study” by the U.S. Geological Survey. The aquifer is located beneath all of Florida, in addition to parts of Georgia, Alabama, Mississippi and South Carolina.

Florida is also home to the Biscayne Aquifer, which serves as South Florida’s principal source of drinking water, including Miami-Dade and Broward County. The FAS and Biscayne Aquifer are both made of carbonate rock, particularly limestone and dolostone. This trait lends them a high porosity and permeability, making them very productive as aquifers but also very susceptible to the effects of sea level rise.

“Florida’s geography as a peninsula between two bodies of saltwater creates the potential for saltwater intrusion into the aquifers,” Tara Wade and Tatiana Borisova said in a 2022 University of Florida’s Institute of Food and Agricultural Sciences article. “...In some places, excessively pumping a well can increase saltwater intrusion. If water is pumped at a rate faster than the aquifer is replenished, the pressure of freshwater over saltwater in the land mass is decreased. This decrease may cause the level of the saltwater-freshwater interface to rise in the aquifer, degrading water quality.”

Sea level rise, in combination with over-extraction, is causing saltwater intrusion.

As sea levels rise, hydraulic pressure increases, pushing saltwater deeper into the aquifers. Over-extraction then contributes by lowering the freshwater table, which is the boundary between an aquifer and ground unsaturated with water. This creates a “cone of depression,” an area where groundwater levels are reduced around wells. The decreased pressure from the freshwater table allows saltwater to move in and fill the empty space.

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me] because it means that the aquifers could become impure, and it could make it a lot harder and more energy consuming to convert the saltwater into drinkable water which could increase water prices,” sophomore Alvin Cao said.

Maps from the Saltwater Interface Monitoring and Mapping Program, implemented by the South Florida Water Management District, show that since 2019, the saltwater interface—the boundary between freshwater and saltwater in aquifers—has moved inland significantly. Cities in Broward County have seen some of the most drastic changes. Davie, for instance, has seen an inwards shift of four miles.

Since groundwater is used for drinking water, and groundwater is becoming more saline due to saltwater intrusion, treatment costs are going to increase. This is because saline water poses health problems such as kidney damage and hypertension.

Then, if the saltwater intrusion is excessive enough to render a well useless, it would need to be moved, which is a costly endeavor.

“For the past few years, Everglades National Park has placed notices at the Flamingo campsite bathrooms that the water has elevated sodium levels,” Serrano said. “Last I saw, a couple years back, the signs stated the water was within drinkable range but of concern for people that had issues—high blood pressure, etc. At some point, the level

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**Alvin Cao, 10**

will be too high, requiring the park to begin the costly project of bringing piped city water to the site.”

Water from aquifers is not just used as drinking water though; it is also used for agricultural purposes, often being extracted to use in irrigation systems to water crops. If crops are being watered with saline water, crop yield and quality may be adversely affected.

“Agricultural production has also been affected [by saltwater intrusion], with many wells showing elevated salt levels meaning alteration of soil management and eventual loss of that ‘free’ water source which will increase production costs,” Serrano said.

## Hurricanes

Climate change is causing hurricanes to strengthen, leaving Florida’s Big Bend highly vulnerable due to its proximity to the Gulf of Mexico, recently renamed the Gulf of America by President Donald Trump in Executive Order 14172. This was seen with the hurricanes Helene and Milton, which hit Florida in September and October 2024, respectively.

“I feel like climate change did impact the previous hurricanes simply due to how hurricanes work, and everything that’s involved with their formation,” freshman Ariana Maisanova said. “It scares me a little bit... because I feel like as climate change starts to become a bigger and bigger thing I’m scared that hurricanes are going

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to get bigger too. Especially because we know how bad and impactful the last hurricanes were, it just seems like everything else is going to become a lot worse.” According to the Florida Climate Center, sea levels on Florida’s Gulf Coast are six inches higher than they were a few decades ago, and this trend is only accelerating. The federal



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Ariana Maisanova, 09

government’s Fifth National Climate Assessment found that between 2020 and 2050 the Western Gulf Coast will experience an average sea level rise of 12-16 inches. When water levels are higher storm surges push further inland.

“Experts have documented a substantial increase for most measures of Atlantic hurricane activity since the early 1980s, including the number of strong-category four and five-storms,” Bennett said. “They predict that we will continue to see more storms of greater intensity. These storms threaten human communities in Florida because of the dangerous winds and flooding, which is also exacerbated by rising sea levels. People in my own community have lost their homes because of these storms. These storms also create a greater risk of dangerous pollution events, though fortunately, with Milton, we were lucky this time. These storms also threaten our biodiversity.”

Studies have proven that just small increases in sea level rise greatly increase storm surge damage. Hurricane Sandy proved this in 2012.

The 2021 Climate Central paper “Economic damages from Hurricane Sandy attributable to sea level rise caused by anthropogenic

climate change” describes how up to \$8.1 billion of the damage caused by Sandy across New York, Connecticut and New Jersey can be attributed to sea level rise.

Since 1900, anthropogenic global warming, or human-caused global warming, can definitively be attributed to 3.8 inches of sea level rise in New York City. The paper details how Hurricane Sandy’s storm surge in the tri-state area would have impacted 71,000 (8.8%) fewer people, 36,000 (8.8%) fewer housing units and caused 13% less storm damage had sea levels been 3.8 inches lower.

Also, hotter than normal ocean temperatures cause hurricanes to intensify more quickly: the warmer the temperature, the more energy available for storms to use. This finding was validated by the 2023 paper “Observed increases in North Atlantic tropical cyclone peak intensification rates” published in Scientific Reports, which suggests that weak hurricanes and tropical storms in the Atlantic basin—which includes the Gulf—may be twice as likely to strengthen into a major hurricane in 24 hours as a result of hotter ocean temperatures.

Climate Central’s Climate Shift Index found that human-induced climate change made warmer sea surface temperatures in the Northern Caribbean and Eastern Gulf of Mexico 200-500 times more likely. Both of these locations comprised Hurricane Helene’s path, and Hurricane Helene itself rapidly intensified before hitting the Big Bend.

“The hurricanes have been getting stronger according to the news. Normally I hear about Category 5 hurricanes and I think that that’s becoming a lot more frequent and normal,” senior Matthew Toussaint said. “Hurricanes happen without climate change, but climate change is definitely speeding up intensification where it wasn’t before.”

A similar phenomenon was seen with Hurricane Milton. Milton peaked twice in the Southern Gulf of Mexico, making it one of the five most intense Atlantic storms on record. At the same time Milton was located in the area, a marine heatwave was occurring.

In the Gulf of Mexico, marine heatwaves make rapid intensification 50% more likely on average, as reported in the 2024 study “Rapid Intensification of tropical cyclones in the Gulf of Mexico is more likely during marine heatwaves.”

The Gulf Coast is additionally vulnerable to flooding from hurricanes as a result of seagrass loss. The northeastern portion of the Gulf of Mexico is the location of the continental U.S.’ second largest contiguous seagrass meadow. The 2023 study “Extensive and Continuing Loss of Seagrasses in Florida’s Big Bend (USA)” published in the journal Environmental Management, discovered that between 2001 and 2022, 15% of the meadow’s area was lost.

“The lack of seagrass means more waves and stronger hurricanes,” Goldstein said. “Typically what they do is they block the impact from actually reaching the shore, similar to how our mangrove trees work. The lack of that is going to keep causing a positive feedback loop, where it just gets worse and worse until there’s nothing we can do about it.”

Typically, seagrass serves as a buffer, stabilizing sediments and absorbing wave energy so as to reduce the effects of storm surges. A loss of seagrass along Florida’s Gulf Coast means that the area is more susceptible to the damage posed by future hurricanes.

### Coral Reefs

The Florida Reef, located near the Florida Keys, is the only living coral reef system in the continental U.S. Reefs are the most biodiverse aquatic ecosystems, providing a vast variety of marine organisms with shelter, breeding sites and food. Plus, they benefit people by helping mitigate strong waves, pollution and ocean acidification.

All of these benefits are at risk of disappearing if global warming continues to kill coral via a process known as bleaching.

“The climate emergency, along with thoughtless human development, is directly tied to current and predicted global biodiversity loss—and each species lost is the loss of another thread in the fraying fabric of life that supports us all,” Bennett said. “These species have an inherent right to exist, and we shouldn’t take that from them. Moreover, whether it’s insects, bats, and birds that help pollinate our food, coral reefs that serve as the nurseries for our fisheries, freshwater mussels that filter our water, or the tiniest microbes that keep our soils healthy, we need biodiversity for our own health and happiness.”

Coral are dependent on a type of algae called zooxanthellae for the proteins and sugars they need to survive. The coral and algae have a symbiotic relationship, and the algae are responsible for coral’s color. When ocean temperatures get too warm, zooxanthellae get stressed out and leave the coral, causing them to lose their pigment and starve.

“I’m in AP Enviro right now, and it’s extremely glaring how applicable what we’re learning about is to what is going on in the world today,” junior Lia Schwartz said. “We talked about coral bleaching in class and to know that it’s a genuine threat to aquatic ecosystems right now is such a sad reality for Florida. We are in part to blame too as we contribute to global warming, so it’s really disappointing to witness.”

In the summer of 2023, the Florida Keys experienced a marine heatwave that extensively harmed the Florida Reef. The heat wave constituted the hottest temperatures ever recorded in the region during the satellite record,

according to the NOAA. These temperatures exceeded the coral’s threshold for bleaching and occurred for a prolonged period of time, leading to mass-mortality.

Even prior to this event though, the coral in the Keys were suffering. The NOAA has seen a 90% decline in healthy coral cover in the Florida Keys since the late 1970s. The 2023 mass bleaching event only made a bad situation worse.

“[The reef decline] does upset me because they look pretty cool, and they also are really good habitats for marine organisms,” freshman Shia Ogilvie said. “If they decline, marine organisms also decline, which is not good. [Plus,] our tourism will also decline because it means less attraction, and our economy is also going to go down.”

The NOAA’s Mission: Iconic Reef program began in 2019 as a means of restoring South Florida’s reefs. To do so, coral colonies were out-planted on seven ailing reefs in the area. The aforementioned heat wave proved costly for the program’s efforts and led many involved with the project to rethink the effectiveness of their approach.

Staghorn and Elkhorn coral are federally protected species under the Endangered Species Act, with both designated as threatened. These species are easy to propagate and have thus been favored in restoration efforts, including Mission: Iconic Reef’s.

In February 2024, after the heat wave, a team of NOAA researchers surveyed the Mission: Iconic Reef sites. Across five of the seven sites, under 22% of the 1,500 out-planted staghorn were still alive and under 5% of the 1,000 out-planted elkhorn were still alive. No staghorn or elkhorn coral were found alive at all in the surveyed sample areas of the Looe Key Reef.

Had there been no intervention by coral practitioners, the possibility looms that all of the wild staghorn and elkhorn coral in the Keys could have been lost.

“[Reef decline] does upset me a little because the coral reefs are supposed to be there to help the ocean and marine life, and without the coral, then the ocean ecosystem could be out of balance which could cause problems,” sophomore Alvin Cao said. “It could mean that Florida’s tourism could get worse too.”

Coral bleaching is not just a threat to biodiversity, but a threat to the state of Florida. The Florida Department of Environmental Protection states on their website that “the total tourism value of Florida’s Coral Reef is estimated at \$1.1 billion annually. Coral reefs are estimated to annually support 71,000 jobs in South Florida.” With reefs dying, Florida is susceptible to losing a great deal of money—\$55 billion in reef-related tourism money by 2100, as stated in the IPCC report, to be exact.

“Florida’s GDP has tourism as a heavy component” Serrano said. “Loss of reefs, shorelines and recreation translates to billions of dollars of business loss and thus the accompanying tax revenue.”

Reefs are particularly beneficial to a place such as Florida, that is frequently subject to hurricanes. The 2020 NOAA Coral Reef Status Report states that healthy reefs can absorb 97% of wave energy from hurricanes and storms, so to ensure the Florida Reef is thriving is to ensure that the state of Florida is better protected.

### Florida Legislature

Human-caused climate change is a risk to the ecosystems and the people of Florida. The burning of fossil fuels releases heat-trapping greenhouse gases into the atmosphere, effectively contributing to coastal flooding, saltwater intrusion, the intensification of hurricanes and coral bleaching, all of which Florida is uniquely vulnerable to.

Former Florida Gov. Charlie Crist recognized the potential for such consequences over a decade ago when he implemented measures to reduce greenhouse gas emissions and increase renewable energy usage.

On May 15, 2024, current Gov. Ron DeSantis signed House Bill 1645 into law. This law went back on much of what was left of Crist’s policy, which was previously dismantled by former Gov. Rick Scott and even Crist himself starting in 2009 when he attempted to run for the U.S. Senate.



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Lia Schwartz, 11

encourage more nuclear power development, among other things.

Natural gas accounted for three-fourths of Florida’s in-state net generation of electricity in 2021 and is distributed via five interstate pipelines according to the U.S. Energy Information Administration. Clearly, it is a major source of electricity in the state.

Given this information, some environmentalists posit that this law is simply another way Florida legislators are doing the bidding of the natural gas industry.

“Floridians are on the frontlines of rising sea levels, rising extreme heat, rising property insurance prices, more frequent flooding, and more severe storms,” Executive Director of the CLEO Institute Yoca Ardití-Rocha said in a statement released on May 15, 2024. “This purposeful act of cognitive dissonance is proof that the governor and the state legislature are not acting in the best interests of Floridians, but rather to protect profits for the fossil fuel industry.”

The Florida Legislature has, however, committed a lot of money to helping the state’s infrastructure better adapt to increasing sea levels and temperatures. What the Florida Legislature is not doing, according to critics, is committing money to addressing the root cause of the issue, nor to protecting nature.

“The Florida Legislature is not helping Floridians curb the driver of climate change: pollution from burning fossil fuels,” Bennett said. “Instead, they appear to be denying the existence of climate change. Last year, the legislature passed and Governor DeSantis signed a law that removes mention of climate change from state statutes. Florida lawmakers are also not doing enough to prepare communities for the extreme weather, extreme heat, and flooding that are being driven by climate change. For example, protecting wetlands is important to buffer communities from storm surge and flooding; however, legislators have been weakening laws that manage human development away from important environmental resources like wetlands while environmental officials continue to issue permits for extensive wetland destruction across the state.”

Consequently, many concerned parties argue that until legislators are willing to recognize the continued threats of climate change, the state, its citizens and its ecosystems will remain in jeopardy.

STORY BY Andie Korenge