THE CLIMATE IS CHANGING AND SO MUST WE: THE NEED TO PRIORITIZE AT-RISK COMMUNITIES AND ECOSYSTEMS

Jaclyn Lopez*

ABSTRACT

The climate is changing, and our laws and policies threaten to leave behind vulnerable communities and ecosystems. About half of the people and imperiled plants and animals in the United States are in coastal counties. Coastal communities' ability to cope with the impacts of climate change will depend on how well local adaptation and resiliency laws and policies work to protect them from rising seas, flooding, saltwater intrusion, intensifying storm activity, and increased heat indices. At the same time, these very same adaptation laws and policies may inadvertently harm vulnerable communities and biodiversity. By 2040 – when today's kindergarteners graduate college – Florida's population will increase by 20% and sea levels will rise an additional foot. With its low elevation and location at the end of Hurricane Alley, Florida is "ground zero" for climate change impacts in the United States. The region's struggles with industrial pollution create additional risk factors. Marginalized communities and imperiled biodiversity are caught amid climate impacts and existing, dangerous infrastructure. Florida is an apt case study for exploring concepts such as managed retreat, social vulnerability, species extinctions, assisted migration, and adaptive management. This Article concludes by making

* Jaclyn Lopez is an assistant professor and the director of the Jacobs Public Interest Law Clinic for Democracy and the Environment at Stetson University College of Law. She wishes to thank Professor Hubertz, Matthew Schubert and Matthew Cole, and the editorial staff for their encouragement and thoughtful review. This article benefited from feedback received at the Vermont Law and Graduate School's Colloquium on Environmental Scholarship in September 2023. The author litigated some of the cases referenced in this Article, but all opinions expressed in this Article are her own, as are any errors. *See* William D. Douglas, *Law Reviews and Full Disclosure*, 40 Wash. L. Rev. 227, 232 (1965).

general recommendations for local governments looking to proactively center their resiliency and adaptation efforts on the survival of vulnerable communities and imperiled plants and animals.

INTRODUCTION

In the realm of medicine, resilience is "the ability to adapt to change and recover quickly from setbacks such as illness, injury, or misfortune."[1] Someone who is resilient can stave off disease, accelerate healing after trauma, and have a generally good quality of life. After being repeatedly bashed by hurricanes, major storms, and flooding over the last decade, coastal communities in the southeast are – or should be – scrambling to rebuild for resilience. These destructive climate events have a human cost as well as an economic one. With nearly 40% of the people in the nation living in coastal counties,[2] local communities face the tall order of adapting to the new normal of climate change. Unfortunately, climate change is characterized by rising sea levels at unprecedented,[3] and potentially, unpredictable rates.[4] Extreme coastal and inland flooding is becoming more common, as are hurricanes, saltwater intrusion, heat waves, and now heat domes.[5] Coastal communities also often have significant concentrations of industrial activity, and with it, the potential for industrial pollution and related weather accidents.[6]

Meanwhile, as a consequence of climate change, we find ourselves in a new epoch – the Anthropocene – named for the vast human impacts on Earth.[7] Studies project global extinction rates of 15-37%, with 58% of plants

1. Harvard Med. Sch., *Medical Dictionary of Health Terms: Q-Z, Harvard Health* (Dec. 13, 2011), https://www.health.harvard.edu/q-through-z#R-terms [perma.cc/4ZFU-WXQK]; Romana Babić et al., *Resilience in Health and Illness*, 32 PSYCHIATRIA DANUBINA 226 (2020).

2. *What percentage of the American population lives near the coast?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html [https://perma.cc/K3VJ-WWYY].(last visited Feb. 25, 2024).

3. Sonke Dangendorf, et al., *Acceleration of U.S. Southeast and Gulf coast sea-level rise amplified by internal climate variability*, 14 NATURE COMMC'NS April 2023, at 2.

4. D. Holland and D. Holland, *On the Rocks: The Challenges of Predicting Sea Level Rise*, (Oct. 19, 2015), https://eos.org/features/on-the-rocks-the-challenges-of-predicting-sea-level-rise, [https://perma.cc/5W8G-AV4P].

5. *See* discussion *infra* Part II.

6. *Id.*

7. Naomi Oreskes, *Calling Our Times the 'Anthropocene Epoch' Matters Dearly to You*, Scientific American (Jan. 1, 2024), https://www.scientificamerican.com/article/calling-our-times-the-

and 35% of animals losing more than half their habitat by 2080.[8] A recent study of more than 8,000 amphibians found that they are the most threatened vertebrate class, with more than 40% globally threatened, and the leading cause is now climate change.[9]

As coastal communities, specifically local governments, rebuild and look ahead to the challenges of climate change, they must prioritize their most vulnerable populations and ecosystems for resiliency planning.[10] Florida is one of the fastest-growing states, and the majority of its population and economic engine are in its coastal communities.[11] More than half of Florida's municipalities will be affected by sea level rise, threatening local economies.[12] Managed retreat and assisted migration are policy prescriptions for addressing at-risk communities and ecosystems,[13] but they are wrought with their own challenges.

Part II of this Article examines how climate change is affecting where and how people, plants, and animals live. It argues that collectively, we are reacting—but not adapting—to climate change, often with grave casualties. It explains climate change is already happening: we are already navigating its heat waves, storm events, and flooding. Communities are already forced to make difficult decisions about their future health and safety. Plants and animals are already facing climate-induced extinctions. Part III of this Article highlights examples of how adaptation strategies often ignore or inadequately address the needs of our most vulnerable communities and ecosystems. Part IV brings Florida's efforts into focus. Florida provides a good case study of the threats state and local communities face and how they are reacting to them. Florida is already suffering from the climate stressors of sea level rise, flooding, and heat.[14] It also has one of the fastest-

---

anthropocene-epoch-matters-dearly-to-you/, [https://perma.cc/AYY7-M9R5].

8. Chris D. Thomas et al., *Extinction Risk from Climate Change*, 427 NATURE 145, 145 (2004).

9. Jennifer Luedtke et al., *Ongoing Declines for the World's Amphibians in the Face of Emerging Threats*, 622 NATURE 308, 308, 311 (2023).

10. Reed F. Noss, *Between the Devil and the Deep Blue Sea: Florida's Unenviable Position with Respect to Sea Level Rise*, 107 CLIMATE CHANGE 1, 11-13 (2011).

11. Mark Perry, Luke Rogers, & Kristie Wilder, *Florida Fastest-Growing State for First Time Since 1957*, U.S. Census Bureau (Dec. 22, 2022), https://www.census.gov/library/stories/2022/12/florida-fastest-growing-state.html [perma.cc/RUC6-MUGW].

12. Linda Shi et al., *Can Florida's Coast Survive Its Reliance on Development?*, J. AM. PLAN. ASS'N 1, 1 (2023).

13. *Infra* IIIb.

14. Three of the top five cities most vulnerable to hurricanes are in Florida (the Keys, Miami,

growing populations,[15] especially among some of the more vulnerable populations,[16] and ranks high in both biodiversity and extinction threats.[17] Part V offers broad recommendations for framing resiliency planning for local governments moving forward.

I. CLIMATE CHANGE IS AFFECTING WHERE AND HOW PEOPLE AND BIODIVERSITY CAN LIVE.

The climate is changing, and so must we.[18] Climate change is already redefining what it is like to live in coastal areas, especially in the southeast United States.[19] The seas are higher, especially during king tides and storms.[20] Neighborhoods are flooding more than ever before.[21] The air is hotter, especially at night.[22] Threats of industrial pollution loom large.[23]

---

and Tampa). Kevin France, *Top 5 US cities most vulnerable to hurricanes*, ACCUWEATHER, https://www.accuweather.com/en/weather-news/top-5-us-cities-most-vulnerable-to-hurricanes/359885 [https://perma.cc/L4FF-49LQ] (last visited Nov. 13, 2023).

15. *Florida Fastest-Growing State for First Time Since 1957*, U.S. CENSUS BUREAU (Dec. 22, 2022), https://www.census.gov/library/stories/2022/12/florida-fastest-growing-state.html, [https://perma.cc/RUC6-MUGW].

16. Jens Manuel Krogstad, *Hispanics have accounted for more than half of total U.S. population growth since 2010*, PEW RSCH. CTR. (July 10, 2020), https://www.pewresearch.org/short-reads/2020/07/10/hispanics-have-accounted-for-more-than-half-of-total-u-s-population-growth-since-2010/, [https://perma.cc/V5HG-6LRH]; William H. Frey, *Six maps that reveal America's expanding racial diversity*, BROOKINGS (Sept. 5, 2019) https://www.brookings.edu/articles/americas-racial-diversity-in-six-maps/, [https://perma.cc/T2WY-6DYD].

17. Beth Stys et al. *Climate Change Impacts on Florida's Biodiversity and Ecology*, in FLORIDA'S CLIMATE: CHANGES, VARIATIONS, & IMPACTS 339 (2017).

18. CYNTHIA KAUFMAN & BILL MCKIBBEN, THE SEA IS RISING AND SO ARE WE: A CLIMATE JUSTICE HANDBOOK (2021).

19. *Climate Mapping for Resilience and Adaptation*, U.S. GLOB. CHANGE RSCH. PROGRAM, https://resilience.climate.gov/ [https://perma.cc/S364-S4FB] (listing five climate-related hazards: wildfire, drought, inland flooding, coastal flooding, and extreme heat).

20. King tides are unusually high tides that occur seasonally and near the full and new moon. *What is a King Tide*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/kingtide.html [https://perma.cc/N4TN-BEKJ] (last visited Feb. 25, 2024).

21. Evelyn G. Shu, *Integrating climate change induced flood risk into future population projections*, 14 NATURE COMMC'NS, December 2013, at 5.

22. Jennifer Runkle et al., *State Climate Summaries 2022 Florida*, NAT'L CTRS. FOR ENV'T INFO., https://statesummaries.ncics.org/chapter/fl/#:~:text=By%202050%2C%20most%20of%20the,precipitation%20and%20drought%20are%20projected [https://perma.cc/4HUE-TUEY].

23. U.S. GOV'T ACCOUNTABILITY OFF., GAO-22-104494, REPORT TO CONGRESSIONAL REQUESTERS: CHEMICAL ACCIDENT PREVENTION – EPA SHOULD ENSURE REGULATED FACILITIES CONSIDER RISKS FROM CLIMATE CHANGE, (2022); Mark Schleifstein, *I've Investigate Industrial*

Plants and animals are in steep decline at an alarming rate.[24] The situation is projected to get much worse. Studies predict that by the end of this century, 13 million Americans may be forced to migrate when climate change transforms their environment so drastically that it is no longer ideal for supporting human life.[25]

Like the rest of the southeast, Florida is suffering from virtually all of the well-known climate impacts, including sea level rise, storms, flooding, and heat.[26] It is well-settled that climate change is a major threat to the existence of Florida's natural ecosystems, and vulnerable coastal communities are at significant risk of harm. Florida is a long, narrow peninsula, yet has the third largest population in the United States,[27] so every square inch is valuable. The majority of Floridians live in coastal counties,[28] and no one is ever more than 60 miles from the coast.[29] Nearly 500,000 Floridians live on land less than three feet above sea level,[30] a quarter of them are classified as socially vulnerable, and 55,000 of them are medically vulnerable.[31] The predicted 10 inches of sea level rise by 2040 threatens to put 300,000 homes and $145 billion in property at risk of

Pollution for 35 Years. We're Going Backwards, TIMES-PICAYUNE (Oct. 30, 2019) available at https://www.propublica.org/article/ive-investigated-industrial-pollution-for-35-years-were-going-backwards#.

24. IPBES, SUMMARY FOR POLICYMAKERS OF THE GLOBAL ASSESSMENT REPORT ON BIODIVERSITY AND ECOSYSTEM SERVICES OF THE INTERGOVERNMENTAL SCIENCE-POLICY PLATFORM ON BIODIVERSITY AND ECOSYSTEM SERVICES 11–12 ((Sandra Díaz, et al. eds. 2019).

25. Abrahm Lustgarten & Meridith Kohut, *How Climate Migration Will Reshape America, N.Y. TIMES MAG.,* Sept. 15, 2020, at 10 (citing Mathew Hauer et al., *Millions Projected to Be at Risk from Sea-Level Rise in the Continental United States*, 6 NATURE CLIMATE CHANGE 691, 691 (2016)).

26. Alex Harris, *Climate change has 'irreversibly' changed Florida, a new global report says*, PHYS.ORG (Feb. 28, 2022),https://phys.org/news/2022-02-climate-irreversibly-florida-global.html, [https://perma.cc/6J22-VS4U] .

27. *US States By Population*, WORLDATLAS (last visited Jan. 2, 2024), https://www.worldatlas.com/geography/us-states-by-population.html [https://perma.cc/3L5T-4WPL].

28. *Florida Population (2021)*, COUNTRY DIG. (Sept. 4, 2021), https://countrydigest.org/florida-population/#., [https://perma.cc/FF5C-9NP7].

29. *Interesting Geography Facts About Florida*, GEOGRAPHY REALM, (updated August 23, 2023), https://www.geographyrealm.com/interesting-geography-facts-about-florida/, [https://perma.cc/A499-8LKE].

30. Daniel Raimi, et al., FLORIDA CLIMATE OUTLOOK: ASSESSING PHYSICAL AND ECONOMIC IMPACTS THROUGH 2040 12–13 (2020), available at https://media.rff.org/documents/Florida_Climate_Outlook.pdf.

31. Christopher Emrich et al., CLIMATE-SENSITIVE HAZARDS IN FLORIDA: IDENTIFYING AND PRIORITIZING THREATS TO BUILD RESISTANCE AGAINST CLIMATE EFFECTS 10, 22 (2014) available at climate-sensitive-hazards-in-florida-final-report.pdf.).

flooding.[32] While it is estimated that one million acres of land in Florida will be lost to sea level rise alone and will force the relocation of 250,000 Florida residents, these ominous threats do not appear to be much of a deterrent; Florida's population is projected to increase 20% over the same 25-year timeframe.[33]

Coastal flooding has become more damaging as coastal areas become more dense with human populations.[34] Making matters worse, heavy rains amplify coastal flooding when storm surge or king tides occur at the same time.[35] Nuisance flooding, or lowland flooding caused by high tide due to sea level rise, causes significant property damage and social disruption,[36] and flooding is expected to worsen as higher sea surfaces push storm surge and tidal flooding further inland.[37] Forty to sixty percent of oceanfront communities on the U.S.'s East and Gulf coasts are projected to experience chronic inundation by 2100,[38] and low-wealth and communities of color will be the most susceptible to financial loss associated with flooding.[39] Florida leads the nation with the highest percentage of senior citizens,[40] and communities with higher rates of elderly people are also at risk of climate change-related wealth loss.[41] Renters

32. *Sea Level 2040*, 1,000 FRIENDS OF FLA., https://1000fof.org/sealevel2040/sea-level-2040/#state2040 [https://perma.cc/Z97S-UC6B] (last visited Jan. 2, 2024); Raimi, *supra* note 30, at 1, 13.

33. *Sea Level 2040, supra* note 32.

34. Jeremy Weiss, Jonathan Overpeck, & Ben Strauss, *Implications of Recent Sea Level Rise Science for Low-Elevation Areas in Coastal Cities of the Coterminous U.S.A.*, 105 CLIMATIC CHANGE 635, 635 (2011); Benjamin Strauss et al., *Tidally Adjusted Estimates of Topographic Vulnerability to Sea Level Rise & Flooding for the Contiguous U.S.*, 7 ENV'T RSCH. LETTERS 1, 1 (2012); Barbara Neumann, et al., *Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding – A Global Assessment*, PLOS ONE 10(3):E0118571, Mar. 2015, at 2.

35. Thomas Wahl et al., *Increasing Risk of Compound Flooding from Storm Surge & Rainfall for Major U.S. cities*, 5 NATURE CLIMATE CHANGE 1093, 1093 (2015).

36. Shimon Wdowinski et al., *Increasing Flood Hazard in Coastal Communities due to Rising Sea Level: Case Study of Miami Beach, Fla.*, 126 OCEAN & COASTAL MGT. 1, 1–8 (2016).

37. Katherine Hayhoe et al., *Our Changing Climate*, 2 IMPACTS, RISKS, & ADAPTATION IN THE U.S.: FOURTH NATIONAL CLIMATE ASSESSMENT 72, (2018), at 119; Claudia Tebaldi, B.H. Strauss, & C.E. Zervas, *Modelling Sea Level Rise Impacts on Storm Surges Along US Coasts, 7* ENV'T RSCH LETTERS 1, 1, 8, 10 (2012).

38. Kristina A. Dahl et al., WHEN RISING SEAS HIT HOME: HARD CHOICES AHEAD FOR HUNDREDS OF US COASTAL COMMUNITIES 25(2017).

39. DAVID MAIDMENT ET AL., FRAMING THE CHALLENGE OF URBAN FLOODING IN THE U.S. 3 (2019), https://www.ncbi.nlm.nih.gov/books/NBK541180/ [https://perma.cc/VMW2-CEL9].

40. Emma Rubin, *Elderly Population in U.S. by State*, CONSUMER AFFAIRS (Jan. 19, 2023), https://www.consumeraffairs.com/homeowners/elderly-population-by-state.html [perma.cc/M8F3-PDPX] (the national average population over 65 is 16.5%, but in Florida it is 21%).

41. Janet L. Gamble, et al. *Climate Change and Older Americans: State of the Science*, 121 ENV'T

are another vulnerable demographic that may be harmed when landlords are unwilling or unable to repair storm and flood damage.[42]

Atlantic hurricanes and hurricane-generated storm surge is increasing in intensity.[43] Hurricanes are extremely disruptive to normal life: schools, tourist attractions, airports, seaports, and most other businesses close in anticipation of the storm, during the storm, and until storm clean-up commences.[44] Hurricanes often affect not just the directly impacted region, but send ripples throughout the nation.[45] These storms take a tremendous human and economic toll: Hurricane Irma cost $50 billion and Hurricane Ian more than $115 billion.[46] Together, these two storms killed more than 200 people in Florida.[47]

Hurricane Irma, a Category 5, illustrates just how destructive one hurricane can be. Irma first tore through Puerto Rico and the U.S. Virgin Islands at 185 miles per hour.[48] It went on to make landfall in the Florida Keys, with an initial storm surge of 5-8 feet.[49] It poured 10-15 inches of rain on the state,[50] significantly damaged 65% of buildings, and destroyed 25% of buildings in the Keys.[51] Hurricane Irma was so strong and massive that it pulled water out of Tampa Bay, which is located hundreds of miles away, and it generated wind speeds of 40 mph more than 400 miles away.[52] Three states were placed under evacuation orders due to the sheer size and strength

---

HEALTH PERSP. 15, 19 (2013).

42. Molly Prindle, *Landlords' Responsibilities Under the Implied Warranty of Habitability & the Covenant of Quiet Enjoyment Extend to Hurricane-Caused Damage*, 68 AM. U. L. REV. 91, 91 (2019).

43. Hayhoe, *supra* note 37, at 119.

44. SELECT COMM'N ON HURRICANE RESPONSE & PREPAREDNESS FINAL REP., H.R. REP., at 1–5 (Fla. 2018).

45. *Id.* For example, travel to and from Florida was disrupted as were several industries of national significance such as tourism and citrus.

46. NAT'L CTRS. FOR ENV'T INFO., COSTLIEST U.S. TROPICAL CYCLONES 2 (2024).

47. *Id.*

48. *Detailed Meteorological Summary on Hurricane Irma*, NAT'L WEATHER SERV. *Detailed Meteorological Summary on Hurricane Irma*, https://www.weather.gov/tae/Irma_technical_summary [perma.cc/JAL7-YAJY].

49. JOHN P. CANGIALOSI ET AL., NATIONAL HURRICANE CENTER, TROPICAL CYCLONE REPORT: HURRICANE IRMA (AL112017), at 8 (2021), available at https://www.nhc.noaa.gov/data/tcr/AL112017_Irma.pdf.

50. *Id.* at 12.

51. *Id.* at 16.

52. *Detailed Meteorological Summary on Hurricane Irma*, *supra* note 48.

of Irma,[53] and 6.8 million people in Florida were forced to evacuate.[54] Irma dumped over 15 inches of rain on the Fort Pierce/St. Lucie area,[55] and put some streets in downtown Jacksonville under five feet of water.[56] It also spit out at least 25 tornadoes, crushing buildings and knocking out electricity.[57] Irma was just one of three Atlantic hurricanes to make landfall in the United States during the 2017 hurricane season.[58]

Saltwater intrusion is also a growing concern. South Florida has been constructing salinity control measures to protect drinking water for more than 70 years,[59] and the meeting point of saltwater and freshwater is moving inland.[60] Caused by increases of sea levels and reduction in precipitation, saltwater intrusion can contaminate drinking water (for humans, other animals, and plants) and significantly alter habitat.[61] Some think saltwater intrusion may even be working to erode the underground foundations of roads and coastal buildings, like the condo tower in Surfside, Florida killing 98 people when it suddenly collapsed.[62] Rising seas, high temperatures, and drought conditions in the upper Mississippi River have caused saltwater intrusion in the lower Mississippi River.[63] To offset the threat saltwater intrusion posed to drinking

53. FLA. ASSOC. OF CNTYS., EVACUATION REPORT 1 (2018), available at https://www.fl-counties.com/sites/default/files/2018-02/Evacuations%20Report.pdf.

54. *Id*.

55. CANGIALOSI ET AL., *supra* note 49, at 33.

56. Adam Terando et al., *Southeast*, *in* IMPACTS, RISKS, & ADAPTATION IN THE U.S.: FOURTH NAT'L CLIMATE ASSESSMENT 2, 759 (2018).

57. *See* CANGIALOSI ET AL., *supra* note 49, at 12.

58. *Billion-Dollar Weather and Climate Disasters: Events*, NAT'L CTRS. FOR ENV'T INFO, https://www.ncei.noaa.gov/access/billions/events/US/2017?disasters[]=tropical-cyclone, [https://perma.cc/NXC8-5RU9].

59. *Southeast Florida Regional Climate Compact*, *Indicator: Saltwater Intrusion,* SOUTHEAST FLORIDA REGIONAL COMPACT CLIMATE CHANGE (2020), https://southeastfloridaclimatecompact.org/indicator-saltwater-intrusion/ [https://perma.cc/PBH6-ZSZQ].

60. Bill Lambrecht, *Salt Levels in Florida's Groundwater Rising at Alarming Rates; Nuke Plant is One Cause*, CNS MD. (Nov. 30, 2020), https://cnsmaryland.org/2020/11/23/salt-levels-in-floridas-groundwater-rising-at-alarming-rates-nuke-plant-is-one-cause/ [https://perma.cc/8JCK-67BN].

61. Daniel Cusik & E&E News, *Where Rising Seas Threaten Drinking Water, Scientists Look for Affordable Solutions*, SCI. AM. (Mar. 17, 2022), https://www.scientificamerican.com/article/where-rising-seas-threaten-drinking-water-scientists-look-for-affordable-solutions/, [https://perma.cc/MQN3-6S9B].

62. Jon Schuppe, *Surfside Collapse Exposes an Overlooked Threat: Saltwater Rising from Underground*, NBC NEWS (Feb. 17, 2022), https://www.nbcnews.com/news/us-news/surfside-condo-collapse-salt-groundwater-rcna16473 [https://perma.cc/WZZ5-5NTF].

63. Chelsea Harvey & E&E News, *Here's Why Salt Water Is Invading the Mississippi and Whether It Will Happen More Often*, SCI. AM. (Oct. 12, 2023).

water, the U.S. Army Corps of Engineers recently had to barge 36 million gallons of fresh water a day.[64] The Corps had earlier added an additional 25 feet to an underwater levee in the Mississippi River designed to slow saltwater intrusion.[65]

But it is not just the water, it is the heat too. 2023 has been the hottest year on record and 2024 will likely surpass it.[66] July 2023 was the hottest month ever recorded, and September 2023 beat the previous September record by 0.5C.[67] The Intergovernmental Panel on Climate Change predicts that global temperatures will increase 3.3°C to 5.7°C by the end of this century.[68] One study offers a sobering conclusion:

> In the future, moist heat extremes will be outside the bounds of past human experience and beyond current heat mitigation strategies for billions of people. While some physiological adaptation from the threshold described here is possible, additional behavioral, cultural, and technical adaptation will be required to maintain healthy lifestyles.[69]

Extreme heat is predicted for the southeast region in particular.[70] Florida has already experienced a 2-degree Fahrenheit increase over the last 20 years.[71]

---

https://www.scientificamerican.com/article/heres-why-salt-water-is-invading-the-mississippi-and-whether-it-will-happen-more-often/ [https://perma.cc/886U-BKRK].

64. Jamiel Lynch & Rachel Ramirez, *Army Corps Will Barge in up to 36 Million Gallons of Freshwater a Day as Saltwater Threatens Drinking Water South of New Orleans*, CNN (Sept. 24, 2023), https://www.cnn.com/2023/09/23/us/freshwater-new-orleans-saltwater-mississippi-river/index.html [https://perma.cc/ZH45-2YWM].

65. *Id.*

66. Damian Carrington, *Gobsmackingly Bananas: Scientists Stunned by Plant's Record September Heat*, THE GUARDIAN (Oct. 4, 2023), https://www.theguardian.com/environment/2023/oct/05/gobsmackingly-bananas-scientists-stunned-by-planets-record-septemberheat#:~:text=Global%20temperatures%20soared%20to%20a,the%20hottest%20month%20ever%20recorded [https://perma.cc/M7KL-F88N].

67. *Id.*

68. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2021 SUMMARY FOR POLICYMAKERS 14 (2021).

69. Daniel Vecellio et al., *Greatly Enhanced Risk to Humans as a Consequence of Empirically Determined Lower Moist Heat Stress Tolerance*, 120 ENV'T SCIS. 1, 1 (2023).

70. For example, Sarasota County is predicted to have 79 days above 100 heat index in 2023, and 112 by 2053. Ben Montgomery, *Mapping What Florida's Heat Will Look Like in 30 years*, AXIOS (Aug. 16, 2022), https://www.axios.com/local/tampa-bay/2022/08/16/florida-extreme-heat-projections [https://perma.cc/JC8F-99XS].

71. Jennifer Runkle et al., *State Climate Summaries 2022 Florida*, NAT'L CTRS. FOR ENV'T INFO.,

The summer of 2023 saw dozens of heat advisories from the National Weather Service and the Florida Division of Emergency Management placed hundreds of millions of Americans on warning. Unprecedented numbers of patients landed in emergency rooms for heat-related illnesses.[72] The increase in nighttime temperatures limits people's ability to recover from these record-breaking daytime highs.[73] Florida will also experience the largest heat index escalation in the United States, with an 8-15 degree Fahrenheit "feels-like" temperature increase by 2050.[74]

Some power companies have committed to keeping the power on, even for customers with overdue bills and when the heat index reaches 105,[75] but no Florida law requires that they do so.[76] Florida lawmakers have proposed but never passed, laws to protect employees from heat illness by requiring employers and employees to learn more about the symptoms of heat illness, providing water on-site, and access to shade.[77] The federal Department of Labor's Occupational Safety and Health Administration published an advanced notice of proposed rulemaking on heat illness prevention a few years ago but never finalized any requirements.[78]

---

https://statesummaries.ncics.org/chapter/fl/#:~:text=By%202050%2C%20most%20of%20the,precipitation%20and%20drought%20are%20projected [https://perma.cc/4HUE-TUEY].

72. Megan Mellado, *Emergency Rooms Seeing Uptick in Heat-related Incidents in Florida*, WESH 2 (July 20, 2023), https://www.wesh.com/article/heat-risk-florida/44604312 [https://perma.cc/NQB8-T5E4].

73. Luis Melecio-Zambrano, *Extreme heat taxes the body in many ways. Here's how*, SCIENCENEWS, (Aug. 6, 2023) https://www.sciencenews.org/article/extreme-heat-human-body-climate#, [https://perma.cc/Z527-NV9J].

74. Runkle et al., *supra* note 71, at 4. Heat index refers to the human-perceived temperature by combining humidity and temperature. *What is the heat index,* Nat'l Weather Serv., https://www.weather.gov/ama/heatindex [https://perma.cc/4HNS-ZE2Q].

75. Cheryl McCloud, *Can't Pay Your Electric Bill and Worried During This Heat Wave? These Programs Might Help*, TREASURE COAST NEWSPAPERS (July 26, 2023), https://www.aol.com/lifestyle/cant-pay-electric-bill-worried-172432897.html [https://perma.cc/E2C6-CYZF].

76. Shannon Clowe, *Hundreds of people across Tampa Bay area struggle to pay electric bills amid hot temperatures*, MSN (July 31, 2023), https://www.msn.com/en-us/money/markets/hundreds-of-people-across-tampa-bay-area-struggle-to-pay-electric-bills-amid-hot-temperatures/ar-AA1eBRqK [https://perma.cc/A7YY-763F].

77. SB 732 2022 did not pass. SB 706, proposed in 2023, did not pass. *See* S.B. 732, (Fla. 2022); *see also* S.B. 706, (Fla. 2023).

78. Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings, 86 Fed. Reg. 59309 (Oct. 27, 2021) (to be codified at 29 C.F.R, pts. 1910, 1915, 1917, 1918, 1926, and 1928).

High temperatures affect the human body's ability to regulate internal temperatures, leading to cramps, exhaustion, heatstroke, hyperthermia, and potential worsening of pre-existing conditions like cardiovascular and respiratory diseases and diabetes.[79] One study estimates that annual mortality due to heat in the U.S. is more than 10,000 people.[80] Heat is currently the leading weather-related cause of death in the United States,[81] and experts warn that 2023 is expected to set a new record for heat-related mortality, outpacing hurricane mortality 8-to-1.[82] The temperature rise will also make year-round mosquito activity more prevalent, increasing the risk of deadly viruses including dengue, chikungunya, and Zika.[83] Just this summer, a U.S.-borne malaria outbreak hit a west-central Florida community, a rare occurrence for this part of the world.[84] Heatwaves will become more deadly, especially when electric grids collapse under demand or during storms, and especially for people who work outdoors.[85]

The effects of heat are more acute in urban areas where heat island effects increase the "feels-like" temperature, in part due to a lack of trees and overabundance of low-albedo surfaces like asphalt.[86] Low-wealth and communities of color are disproportionately concentrated in urban areas and are therefore disparately impacted by the heat island effect.[87] The elderly,

79. *Heat and Health*, WORLD HEALTH ORG. (June 1, 2018) https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health, [https://perma.cc/FV6N-B3NW].

80. Drew Shindell et al., *The Effects of Heat Exposure on Human Mortality Throughout the United States*, Apr. 2020, at 7.

81. *Climate Change Indicators: Heat-Related Deaths*, EPA, https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths [https://perma.cc/E28W-U2BT] (last visited Feb. 25, 2024).

82. Oliver Milman, *'Silent killer': experts warn of record US deaths from extreme heat*, THE GUARDIAN (Aug. 1, 2023), https://www.theguardian.com/us-news/2023/aug/01/heat-related-deaths-us-temperatures-heatwave [https://perma.cc/9XMR-7LBM].

83. *See* Lynne Carter, *2018: Southeast*, in IMPACTS, RISKS, AND ADAPTATION IN THE UNITED STATES: FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II, at 734, 768 (2018).

84. Stephanie Colombini, *In Florida's local malaria outbreak, forgotten bite led to surprise hospitalization*, NPR (July 26, 2023, 10:21 AM), https://www.npr.org/sections/health-shots/2023/07/26/1189852024/in-floridas-local-malaria-outbreak-forgotten-bite-led-to-surprise-hospitalizatio#:~:text=Hannah%20Heath-,Hannah%20Heath%2C%2039%2C%20never%20imagined%20the%20vomiting%20and%20fever%20she,eight%20people%20in%20the%20U.S [https://perma.cc/VY6R-XHH8].

85. Brian Stone Jr. et al., *How Blackouts During Heat Waves Amplify Mortality and Morbidity Risk*, 57 ENV'T SCI.E & TECH. 8245, 8250, 8252 (2023).

86. *Urban Heat Hot Spots*, CLIMATE MATTERS: CLIMATE CENT. (July 26, 2023), https://www.climatecentral.org/climate-matters/urban-heat-islands-2023 [https://perma.cc/R6BA-LBQF].

87. Angel Hsu et al., *Disproportionate Exposure to Urban Heat Island Intensity Across Major*

children, and outdoor workers are particularly susceptible to heat-related morbidity and mortality.[88]

Coastal areas can also present an additional threat of exposure to industrial pollution. Since these areas are densely urban and have access to shipping channels, they become shipping and industrial corridors for the utility and fertilizer sectors.[89] Near Port Tampa, on Tampa Bay, an active phosphogypsum stack (radioactive waste from processing phosphate fertilizer) looms over Old Progress Village. Progress Village, which was created in the 1950s to help rehome Tampa's segregated, Black residents who were displaced by an interstate construction project,[90] soon faced the expansion of a fertilizer facility's phosphogypsum waste.[91] The community petitioned their county commissions to deny the local permits, asking:[92]

> What do you tell people 15 or 20 years from now when someone wants to know who let a company put two mountains of waste within the city limits of Tampa? How do you tell the next generation that we have messed up again? What do I tell my grandkids? Will their mother and father let them visit me?[93] The county commissioners authorized the permit in 1984.[94]

It was not long before rain and wind from Hurricane Frances caused a berm impounding water at the top of the phosphogypsum stack near Progress Village to fail and release 65 million gallons of toxic, acidic, nutrient-laden process wastewater into Hillsborough Bay, which is habitat for birds, fish,

---

US Cities, NATURE COMMC'NS 1, 2, 5 (2021); Bruce Coffyn Mitchell & Jayajit Chakraborty, *Urban Heat and Climate Justice: A Landscape of Thermal Inequity in Pinellas County, Fla.*, 104 GEOGRAPHIC R. 459, 459-61 (2014).

88. Kristie Ebi et al., *Hot Weather and Heat Extremes: Health Risks*, 398 LANCET 698, 698, 703 (2021); Marcus Sarofim et al., *Temperature-Related Death and Illness*, *in* THE IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN THE UNITED STATES: A SCIENTIFIC ASSESSMENT. U.S. GLOBAL CHANGE RESEARCH PROGRAM 59 (2016).

89. Zack Colman, *The Toxic Waste Threat that Climate Change Is Making Worse*, POLITICO (Aug. 26, 2019), www.politico.com/story/2019/08/26/toxic-waste-climate-change-worse-1672998 [https://perma.cc/U7C4-RTZD]; FERTILIZER INST., OPERATIONAL U.S. FERTILIZER PRODUCTION FACILITIES - N,P & K 1, available at usproductionmaps(updated).pdf (tfi.org) (last visited Feb. 25, 2024).

90. Laura E. Baum, Neighborhood Perceptions of Proximal Industries in Progress Village, FL (May 20, 2016) (M.A. thesis, University of South Florida) (on file with the University of South Florida).

91. *Id.* at 66.

92. *Id*. at 71.

93. *Id*. at 72–73.

94. *Id*. at 74.

bottlenose dolphins and manatees.[95] This toxic disaster killed and injured marshes, mangroves, seagrasses, crab species, shrimp species, fish species, and stingrays.[96] The discharge killed more than 78 acres of mangroves, 57 acres of tidal marsh, and 21 acres of seagrass.[97] Sixty-one percent of the people living within three miles of the phosphogypsum stack are "people of color," and 35% are low-income.[98]

Twenty-five miles south of Miami, Florida Power & Light's Turkey Point power plant is threatening harm to another vulnerable community. In addition to contributing to groundwater salinization,[99] Florida Power & Light Co. has submitted an application that if approved would permit it to continue operations another 80 years despite being nearly at sea level and extremely vulnerable to sea level rise and storms.[100] The plant, which bizarrely provides habitat for endangered crocodiles in its canals, is also harming those crocodiles by altering salinity and temperature in the canals and running over crocodiles in company vehicles.[101]

Another energy provider, the Tampa Electric Company ("TECO"), is a coal-powered plant that sits in an industrialized area just south of downtown

95. Consent Decree Addressing Natural Resource Damages, *United States v. Mosaic Fertilizer, LLC*, No. 13-cv-00386-RAL-TGW app. A, 9–10 (M.D. Fla. Feb. 11, 2013); Compl. for Natural Resource Damages at 3, *United States v. Mosaic Fertilizer, LLC*, No. 13-cv-00386-RAL-TGW 1, 3 (M.D. Fla. Feb. 11, 2013).

96. Consent Decree Addressing Natural Resource Damages, *supra* note 95.

97. *Id*. at app. A, 11.

98. *Detailed Facility Report*, U.S. ENV'T PROT. AGENCY, https://echo.epa.gov/detailed-facility-report?fid=110056968875#overEffReport [https://perma.cc/MHG2-4WVP] (last visited Jan. 8, 2024) (using 3 mile radius).

99. Lambrecht, *supra* note 60.

100. Kristi Swartz & Jeremy Dillon, *Feds Walk Back Plan for Nuclear Reactors to Run 80 Years*, E&E NEWS (Feb. 25, 2022, 7:14 AM) https://www.eenews.net/articles/feds-walk-back-plans-for-nuclear-reactors-to-run-80-years/#:~:text=Federal%20nuclear%20regulators%20have%20reversed,environmental%20study%20is%20needed%20beforehand. [https://perma.cc/A3TS-2RQM].

101. Letter from Elise Pautler Bennett, Deputy Florida Dir. & Senior Att'y, Ctr. for Biological Diversity to Christopher T. Hanson, Chairman, U.S. Nuclear Regul. Comm'n, et al., (June 16, 2022), https://www.biologicaldiversity.org/programs/biodiversity/pdfs/Turkey-Point-nuclear-plant-violations-2022-06-16.pdf?_gl=1*1u5o298*_gcl_au*MTAwNTI0Mjc1MS4xNjkyNzExMzU0 [https://perma.cc/BZ2D-5HDX]; Brigit Katz, *Why Florida Crocs are Thriving Outside a Nuclear Power Plant*, SMITHSONIAN MAGAZINE (July 23, 2019), https://www.smithsonianmag.com/smart-news/florida-crocs-are-thriving-outside-nuclear-power-plant-180972712/ [https://perma.cc/P7HQ-XGRC]; Greg Allen, *Nuclear Plant May Be In Hot Water Over Its Cooling System*, NPR (July 23, 2014, 4:08 PM), https://www.npr.org/2014/07/23/334494701/nuclear-plant-may-be-in-hot-water-over-its-cooling-system [https://perma.cc/X5NA-KPF2].

Tampa and is transitioning to natural gas.[102] The surrounding neighborhoods are 54% persons of color and 22% low income.[103] TECO was the subject of a historic lawsuit and settlement agreement, the first to result from a national enforcement action against power plants for illegally releasing massive amounts of air pollutants.[104] Tampa Electric is still considered one of the state's top polluting power plants.[105] Tampa Electric warned it might shut down operations in a portion of its service area in anticipation of a hurricane, in an area that was already under evacuation notice. The company explained that proactively shutting down parts of the system in advance of the storm would protect equipment from storm surge, and, if the damage were avoided, would allow TECO to restore power more quickly.[106]

Florida's biodiversity is also taking a climate hit. These climate impacts are worsened by human responses to climate change.[107] More than half the nation lives near the coast and about 40% of species listed as endangered or threatened under the Endangered Species Act in the United States share

102. Kevin Clark, *Tampa Electric's Coal-to-Gas transition takes next step,* POWER ENG'G (April 8, 2022), https://www.power-eng.com/coal/tampa-electrics-coal-to-gas-transition-takes-next-step/ [https://perma.cc/WV85-A3PB].

103. *Detailed Facility Report*, EPA, https://echo.epa.gov/detailed-facility-report?fid=110008319505&ej_type=sup&ej_compare=US [https://perma.cc/UY8X-VMYQ] (last visited Jan. 8, 2024).

104. *Tampa Electric Company (TECO) Clean Air Act (CAA) Settlement*, U.S. ENV'T PROT. AGENCY (Feb. 15, 2023), https://www.epa.gov/enforcement/tampa-electric-company-teco-clean-air-act-caa-settlement [https://perma.cc/4836-4P42].

105. Jordan Schneider, Travis Madsen, & Julian Boggs, *America's Dirtiest Power Plants: Their Oversized Contribution to Global Warming and What We Can Do About It*, ENVIRONMENT FLORIDA RESEARCH & POLICY CENTER (Sept. 2013), https://publicinterestnetwork.org/wp-content/uploads/2013/09/Power_Plants_FL_scrn_0.pdf [perma.cc/3LRK-6FYH].

106. Andrea Chu, *TECO may proactively shut down power Wednesday to parts of Tampa*, WTSP (Sept. 27, 2022, 10:24 AM) https://www.wtsp.com/article/weather/hurricane/tampa-electric-teco-power-shut-down-hurricane-ian/67-6554496c-ea4b-4eba-803c-ca06cb66a77a [https://perma.cc/T3YG-N695].

107. Christopher Craft et al., *Forecasting the Effects of Accelerated Sea-Level Rise on Tidal Marsh Ecosystem Services,* 7 FRONTIERS ECOLOGY & ENV'T 73, 73 (2008); Omar Defeo et al., *Threats to Sandy Beach Ecosystems: A Review,* 81 ESTUARINE, COASTAL & SHELF SCI. 1, 1 (2008); Duncan M. FitzGerald et al., C*oastal Impacts Due to Sea-Level Rise,* 36 ANN. REV. OF EARTH & PLANETARY SCI. 601, 601 (2008); Olivia LeDee, Kristen Nelson & Francesca Cuthbert, *The Challenge of Threatened and Endangered Species Management in Coastal Areas,* 38 COASTAL MGMT. 337, 338 (2010); Shaily Menon et al., *Preliminary Global Assessment of Terrestrial Biodiversity Consequences of Sea-Level Rise Mediated by Climate Change*, 19 BIODIVERSITY CONSERVATION 1599, 1599 (2010); Reed F. Noss, *Between the Devil and the Deep Blue Sea: Florida's Unenviable Position with Respect to Sea Level Rise,* 107 CLIMATIC CHANGE 1, 1 (2011); Donald Scavia et al., *Climate Change Impacts on U.S. Coastal and Marine Ecosystems,* 25 ESTUARIES 149, 149 (2002).

these coastal habitats.[108] Coastal ecosystems and biodiversity are caught between rising seas and coastal armoring.[109] Florida, on average, sits just a few feet above sea level. While sea levels have changed dramatically affecting Florida's coastline for thousands of years, vegetation zones have tracked those sea level changes slowly over time.[110] The difference in this Anthropocene era is that the climate is changing far faster than it has in recorded history—so quickly that it is outpacing species' ability to evolve or adapt.[111] In the past, biodiversity and ecosystems did not have to overcome the same human-made infrastructure obstacles.[112] For example, sea levels are projected to rise 10-12 inches in the next 30 years (from 2020-2050), which is about the same total amount of sea level rise over the past 100 years (1920-2020).[113]

Endangered species such as the Florida grasshopper sparrow, Miami blue butterfly, and the Florida key deer are "highly likely to be extinct" in the next 75 years due to climate change.[114] Coastal forests are retreating from saltwater intrusion.[115] Increased salinity is also destroying imperiled south Florida pine rocklands.[116] Warming temperatures are enabling the

108. LeDee, Nelson, & Cuthbert, *supra* note 107, at 337.

109. Jaclyn Lopez, *Biodiversity on the Brink: The Role of "Assisted Migration" in Managing Endangered Species Threatened with Rising Seas,* 39 HARV. ENV'L. L. REV. 157, 157 (2014).

110. G. Lynn Wingard, Joel W. Hudley & Frank E. Marshall, U.S. GEOLOGICAL SURVEY, ESTUARIES OF THE GREATER EVERGLADES ECOSYSTEM: LABORATORIES OF LONG-TERM CHANGE 3 (2010).

111. Ignacio Quintero & John J. Wiens, *Rates of projected climate change dramatically exceed past rates of climatic niche evolution among vertebrate species*, 16 ECOLOGY LETTERS 1095, 1102 (2013); Joanne M. Bennett et al, *The evolution of critical thermal limits of life on Earth*, 12 NATURE COMMC'NS, Feb. 2021, at 6; Viktoriia Radchuk et al, *Adaptive responses of animals to climate change are most likely insufficient*, 10 NAT COMMC'NS, , July 2019, at 3.

112. Carrie A. Schloss, Tristan A. Nunez & Joshua L. Lawler, *Dispersal Will Limit Ability of Mammals to Track Climate Change in Western Hemisphere*, 109 PROC. OF THE NAT'L ACAD. OF SCI. FOR THE U.S. 8606, 8607–09 (2012).

113. William V. Sweet et al., NOAA NAT'L OCEAN SERV., GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES: UPDATED MEAN PROJECTIONS AND EXTREME WATER LEVEL PROBABILITIES ALONG U.S. COASTLINES xii (Feb. 2022).

114. Joshua Steven Reece et al., *A Vulnerability Assessment of 300 Species in Florida: Threats from Sea Level Rise, Land Use, and Climate Change*, 8 PLOS ONE 1, 4 (2013).

115. Kimberlyn Williams et al, *Sea-Level Rise and Coastal Forest Retreat on the West Coast of Florida*, 80 ECOLOGY 2045, 2059 (1999); *see generally* Kimberlyn Williams, Michelina Macdonald, & Leonel da Silveira Lobo Sternberg, *Interactions of Storm, Drought, and Sea-level Rise on Coastal Forest: A Case Study.* 19 J. OF COASTAL RSCH. 1116, (2003); Larisa R.G. Desantis et al., *Sea-level Rise and Drought Interactions Accelerate Forest Decline on the Gulf Coast of Fla., USA*, 13 GLOB. CHANGE BIOLOGY 2349, 2358 (2007).

116. FLA. NATURAL AREAS INVENTORY, GUIDE TO THE NATURAL COMMUNITIES OF FLA. 70

northward migration of nonnative, invasive species like pythons, tegus, and Brazilian pepper.[117] Our marine species may fare even worse: studies suggest warming and related deoxygenation will have extremely long-term effects well beyond when global temperatures peak.[118] Marine heat waves have led to the 10 billion decline of snow crabs.[119] In already warmer waters, record-breaking heat in Caribbean waters threatens to kill an unprecedented amount of coral.[120] Warming waters are killing coral off the coast of Florida.[121]

(2010).

117. Michael Osland et al, *Tropicalization of temperate ecosystems in North America: The northward range expansion of tropical organisms in response to warming winter temperatures*, 27 GLOB. CHANGE BIOLOGY 3009, 3011, 3015, 3020, 3024 (2021); Michael L. Avery et al., *Cold Weather and the Potential Range of Invasive Burmese Pythons*, 12 BIOLOGICAL INVASIONS 3649, 3649 (2010); Elliot R. Jacobson et al., *Environmental Temperatures, Physiology and Behavior Limit the Range Expansion of Invasive Burmese Pythons in Southeastern USA*, 7 INTEGRATIVE ZOOLOGY 271 (2012); Frank Mazzotti et al., *Large Reptiles and Cold Temperatures: Do Extreme Cold Spells Set Distributional Limits for Tropical Reptiles in Florida?,* 7 ECOSPHERE 1 (2016).

118. Yeray Santana-Falcon et al, *Irreversible Loss in Marine Ecosystem Habitability After a Temperature Overshoot*, 4 COMM'N EARTH & ENV'T at 1 (2023).

119. Cody Szuwalski et al., *The Collapse of Eastern Bering Sea Snow Crab,* 382 MARINE HEADWATERS 306, 306 (2023).

120. Denise Chow, *Extreme Ocean Temperatures Threaten to Wipe Out Caribbean Coral*, NBC NEWS (Oct. 23, 2023, 6:00 AM), https://www.nbcnews.com/science/environment/extreme-ocean-temperatures-threaten-wipe-caribbean-coral-rcna120594 [https://perma.cc/KW85-PNZX].

121. Loren McClenachan et al., *Ghost Reefs: Nautical Charts Document Large Spatial Scale of Coral Reef Loss Over 240 Years*, 3 SC. ADVANCES 1, 2 (2017); U.S. ENV'T PROTECTION AGENCY, CLIMATE CHANGE IN THE UNITED STATES: BENEFITS OF GLOBAL ACTION 66 (2015); Diana R. Lane et al., *Quantifying and Valuing Potential Climate Change Impacts on Coral Reefs in the United States: Comparison of Two Scenarios*, # PLOS ONE 1, 1, 7–8 (2013).

II. STRATEGIES TO ADAPT TO CLIMATE CHANGE IMPACTS ARE HARMING VULNERABLE COMMUNITIES AND BIODIVERSITY.

Many communities recognize the need to become more resilient to climate change, and some have begun to plan for climate change.[122] Local governments, as opposed to state and federal governments, are hit hardest financially by climate catastrophes, with impacts to housing and their economy.[123] Individuals can be vulnerable due to where they live relative to climate threats, but this Article seeks to focus on communities that are vulnerable not merely due to their geographic proximity to climate threats, but due to additional factors as well.

The National Climate Resilience Framework defines resilience as "the ability to prepare for threats and hazards, adapt the changing conditions, and withstand and recover rapidly from adverse conditions and disruptions."[124] Its principles of climate resilience are that solutions be implemented proactively, systems are considered holistically, equitable and just solutions should be prioritized, the most vulnerable communities should be centered, decision-making should be collaborative and inclusive, and solutions should be durable and multi-beneficial.[125]

---

122. A. AMEKUDZI, ET AL., TRANSIT CLIMATE CHANGE ADAPTATION ASSESSMENT FOR THE METROPOLITAN ATLANTA RAPID TRANSIT AUTHORITY 1 (2013), https://www.transit.dot.gov/sites/fta.dot.gov/files/FTA_Report_No._0076.pdf [https://perma.cc/8DAT-TE4Z]; City of Atlanta, 2015: Climate Action Plan. Mayor's Office of Sustainability, Atlanta, GA (GA 2015), https://www.globalcovenantofmayors.org/wp-content/uploads/2017/11/Atlanta-Climate-Action-Plan-07-23-2015.pdf [https://perma.cc/D9K2-N37L]; South Florida Regional Climate Change Compact (SFRCCC), Southeast Florida Regional Climate Change Compact, Regional Climate Action Plan 2.0 (Fla. 2017), https://southeastfloridaclimatecompact.org/wp-content/uploads/2018/04/RCAP-2.0-Abridged-Version.pdf [https://perma.cc/98W4-D4JG]; City of Fayetteville, 2017: Arkansans Can Take Steps to Respond to Climate Change (Ark.), https://www.fayetteville-ar.gov/DocumentCenter/View/14890/Commentary_Climate-Change?bidId= [https://perma.cc/U4SN-839A]; 100 RESILIENT CITIES, RESILIENT ATLANTA: ACTIONS TO BUILD A MORE EQUITABLE FUTURE 150 (2017), https://resilientcitiesnetwork.org/downloadable_resources/Network/Atlanta-Resilience-Strategy-English.pdf [https://perma.cc/9KDV-UYK4].

123. Carolyn Kousky et al., *As Disasters Become More Costly, the US Needs a Better Way to Distribute the Burden*, BROOKINGS INSTITUTE, (Sept. 13, 2023), https://www.brookings.edu/articles/as-disasters-become-more-costly-the-us-needs-a-better-way-to-distribute-the-burden/ [https://perma.cc/5Z7W-MUVX].

124. THE WHITE HOUSE, NATIONAL CLIMATE RESILIENCE FRAMEWORK 7 (2023).

125. *Id.* at 7–8.

The U.S. Climate Resilience Toolkit describes "The Steps to Resilience" as: (1) understand exposure; (2) assess vulnerability & risk; (3) investigate options; (4) prioritize & plan; and (5) take action.[126] The framework is intended to be iterative, incorporating feedback and lessons learned as communities continue to adapt to a changing climate.[127] The regulatory floor should be that the laws and policies should meet "the needs of the present without compromising the ability of future generations to meet their needs."[128] This position is underscored by the fact that the Paris Agreement advances the majority of the United Nation's 2030 Agenda for Sustainable Development's sustainable development goals.[129]

Robert Kuehn's *A Taxonomy of Environmental Justice* lays out four overlapping injustices (distributive, procedural, corrective, and social) that contribute to environmental injustice and are also relevant to climate injustice.[130] The effect of these phenomena is that vulnerable communities are simultaneously disproportionately exposed to pollution – both through project siting and inadequate enforcement, and are left out of governmental decision-making. These same factors apply doubly to the climate injustices on local and global scales.[131]

126. *Steps to Resilience Overview*, U.S. CLIMATE RESILIENCE TOOLKIT (Jan. 13, 2023), https://toolkit.climate.gov/steps-to-resilience/steps-resilience-overview [https://perma.cc/HUD7-CAKY].

127. *Take Action*, U.S. CLIMATE RESILIENCE TOOLKIT, https://toolkit.climate.gov/steps-to-resilience/take-action [https://perma.cc/5RSQ-TSC2] (last visited Feb. 25, 2024).

128. UNITED NATIONS, REPORT OF THE WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT: OUR COMMON FUTURE 16 (1987).

129. Eliza Northrop et al., Examining the Alignment Between the Intended Nationally Determined Contributions and Sustainable Development Goals 10–11 (Sept. 2016) (working paper).

130. Robert Kuehn, *A Taxonomy of Environmental Justice*, 30 ENV'T. L. REP. 10681, 10681-83 (2000); *see also* Carmen Gonzalez, *Climate Justice and Climate Displacement: Evaluating the Emerging Legal and Policy Responses*, 36 WIS. INT'L L. J. 366, 370 (2019) (explaining that the concept of climate in/justice is derived from U.S. scholar's descriptions of environmental in/justice).

131. *Id.*

The U.S. Global Change Research Program describes vulnerability in terms of exposure, sensitivity, and adaptative capacity.[132] Exposure describes the contact between a person and a climate change stressor. Sensitivity is the degree a person is affected by the stressor. Adaptive capacity refers to the ability of communities to address the stressors, defining resilience as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events." [133] It identifies climate drivers of increased temperatures, precipitation extremes and weather events, and sea level rise.[134] It describes vulnerable groups of people as "populations of concern," which includes low-wealth, communities of color, immigrant groups (especially with limited English proficiency), Indigenous populations, children, pregnant women, the elderly, certain occupational groups, and persons with disabilities and certain medical conditions.[135] It provides some stunning examples of how climate change might impact certain vulnerable populations. For example, the number of people with cognitive impairments or mental illness is expected to more than double by 2050, and those individuals may need special help with emergency responses.[136] The number of people with diabetes, obesity, and/or cardiovascular disease is expected to more than double by 2050, and they may be more sensitive to heat stress.[137] The Research Program also acknowledges that existing health disparities among non-Hispanic blacks and Hispanics, including low birth weights, infant deaths, obesity, and hypertension, may make these individuals more susceptible to climate stressors.[138]

The Centers for Disease Control has identified four themes, grouping 16 social vulnerability factors: socioeconomic status (below 150% poverty, unemployed, housing cost burden, no high school diploma, no health

132. J.A. Balbus et al., *Introduction: Climate Change and Human Health, in* THE IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN THE UNITED STATES: A SCIENTIFIC ASSESSMENT 29 (2016), https://health2016.globalchange.gov/climate-change-and-human-health [https://perma.cc/2Q3C-JAC2].

133. *Id.* at 30.

134. *Id.* at 4.

135. J.L. Gamble, *Populations of Concern*, *in* THE IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN THE UNITED STATES 249 (2016), https://health2016.globalchange.gov/low/ClimateHealth2016_09_Populations_small.pdf [https://perma.cc/75MT-AH3R].

136. Balbus et al., supra note 132, at 34.

137. *Id.* 34 tbl. 1.

138. *Id.* at 35.

insurance), household characteristics (aged 65 or older, aged 17 or younger, civilian with a disability, single-parent households, English language proficiency), racial and ethnic minority status (Hispanic or Latino, Black and African American, American Indian, Native Hawaiian or other Pacific Islander, other races), housing type, and transportation (multi-unit structures, mobile homes, crowding, no vehicle, group quarters).[139]

The U.S. Climate Vulnerability Index seeks to visually illustrate climate vulnerability by mapping baseline vulnerability and climate change risks.[140] It is based on an analysis of multiple resources, including the EPA's environmental justice screening tool, and several other governmental resources and published studies. The U.S. Climate Vulnerability Index identifies 184 indicators comprising four baseline vulnerabilities: health, social/economic, infrastructure, and environment; and three climate change risks: health, social/economic, and extreme events. The report shows that climate change exacerbates existing disparities.[141] Baseline vulnerabilities are factors that reduce resiliency and include prevalence of disease, access to care, life expectancy, redlining, crime statistics, NGO support, transportation, energy, food, water and waste management, governance, pollution, and land uses.[142]

139. *At A Glance: CDC/ATSDR Social Vulnerability Index*, CDC/ATDSR, https://www.atsdr.cdc.gov/placeandhealth/svi/at-a-glance_svi.html [https://perma.cc/V97E-2GDY].

140. *Land Use in Florida,* THE U.S. CLIMATE VULNERABILITY INDEX, https://map.climatevulnerabilityindex.org/map/environment_land_use/florida?mapBoundaries=Tract&mapFilter=0&reportBoundaries=Tract&geoContext=State [https://perma.cc/Q25G-GCQH] (last visited Jan. 8, 2024); *see generally* P. Grace Tee Lewis et al., *Characterizing Vulnerability to Climate Change Across the U.S.*, 172 ENV'T INT'L, Feb. 2023.

141. Lewis et al., *supra* note 140 at 5.

142. Climate Vulnerability Index, *Climate Vulnerability Index Methodology* fig.1, https://climatevulnerabilityindex.org/wp-content/uploads/2023/09/CVI-Methodology-Figure-1.png [https://perma.cc/HG5A-FUEV].

Resilient systems avoid or minimize exposure; add redundancy or increase robustness;[143] and absorb, weather, and correct themselves after a disturbance.[144] This concept applies to natural ecosystems as well as human.[145] Without aggressive, proactive resiliency and adaptation planning, human migration due to climate change is likely to quickly become catastrophically non-linear. Research shows that historically, there have been six progressive thresholds to climate hazards:

> (1) Adaptation becomes necessary; (2) Adaptation becomes ineffective; (3) Substantive changes in land use/livelihoods become necessary; (4) In situ adaptation fails, migration ensues; (5) Migration rates become nonlinear; and (6) Migration rates cease to be non-linear.[146]

These tipping points will be reached on a case-by-case basis,[147] following stochastic events.[148] Therefore, migration, even within one political boundary or geographic region, will not be uniform. Developing policies before those events occur and changing land use patterns now may provide the most equitable outcomes. These changes can make a community or ecosystem more resilient to climate disruption, which can delay or obviate the need to migrate.[149]

For communities that acknowledge these climate crisis realities soon, the question then becomes "*how* will we retreat?" Professors Ruhl and Craig

143. U.S. ARMY CORPS OF ENGINEERS, COASTAL RISK REDUCTION AND RESILIENCE: USING THE FULL ARRAY OF MEASURES at 2 (2013).

144. Robin K. Craig, *"Stationarity is Dead" – Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 HARV. ENV'T L. REV. 9, 22 (2010).

145. Michael Robert Phillips, Andrew Lawson Jones, & Tony Thomas, *Climate Change, Coastal Management and Acceptable Risk: Consequences for Tourism*, 85 J. COASTAL RSCH. 1411, 1412 (2018).

146. Robert McLeman, *Thresholds in Climate Migration*, 39 POPULATION ENV'T 319, 319 (2018).

147. Ella Nilsen, *After 8 major hurricanes in 6 years, some Gulf Coast communicates are hitting a 'tipping point,'* CNN, (Sept. 3, 2023), https://www.cnn.com/2023/09/03/us/gulf-coast-hurricanes-idalia-rebuilding-climate/index.html [https://perma.cc/9MR3-ESED].

148. In ecology, stochastic events are sudden, random happenings, like storms or fires, that can impact a population. Kohmei Kadowaki, *Stochastic Processes in Ecology*, OXFORD BIBLIOGRAPHIES, https://www.oxfordbibliographies.com/display/document/obo-9780199830060/obo-9780199830060-0224.xml (Nov. 29, 2022).

149. McLeman, *supra* note 146, at 323 ("An inherently resilient (or adaptive, and therefore less vulnerable) system is one where the threshold between a system's present state and a potentially undesirable one is distant or not easily crossed.").

convincingly argue that humanity must proceed with two different, but related objectives in mind to grapple with the climate crisis: aggressively act to cut greenhouse gas emissions to stave off the worst of the projected near-term climate impacts (keeping at no greater than 2C)[150] while simultaneously bracing for the likelihood that these efforts will fail.[151] To "adapt" to the climate crisis future, Ruhl and Craig warn that society will need to employ "transformational adaptation measures as radical as the pace and intensity of changing conditions beyond 2C."[152] Indeed, "adaptation is not just about *preserving* societies in their current state; rather, it always implies a *transformative* project."[153]

Despite apparent executive level interest,[154] the Supreme Court has become more hostile to mitigating climate change.[155] There has been some tepid Congressional bipartisan support for funding and plans to improve disaster community resilience. For example, due in part to the National Flood Insurance Program ("NFIP"), more than half the nation lives on the coast and tens of millions of people live in floodplains.[156] Of those households in floodplains, 33% have children and 29% have seniors.[157] They also have a higher percentage of Hispanics as compared to national averages.[158] The NFIP has also placed many plants and animals at risk for the same reasons: it incentivizes development in floodplains, which destroys species' habitat therein.[159]

150. Noah Diffenbaugh & Elizabeth Barnes, *Data-driven Predictions of the Time Remaining Until Critical Global Warming Thresholds are Reached*, 120 EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES (Jan. 30, 2023), https://www.pnas.org/doi/10.1073/pnas.2207183120, [https://perma.cc/V6D6-WGY3] ("[R]esults suggest a higher likelihood of reaching 2C in the Low scenario than indicated in some previous assessments.").

151. J.B. Ruhl & Robin Kundis Craig, *4℃*, 106 MINN. L. REV. 191, 203 (2021).

152. *Id.* at 201.

153. Benoit Mayer, *Climate Change Adaptation and the Law*, 39 VA. ENVTL. L. J. 141, 150 (2021).

154. Exec. Order No. 14008, 86 CFR § 7619 (2021).

155. *Compare* West Virginia v. Env't Prot. Agency, 142 S. Ct. 2587 (2022), *with* Massachusetts v. E.P.A., 549 U.S. 497 (2007).

156. Jaclyn Lopez, *From Bail Out to Righting the Course: The Commonsense Action the U.S. Must Take to Address Its Flood Crisis*, 33 TUL. ENV'T. L.J. 1, 14–17 (2020); Oliver Wing et al., *Estimates of Present & Future Flood Risk in the Coterminous U.S.*, 13 ENV'T. RES. LETTERS 1, 3 (2018).

157. CAROLINE PERI, STEPHANIE ROSOFF, & JESSICA YAGER, POPULATION IN THE U.S. FLOODPLAINS 1 (2017).

158. *Id.*

159. Lopez, *supra* note 156, at 23.

To help address the unintended consequences of these policies, Congress passed the Community Disaster Relief and Emergency Assistance Act in 2022.[160] The purpose of the statute is to authorize the executive branch to create products that help demonstrate natural hazard risks, including data and ratings for loss exposure, social vulnerability, and community resilience. It also authorizes funds and technical assistance for plans regarding resilience or mitigation in a community disaster resilience zone.[161] A year later, FEMA designated the first communities to receive aid through this Act, including communities in Bay and Washington counties (Florida panhandle); Hillsborough and Pinellas counties (Tampa Bay area); Brevard, Indian, St. Lucie and Martine counties (east coast); DeSoto, Hendry, Charlotte, Collier counties (southwest); and Miami-Dade, Broward, and Palm Beach counties (southeast). These communities were selected because they ranked in the top 50, or top 1%, of communities in the state on the composite National Risk Index and because they qualify as a disadvantaged community by the Climate & Justice Screening Tool.[162]

160. Pub. L. No. 117-255, 136 Stat. 2363.

161. FEMA has identified "community disaster resilience zones," areas that are most at-risk and/or in-need regarding natural hazards or climate change, to direct resources for improved resiliency. *Community Disaster Resilience Zones*, FEMA, https://www.fema.gov/partnerships/community-disaster-resilience-zones [https://perma.cc/NV9T-HKLS] (last visited Feb. 25, 2024).

162. *See* Press Release, FEMA,_FEMA Designates First Communities to Receive Targeted Assistance for Hazards Resilience (Sept. 6, 2023), https://www.fema.gov/press-release/20230906/fema-designates-first-communities-receive-targeted-assistance-hazards [https://perma.cc/65PW-LHD3]; *Community Disaster Resilience Zones Viewer*, FEMA, https://experience.arcgis.com/experience/e3bb8cb79d124a0ca38a05e48afb6fd6/page/Community-Disaster-Resilience-Zone-Viewer/ [https://perma.cc/38KG-7DHB] (last visited Jan. 8, 2024).

Due in part to a lack of federal leadership, resiliency planning is largely falling to local governments. The prevailing local climate adaptation strategies include protect, accommodate, and retreat;[163] or, put another way, hold the line or relocate the line and abandon the line.[164] The extent these strategies prioritize vulnerable communities or ecosystems differs with each strategy, from not at all to potentially.

A. Hold the Line

At this time, holding the line seems to be the most common intentionally adopted approach. Following major storms, communities rush to harden their coastlines through breakwaters and seawalls.[165] A pending Florida bill would prohibit local governments within a 100-mile radius of landfall from Hurricanes Ian and Nicole from updating their land use plans to make them more resilient until 2026, or, in other words, until the communities rebuild.[166] Florida also changed seawall permitting laws to facilitate rapid re-armoring following storms.[167] Seawalls in particular can have destructive effects on natural and built environments. Waves that encounter armor are unable to distribute sand higher up on the beach and instead pull sand away from the beach, accelerating erosion and redistributing the waves' energy

163. Kim Alexander, A. Ryan, & Thomas G. Measham, *Managed Retreat of Coastal Communities: Understanding Responses to Projected Sea Level Rise,* 55 J. OF ENV'T PLANNING AND MGMT., 409, 410 (2012).

164. Sofie Storbjork & Mattias Hjerpe, *Climate-proofing Coastal Cities: What is Needed to go from Envisioning to Enacting Multifunctional Solutions for Waterfront Climate Adaptation?*, 210 ENV'T OCEAN & COASTAL MGMT. Sept. 2021. To advance the line, coastlines are pushed out into the sea with infill, beach nourishment, or other engineering. To hold the line, seawalls and other coastal hardening structures are erected. To abandon the line, nothing is done in respond to natural disaster hazards. To relocate the line is metaphoric, it means to retreat or realign to a location less vulnerable to hazards, which inherently also means abandoning prior existing infrastructure. Phillips, *supra* note 145.

165. Curtis McCloud, *'An absolute nightmare': Residents say race to build new seawalls slowed by state*, (May 23, 2023), https://www.mynews13.com/fl/orlando/news/2023/05/23/seawall-construction-hits-roadblock--dep-slow-to-respond- [https://perma.cc/D5CH-VUVC]; Alex Harris, *'On borrowed time.' Why coastal Florida keeps rebuilding after storms like Hurrican Ian*, WUSF NPR (Nov. 5, 2022), https://www.wusf.org/environment/2022-11-05/on-borrowed-time-why-coastal-florida-keeps-rebuilding-after-storms-like-hurricane-ian.

166. S. SB 2-C: Disaster Relief, 117th Cong. (2023).

167. FLA. STAT. § 161.053; *Coastal Construction Control Line Emergency Permitting,* FLA. DEP'T OF ENVIRONMENTAL PROTECTION (Oct. 12, 2023), https://floridadep.gov/rcp/coastal-construction-control-line/content/coastal-construction-control-line-emergency-permitting [https://perma.cc/S2BT-CCE8].

toward adjacent, unarmored properties.[168] The upland sands and dunes become depleted and as a result the coastal dune habitat, which serves as both a species habitat and natural buffer, is destroyed, leaving species pinched between rising seas and human infrastructure.[169]

For example, on one coastal island in southeast Florida, seawalls have significantly impacted nesting sea turtles.[170] In one nesting season, only 26 of 168 observed nesting attempts were successful; the rest of the sea turtles encountered obstructions, the majority of which were seawalls.[171] The following year only 12 of 123 sea turtles successfully nested after encountering seawalls.[172] These seawalls have severed the interaction between the dune systems and the beach, ultimately resulting in a complete loss of beach, leaving only the seawalls.[173] The damage does not end there: seawalls reduce sand supply downdrift and cause erosion on beaches, reducing sea turtle nesting habitat even on beaches adjacent to the seawalls.[174]

Seawalls prevent a nesting turtle from reaching optimal nesting habitat,[175] forcing them to lay eggs lower on the beach, often resulting in egg mortality. For example, egg mortality is higher for nests laid lower on

168. Omar Defao et al., *Threats to Sandy Beach Ecosystems: A Review*, 81 ESTUARINE, COASTAL & SHELF SCI. 1, 2, 6 (2009); SHAWN W. KELLY, THE UTILIZATION OF SEAWALLS IN RESPONSE TO SHORELINE EROSION 2 (2000).

169. MATTHEW M. LINHAM & ROBERT J. NICHOLLS, TECHNOLOGIES FOR CLIMATE CHANGE ADAPTATION 5 (Xianlo Zhu ed., 2010).

170. Letter from U.S. Fish and Wildlife Service to Fla. Department of Environmental Protection, Singer Island Seawalls Letter of Concern (July 3, 2013) [hereinafter "USFWS Letter of Concern"]. The Service has previously advised the Florida Fish and Wildlife Conservation Commission in reviewing DEP CCCL permits in Walton County that it is the Service's position that coastal walling that is located 20 feet or more seaward of a habitable structure foundation would likely result in incidental take of sea turtles and their nesting habitat." Letter from U.S. Fish and Wildlife Service to Florida Fish and Wildlife Conservation Commission (Apr. 20, 2006).

171. DB ECOLOGICAL SERVICES, INC., 2012 SEA TURTLE NESTING ACTIVITY SINGER ISLAND NORTH 5 (2012) (on file with author).

172. *Id*.

173. Erosive effects of seawalls on adjacent properties are so bad that the state has carved out an exception to the permitting requirements for neighboring properties. Fla. Stat. § 403.813 (2023).

174. Ramakrishnan Balaji et al., *Understanding the effects of seawall construction using a combination of analytical modelling and remote sensing techniques: Case study of Fansa, Gujarat, India*, 8 INT'L J. OCEAN & CLIMATE SYS. 153, 159 (2017); Carol E. Rizkalla & Anne Savage, *Impact of Seawalls on Loggerhead Sea Turtle (Caretta caretta) Nesting and Hatching Success*, 27 J. COASTAL RSCH. 166 (2011).

175. *See generally*. Rizkalla & Savage, *supra* note 174.

the beach[176] because they are more likely to become inundated with water.[177] Additionally, increased moisture can result in the fluctuation of nest temperatures and harm future generations of sea turtles by skewing the sex ratio of hatchlings.[178]

B. Relocate the Line

Managed retreat, an increasingly more common strategy,[179] is the relocation of property to lower hazard areas through passive abandonment or active avoidance and relocation,[180] including setbacks, rolling easements, land acquisition, and zoning.[181] In the climate context, such mass exodus has typically corresponded to disaster relief efforts, as opposed to proactive planning.[182] One reason for this may be the perceived political cost of coastal adaptation planning, especially where managed retreat is specifically called for.[183] Whatever the cause, this adaptation strategy has had limited success in protecting communities; rather than reducing the

176. Blair E. Witherington, Shigetomo Hirama, & Andrea Mosier, *Sea Turtle Responses to Barriers on their Nesting Beach*., 401 J. OF EXPERIMENTAL MARINE BIOLOGY AND ECOLOGY 1, 5 (2011).

177. *Id.*; Allen M. Foley, Sue A. Peck, & Glenn R. Harman, *Effects of Sand Characteristics and Inundation on the Hatchling Success of Logger Head Sea turtle (Caretta caretta) Clutches on low Relief Mangrove Island in Southwest Florid*a, 5 CHELONIAN CONSERVATION AND BIOLOGY 32, 33 (2006).

178. Stephane Caut et al., *Effect of overwash on the embryonic development of leatherback turtles in French Guiana*, 69 MARINE ENV'T RSCH. 254 (2010).

179. John Cary, *Managed retreat increasingly seen as necessary in response to climate change's fury*, CORE 117 CONCEPTS 13182, 13182 (2020).

180. Leah Dundon & Mark Abkowitz, *Climate-induced Managed Retreat in the U.S.: A Review of Current Research*, 33 CLIMATE RISK MGMT. 1 no. 100337,(2021 (comprehensive literature review of managed retreat in the United States); William Neal, Orrin Pilkey, & David Bush, *Managed Retreat*, *in* ENCYCLOPEDIA OF COASTAL SCIENCE (C.W. Finkl & C. Makowski eds., 2017); Phillips, *supra* note 145, at 35.

181. Storbjork & Hjerpe, *supra* note 164, at 1, 2; Idowu Ajibade, Meghan Sullivan, & Melissa Haeffner, *Why Climate Migration is Not Managed Retreat: Six Justifications*, 65 GLOBAL ENV'T CHANGE 1, 2 (Oct. 2020).

182. A.R. Siders, *Social Justice Implications of U.S. Managed Retreat Buyout Program*, CLIMATIC CHANGE 239 (Sept. 2019); Peter Plastrik & John Cleveland, *Can it Happen Here? Improving the Prospect for Managed Retreat by U.S. Cities*, INNOVATION NETWORK FOR COMMUNITIES (Mar. 2019) (calling for a national plan for coastal retreat) (hereinafter Siders, *Social Justice Implications*); A.R. Siders, *The Administrators Dilemma: Closing the Gap between Climate Adaptation Justice in Theory and Practice*, 137 ENV'T SCI. & POL'Y 280 (2022) (hereinafter Siders, *Administrators Dilemma*).

183. Mark T. Gibbs, *Why is Coastal Retreat so Hard to Implement? Understanding the Political Risk of*

Coastal Adaptation Pathways, 130 OCEAN & COASTAL MGMT. 107 (June 2016).

hazard risks, it can often make existing vulnerabilities worse.[184] First, there is ample precedent in the United States of governments relocating low-wealth communities for a purported greater good.[185] Second, this approach fails to capture social costs and benefits which can harm communities.[186]

Mismanaged retreat can harm vulnerable communities when it worsens economic or political inequities or destroys community resources or intact ecosystems.[187] Natural hazards and industrial pollution are often located near low-wealth and minoritized communities.[188] The climate crisis amplifies their threats.[189] These communities tend to be more sensitive to climate-related heat and flooding because they have less of a natural buffer from natural environments.[190]

184. Siders, *Social Justice Implications*, *supra* note 182, at 251; Christina Hanna, Iain White, & Bruce Glavovic, *Managed Retreat in Practice: Mechanisms and Challenges for Implementation*, *in* OXFORD RSCH. ENCYCLOPEDIA OF NATURAL HAZARD SCI. (2019); Idowu Ajibade et al., *Are Managed Retreat Programs Successful and Just? A Global Mapping of Success Typologies, Justice Dimensions, and Trade-offs*, 76 GLOB. ENV'T CHANGE 1, 1 (Aug. 2022); *See also* Plastrik & Cleveland, *supra* note 182.

185. Robert Freudenberg et al., *Buy-In for Buyouts: The Case for Managed Retreat from Flood Zones, in* POL'Y FOCUS REPORT SERIES 1, 7 (2016).

186. Therese Asplund & Mattias Hjerpe, *Project Coordinators' Views on Climate Adaptation Costs and Benefits – Justice Implications*, 25 No. 2 LOC. ENV'T: THE INT'L J. OF JUST. AND SUSTAINABILITY 114, 126 (Jan. 2020).

187. Ajibade et al., *supra* note 184.

188. RICHARD CAMPANELLA, TIME AND PLACE IN NEW ORLEANS: PAST GEOGRAPHIES IN THE PRESENT Day (2002); Jonathan Mahler, *How the Coastline Became a Place to Put the Poor*, N.Y. TIMES (Dec. 4, 2012), https://www.nytimes.com/2012/12/04/nyregion/how-new-york-citys-coastline-became-home-to-the-poor.html [https://perma.cc/7QV5-CN54]**;** Jeremy Martinich et al., *Risks of Sea Level Rise to Disadvantaged Communities in the U.S.*, 18 MITIGATION ADAPTATION STRATEGIES FOR GLOB. CHANGE, 169, 182–83 (Feb. 2012); DENNIS MILETI, DISASTERS BY DESIGN: A REASSESSMENT OF NATURAL HAZARDS IN THE U.S. (1999).

189. David Schlosberg & Lisette Collins, *From Environmental to Climate Justice: Climate Change and the Discourse of Environmental Justice*, 5 WILEY INTERDISC. REV.: CLIMATE CHANGE, 4–5 (2014); Brent Yarnell, *Vulnerability and All that Jazz: Addressing Vulnerability in New Orleans After Hurricane Katrina*, 29 TECH. SOC'Y 249,253 (2007).

190. Craig Anthony Arnold, *Resilience Justice and Community-Based Green and Blue Infrastructure*, 45 WM. & MARY ENVTL. L. & POL'Y REV. 665, 667–68 (2021).

Even still, managed retreat may not always be an option if there is not enough funding or too few relocation sites,[191] an inability to leave a hazard site,[192] or an unwillingness to leave a site.[193] Sometimes, buyout programs harm tax revenue and disturb a community's services and benefits,[194] and the social impacts may not be equally distributed.[195] FEMA's Hazard Mitigation Grant Program funds post-disaster buyouts where local governments administer grants to purchase properties of willing sellers.[196] A homeowner can accept payment and move away, or can stay and meet the floodplain requirements.[197] Some studies show most buyouts occur in dense and higher-wealth counties, but within those counties, in areas with greater racial diversity and lower education levels, income, population density, and English language ability.[198]

Buyout programs can harm social justice, especially where selection criteria mask subjective decision-making,[199] political motivations, or cost-benefit analyses.[200] Nonetheless, FEMA speculates that redeveloping

191. Increasingly it appears there is funding to address many aspects of resiliency. Alexandra Carter & Isabel Jamerson, *Guidebook: Ocean Climate Funding for Coastal Cities*, URBAN OCEAN LAB, https://urbanoceanlab.org/ocean-climate-funding [https://perma.cc/JF57-ND72] (last visited Jan. 8, 2024).

192. Kira Walker, *Immobility: The neglected flipside of the climate displacement crisis*, NEW HUMANITARIAN (Apr. 26, 2021), https://www.thenewhumanitarian.org/analysis/2021/4/26/the-climate-displacement-crisis-has-a-neglected-flipside [https://perma.cc/4LLT-M9AG].

193. Carol Farbotko et al., *Relocation Planning Must Address Voluntary Immobility*, 10 NATURE CLIMATE CHANGE 702, 702 (Aug. 2020).

194. Sherri Binder, Charlene K. Baker & John P. Barile, *Rebuild or Relocate? Resilience and Postdisaster Decision-making After Hurricane Sandy*, 56 AM. J. CMTY. PSYCH., 180 (2015) (discussing factors that compel and discourage buyouts); Helen Wiley, *Must Floodplain Buyouts Decrease Tax Revenue?*, U. PENN. WHARTON: ENV'T, SOC.& GOVERNANCE (ESG) INITIATIVE (July 8, 2018), https://esg.wharton.upenn.edu/news/must-floodplain-buyouts-decrease-tax-revenue/ [https://perma.cc/W7SQ-DLHG]; Siders, *Social Justice Implications*, *supra* note 181, at 239 tbl. 3; CONG. RSCH. SERV., IN11911, FLOOD BUYOUTS: FEDERAL FUNDING FOR PROPERTY ACQUISITION 2 (2023).

195. Alexander et al., *supra* note 127, at 411.

196. *See Hazard Mitigation Grant Program (HMGP)*, FEMA, https://www.fema.gov/grants/mitigation/hazard-mitigation [https://perma.cc/7T5R-D74X] (Last visited Feb. 25, 2024); *see also* Daniel de Vries & James C. Fraser, *Citizenship Rights and Voluntary Decision Making in Post-disaster U.S. Floodplain Buyout Mitigation Program*, 30 INT'L. J. MASS. EMERG. DISASTERS 1, (2012) (explaining the voluntary nature of the program).

197. Katherine Mach et al., *Managed Retreat Through Voluntary Buyouts of Flood-Prone Properties*, 10 SCI. ADVANCES (2019); de Vries & Fraser, *supra* note 159.

198. *Id.*

199. Siders, *supra* note 147, at 239.

200. *Id.*

acquired property to open space raises property values of nearby property.[201] Purchased property indeed has the potential to be rehabilitated to restore ecosystem function,[202] even if floodplain managers sometimes do not return the acquired property to open space.[203] These nature-based solutions help reduce vulnerability while building resilience,[204] and often provide greater benefits for human communities than human-engineered systems.[205] Such ecological barriers can help stave off the impacts of rising sea levels and mitigate the impacts of sudden inundation from storms.[206] The benefits of such "green and blue infrastructure,"[207] like "trees and forests; vegetation, wildlife, and wildlife habitat; parks and recreational lands; biotic infiltration and retention of stormwater; waterways, wetlands, and watershed lands; agricultural lands and soils, including produce gardens and orchards; open space, corridors, and linkages; and oceans, marine systems, and coastal lands,"[208] transcend ecosystem benefits and include "friendship and social networks" and "mental, emotional, and physical health, as well as child development and identity formation."[209]

Likewise, in the context of the protection of biodiversity and conservation of habitat, the protection and enhancement of certain areas, the removal or minimization of stressors, and increasingly, relocation have emerged as key policy prescriptions for adapting to climate change.[210] Executive Order 14072 calls on federal agencies to use "nature-based solutions to tackle climate change and enhance resilience."[211] The E.O. lists some of the benefits of prioritizing habitat restoration: "protect coasts and

201. Elyse Zavar & Ronald R. Hagelman, *Land Use Change on U.S. Floodplain Buyout Sites, 1990-2000*, 25 DISASTER PREVENTION & MGMT. 360, 361 (2016).

202. *Id.* at 362.

203. Zavar & Hagelman, *supra* note 200, at 365 tbl. 1 (2016) (listing different land uses at buyout sites).

204. A.D. Guerry et al., *Protection and Restoration of Coastal Habitats Yield Multiple Benefits for Urban Residents as Sea Level Rise*, 2 URB. SUSTAINABILITY no. 13, 2022, at 1.

205. *Id*.

206. *Id.* at 8.

207. Arnold, *supra* note 155.

208. *Id.* at 673 (list in original).

209. *Id.* at 677.

210. *See generally* Shannon M. Haggerman & Terre Satterfield, *Agreed but not Preferred: Expert Views on Taboo Options for Biodiversity Conservation, Given Climate Change*, 24 ECOLOGICAL APPLICATIONS 548 (2014); Leonie Seabrook & Clive McAlpine, *Restore, Repair or Reinvent: Options for Sustainable Landscapes in a Changing Climate*, 100 LANDSCAPES AND URB. PLAN. 407, 407–10 (2011); Lopez, *supra* note 109.

211. Exec. Order No. 14,072, 87 Fed. Reg. 24,851 (Apr. 22, 2022).

ecosystems, reduce flooding, moderate extreme heat, replenish groundwater sources, capture and store carbon dioxide, conserve biodiversity, and improve the productivity of agricultural and forest lands to produce food and fiber."[212]

In passing the Endangered Species Act ("ESA") more than 50 years ago, Congress declared that endangered and threatened plants and animals are of "esthetic, ecological, education, historical, recreational, and scientific value to the Nation and its people."[213] The purpose of the statute is to "provide a program for the conservation" of such species, to protect them from extinction, and to recover them so the protections of the statute are no longer needed.[214] Recovery plans are the blueprints for recovery and must include criteria to recover the species as well as recovery goals and time estimates.[215]

Dozens of plant species are also listed under the ESA due to climate threats, but the majority of those do not yet have recovery plans.[216] Even though nearly all species listed as endangered or threatened are vulnerable to climate change, only 18% of species have recovery plan actions to address the threats.[217] Borrowed from the National Park Service,[218] the U.S. Fish and Wildlife Service developed a Resist-Accept-Direct framework in 2022 to guide the agency's decision-making regarding management responses to ecosystem transformation from climate change.[219] The

212. *Id.* at 24,854.
213. 16 U.S.C. § 1531(a)(3).
214. 16 U.S.C. § 1531(b).
215. 16 U.S.C. § 1533(f)(1)(B)(i)-(iii).
216. *See* Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for *Chromolaena frustrata* (Cape Sable thoroughwort), *Consolea corallicola* (Florida semaphore cactus), and *Harrisia aboriginum* (Aboriginal prickly-apple), 78 Fed. Reg. 63,796, 63,796 (Oct. 24, 2013); *see also, e.g.*, *Species Profile for Cape Sable Thoroughwort(Chromolaena frustrata)*, U.S. FISH & WILDLIFE SERV., https://ecos.fws.gov/ecp/species/4733, [https://perma.cc/QP2R-JXVS] (last visited Feb. 25, 204), *Aboriginal Prickly-apple (Harrisia (=Cereus) aboriginum (=gracilis))*, U.S. FISH & WILDLIFE SERV., https://ecos.fws.gov/ecp/species/2833 [https://perma.cc/LUU8-9LJF] (last visited Feb. 25, 2024).
217. Aimee Delach et al., *Agency Plans are Inadequate to Conserve U.S. Endangered Species Under Climate Change*, 9 NATURE CLIMATE CHANGE 12, 12 (2019).
218. National Park Service, *Resist-Accept-Direct Framework*, NPS, https://www.nps.gov/subjects/climatechange/resistacceptdirect.htm [https://perma.cc/4Z68-S8UX] (last visited Jan. 8, 2024).
219. *Resist-Accept-Direct (RAD) Webinar Series*, U.S. FISH & WILDLIFE SERVICE, https://www.fws.gov/training/webinar/resist-accept-direct-framework [https://perma.cc/CDX9-7ZCY] (last visited Jan. 8, 2024).

Inflation Reduction Act allocated $62.5 million to the Department of Interior to expedite the recovery plan implementation for 300 species.[220] Congress also allocated $121.25 million through 2026 to help repair National Wildlife Refuges impacted by "adverse weather events."[221]

Assisted migration and genetic rescue are tools wildlife managers are already using to make vulnerable populations of plants and animals more resilient to climate change.[222] This migration can be in the form of passive assisted migration through the designation of critical habitat that is or could be suitable for imperiled species.[223] There is also more active migration involving deliberate relocation of species to move them out of harm's way or to make populations more resilient.[224] The U.S. Fish and Wildlife Service recently updated its regulations regarding the introduction of species outside their historical range to allow for their conservation, particularly in light of climate change.[225] The agency rewrote this regulation specifically to address the conservation of species threatened by climate change, noting, "we did not anticipate the impact of climate change on species and their habitats" when the agency originally adopted the regulations and that it has "since learned that climate change is causing, or is anticipated to cause, many species' suitable habitat to shift outside of their historical range."[226]

However assisted migration is not without its own risks. The National Park Service commissioned a risk assessment protocol for evaluating assisted migration potential for species.[227] The paper identified six main areas of risk, including no action to the target species and recipient ecosystem; risk of relocation to the target species; risk of action on non-

220. *Biden-Harris Administration Announces $62.5 Million Through Investing in America Agenda for Endangered Species Recovery Planning*, DEP'T OF INTERIOR, https://www.doi.gov/pressreleases/biden-harris-administration-announces-625-million-through-investing-america-agenda [https://perma.cc/5NPM-Y96L] (last visited Jan. 8, 2024).

221. *Inflation Reduction Act — Advancing Climate Resiliency and Conservation*, U.S. Fish & Wildlife Service, https://www.fws.gov/initiative/directors-priorities/inflation-reduction-act-advancing-climate-resiliency-and, [https://perma.cc/WQM6-4MY4] (last visited Jan. 8, 2024).

222. Sarah Fitzpatrick et al, *Genetic Rescue Remains Underused for Aiding Recovery of Federally Listed Vertebrates in the U.S.*, 114 J. OF HEREDITY 354 (2023).

223. Lopez, *supra* note 109, at 169.

224. *Id.* at 171–73.

225. Endangered and Threatened Wildlife and Plants; Designation of Experimental Populations, 88 Fed. Reg. 42642 (July 3, 2023).

226. *Id.* at 42643.

227. AVIV KARASOV-OLSON ET AL., U.S. NATIONAL PARK SERVICE PUBLICATIONS AND PAPERS, ECOLOGICAL RISK ASSESSMENT OF MANAGED RELOCATION AS A CLIMATE CHANGE ADAPTATION STRATEGY (2021).

target species in the ecosystem; risk of action on recipient ecosystem; risk associated with invasion; and risk associated with socio-economic values.[228] Another risk that should be considered, and something state and federal wildlife managers already consider with species in their current habitats, is social carrying capacity: the capacity of the human community to accept the introduced species.[229]

III. FLORIDA'S ADAPTATION STRATEGIES MAY NOT BE DOING ENOUGH TO PROTECT VULNERABLE COMMUNITIES AND ECOSYSTEMS.

There are several statewide and local initiatives addressing climate resiliency in Florida,[230] but few seem to be centering vulnerable communities and biodiversity. For example, Florida has one of the strictest building codes in the nation.[231] For every one dollar in added construction cost due to the code, there is an estimated savings of six dollars in reduced wind loss damage.[232] The Florida Department of Environmental Protection (FDEP) has drafted a proposed rule regarding Sea Level Impact Projection Studies for State-Financed Coastal Construction, which proposes that a state-financed constructor produce a study detailing the impact of sea level rise over the next 50 years.[233] However, this rule would not mandate that they implement or act on any of the information in the study, and it would not place a special emphasis on vulnerable communities or biodiversity.[234]

228. *Id.* at 10.

229. Nathan Rott, *Shrinking habitat raises questions about how to save endangered Key deer*, NPR (Oct. 31, 2023) https://www.npr.org/2023/10/31/1209644541/shrinking-habitat-raises-questions-about-how-to-save-endangered-key-deer [https://perma.cc/Y894-5QXM]; Chad Gillis, *Panther Status Change Could Open South Fla. Preserve Lands to Development*, NEWS-PRESS (July 26, 2023), https://www.news-press.com/story/news/environment/2023/07/26/florida-panther-feds-hinted-at-listing-change-but-no-news-yet/70461636007/https://[perma.cc/SGX5-K22B].

230. *Peace River Manasota Regional Water Supply Authority's Decision Matrix for Using Aquifer Storage Recovery and Tampa Bay Water Decision Making Using Climate Science*, U.S. CLIMATE RESISTANCE TOOLKIT, https://toolkit.climate.gov/case-studies/climate-outlooks-help-water-supply-planning [https://perma.cc/G5U3-52FW] (last visited Jan. 8, 2024).

231. Carter, *supra* note 86, at 768; Kevin M. Simmons, Jeffrey Czajkowski & James M. Done, *Economic Effectiveness of Implementing a Statewide Building Code: The Case of Florida*, SOC. SCI. RSCH. NETWORK 1, 64 (July 25, 2017).

232. *Id.*

233. Sea Level Impact Projection (SLIP) Studies for State-Financed Coastal Construction, 62S-7: Draft Rule Jan. 12, 2021.

234. *Id.*

Likewise, the Florida Water & Climate Alliance convenes workshops and develops data regarding water supply and resource planning,[235] but does not mandate particular results.

Florida's Growth Management Act requires coastal communities to develop post-disaster redevelopment plans and recommends such plans for inland counties.[236] The purpose of the plans is to prevent inappropriate or unsafe development.[237] Florida has also authorized funding to facilitate a coordinated approach to improve the state's resilience to flooding and sea level rise by providing funding for critical infrastructure, including transportation and evacuation routes, community and emergency facilities, and natural, cultural, and historic resources.[238] A statewide assessment identified 835,725 routes; 353,907 infrastructure assets; 23,398 facilities, which includes affordable public housing; and 1,301,958 natural, cultural, and historical resource assets, which includes wetlands.[239] The identification of these assets is an important potential starting point of resiliency planning. When key community assets are lost and cannot be replaced, they may signify tipping points in a community's ability to persist. For example, in a small community with a less flexible annual budget, if the only elementary school in the area suffers hurricane damage and cannot reopen, children may have to be bussed to nearby communities, families with young children might find the location less attractive and move away, and small businesses might follow, which can rapidly bankrupt a community which is then forced to migrate somewhere else.[240]

This law also requires the development of a statewide flooding and sea level rise resilience plan, with updates every three years.[241] This "plan" is a

235. *Workshops & Webinars*, FLORIDA WATER AND CLIMATE ALLIANCE, https://www.floridawca.org/workshops-webinars-list [https://perma.cc/RZ9T-SL8T] (last visited Jan. 8, 2024).

236. FLA. STAT. § 163.3177(7)(l) (2023); FLA. STAT. § 163.3178(2) (2023); FLA. ADMIN. CODE r. 9J-012(3)(b)(8) (1994).

237. FLA. STAT. § 163.3178(2)(f) (2023).

238. FLA. STAT. § 380.093 (2023); The bill authorized $12.5 million for Florida's Resilient Coastlines Initiative and $129 million for the Resilient Florida Grant Program. Press Release, Office of Governor Ron DeSantis, Governor Ron DeSantis Signs Bill to Further Strengthen Florida's Resiliency Efforts (May 2021), https://www.flgov.com/2021/05/12/governor-ron-desantis-signs-bill-to-further-strengthen-floridas-resiliency-efforts/ [https://perma.cc/TEE6-WN4Y].

239. FLA. DEP'T OF ENV'T PROT., FLORIDA STATEWIDE RESILIENCE DATASET, STATEWIDE CRITICAL ASSETS: FINAL REPORT ON DATASET 7 2023).

240. McLeman, *supra* note 146, at 332.

241. *Fla. S., CB/CS/SB 1954 -Statewide Flooding and Sea Level Rise Resilience*, THE FLA.

description of grant funding criteria and a list of approved plans.[242] The funding appears to be mostly for stormwater and wastewater treatment repairs, fire stations, seawall construction, and a few living shoreline projects.[243] It provides grant funding to communities to conduct vulnerability assessments, including an analysis of flooding threats, but does not invoke heat or wind or human response to flood threats.[244] It also created the Florida Flood Hub, the mission of which is to provide actionable data on flood threats.[245] Again, none of these policies prescribe particular outcomes or prioritize vulnerable communities or biodiversity.

Florida has also produced a "Florida Adaptation Planning Guidebook," which instructs local governments on how to conduct a vulnerability assessment and describes adaptation and implementation strategies.[246] It lists the four "adaptation" strategies as protection, accommodation, retreat, and avoidance.[247] It describes retreat as potentially appropriate for barrier islands or high-risk areas, but that communities can continue to invest in projects locally.[248] To the extent it characterizes retreat as "managed," it explains that, because stakeholders may not react positively to something that sounds like defeat, it suggests "managed relocation" or "realignment."[249] It is not clear whether or how many communities have used this planning document.

Likewise, Florida has produced a Post-Disaster Redevelopment Planning document offering similar advice and a report summarizing pilot projects of six Florida communities. The report offers insights for the 67 counties and 400+ municipalities that may seek to produce their own post-disaster redevelopment plan[250] The report also emphasizes the necessity of

---

SENATE (2021), https://www.flsenate.gov/Committees/billsummaries/2021/html/2327 [https://perma.cc/3EL7-ENYS].

242. FLA. DEP'T OF ENV'T. PROT., 2022-23 STATEWIDE FLOODING AND SEA LEVEL RISE RESILIENCE PLAN 7 (2023).

243. *Id.*

244. Fla. Stat. § 380.093 (2023).

245. Dyllan Furness, *The Flood Hub Rises to the Challenge of Coastal Resilience in Fla.*, USF COLLEGE OF MARINE SCIENCE (Sept. 2022), https://www.usf.edu/marine-science/news/2022/the-flood-hub-rises-to-the-challenge-of-coastal-resilience-in-florida.aspx [https://perma.cc/R5HG-K55P].

246. FLA. DEPT. ENV'T PROT., FLORIDA ADAPTATION PLANNING GUIDEBOOK (2018).

247. *Id.* at 38.

248. *Id.* at 40.

249. *Id.* at 40.

250. FLA. DEP'T OF CMTY. AFFAIRS & FLA. DIV. OF EMERGENCY MGMT., POST-DISASTER REDEVELOPMENT PLANNING: A GUIDE FOR FLORIDA COMMUNITIES 2–3 (2010).

public participation as "an important component in developing a plan that will be supported,"[251] but, instead of establishing a framework for the plan itself to be community driven, the report conceives of public participation as solicited input. Finally, the report also offers "tips for keeping stakeholder input focused" on the "purpose of the PDRP,"[252] which suggests that the planning process should make room for, but not center, the very public it intends to serve.

A bright spot in Florida's efforts is the Southeast Regional Climate Compact, a partnership between counties in southeast Florida working together to share information and implement strategies to reduce greenhouse gas emissions and make their communities more resilient to climate change.[253] Although the compact is an excellent convenor of resources, it is not binding on any government.[254] Nonetheless, other regions in Florida are modeling their efforts on this one,[255] and south Florida seems to be taking the charge seriously.

For example, Miami-Dade County, the City of Miami, and the City of Miami Beach formed a partnership called the Resilient 305 Strategy, through the 100 Resilient Cities Network.[256] It serves to help guide intergovernmental and community collaboration on resiliency goals and projects.[257] It has developed a Climate Action Strategy, informed by community members and nonprofit organizations, with energy and building, land use and transportation, water and waste goals, and specific objectives with defined timelines,[258] like reducing greenhouse gas emissions

251. *Id.* at 17.

252. *Id.* at 36.

253. *What is the Compact?*, SE. FLA. REG'L CLIMATE CHANGE COMPACT, https://southeastfloridaclimatecompact.org/what-is-the-compact/ [https://perma.cc/8NVT-LKV4] (last visited Feb. 25, 2024).

254. *About the RCAP 3.0*, SE. FLA. REG'L CLIMATE CHANGE COMPACT, https://southeastfloridaclimatecompact.org/about-the-rcap-3-0/ [https://perma.cc/4FKZ-5LV5] (last visited Feb. 25, 2024).

255. *Southwest Florida Regional Resiliency Compact: What is it, and What Does it Mean for Southwest Florida*, AUDUBON FLA., https://fl.audubon.org/faq/southwest-florida-regional-resiliency-compact#:~:text=The%20Southwest%20Florida%20Regional%20Resiliency,and%20mitigate%20climate%20change%20impacts [https://perma.cc/YS9G-TPB4] (last visited Jan. 8, 2024).

256. *Resilient305*, MIAMI-DADE, FLA., OFFICE OF RESILIENCE, https://www.miamidade.gov/global/economy/resilience/resilient305.page [https://perma.cc/6JDX-7SMX] (last visited Jan. 8, 2024).

257. *Id.*

258. *Climate Action Strategy-Revised*, MIAMI-DADE, FLA. (Dec. 2021), climate-action-strategy-final-draft.pdf (miamidade.gov) [https://perma.cc/RP5V-JFS6].

from Miami International Airport by 50% and from Port Miami by 25% by 2030.[259] In particular, its goal of retuning and retrofitting existing buildings emphasizes the importance of reducing energy burdens on vulnerable communities.[260] It has also conducted a heat vulnerability assessment to identify urban heat island areas to prioritize future tree planting.[261] In pursuit of this objective, the county's Department of Environmental Resources Management's Environmentally Endangered Lands program has aided in the reforestation of habitat for federally listed Florida bristle fern.[262] Since 2007, Miami-Dade County has required that its buildings meet certain sustainability standards,[263] and through its Building Efficient 305 initiative, it seeks to improve residential and commercial properties' resilience by improving efficiency and reducing utility costs.[264] In 2021, Miami hired the first ever "Chief Heat Officer," who helps with extreme heat planning,[265] including an Extreme Heat Action Plan with goals to inform the public and cool homes, emergency facilities, and neighborhoods.[266]

Jacksonville also recently published its resiliency plan which identifies 45 actions across 11 adaptation approaches.[267] The plan explains that it was developed over 18 months with hundreds of stakeholders and experts.[268] Development of the plan included community group meetings, nonprofit events, website launch, working groups, surveys, and a symposium.[269] It is an easily digestible document explaining the action, the shocks and stressors

259. *Climate Action Strategy 2023 Progress Report*, MIAMI-DADE, FLA. 1, 14 (Apr. 2023), https://www.miamidade.gov/environment/library/resilience/2023-04-cas-progress-report.pdf [https://perma.cc/D5LL-9EZW].

260. *Id.* at 4.

261. *Id.* at 19.

262. *Id.* at 20.

263. Memorandum, Miami-Dade, Fla., Ordinance 07-65 Concerning the Sustainable Buildings Program (Mar. 6, 2007).

264. *Building Efficiency 305 (BE305)*, MIAMI-DADE, FLA., https://be305about-mdc.hub.arcgis.com/ [https://perma.cc/9BV5-Y5GQ] (last visited Jan. 8, 2024).

265. *Chief Heat Officer*, MIAMI-DADE, FLA., https://www.miamidade.gov/global/economy/environment/chief-heat-officer.page [https://perma.cc/QPZ4-8ZKJ] (last visited Jan. 8, 2024).

266. *Extreme Heat Action Plan*, MIAMI-DADE CTY. OFF. OF RESILIENCE (Dec. 2022), https://www.miamidade.gov/environment/library/2022-heat-action-plan.pdf [https://perma.cc/Y8NM-EGA5].

267. CITY OF JACKSONVILLE, RESILIENT JACKSONVILLE 63 (2023).

268. *Id.* at 55.

269. *Id.* at 64.

addressed, partners, funding mechanisms, timelines, and costs.[270] Some of the actions address improving existing infrastructure and growing in less vulnerable areas, preserving open space and ecosystems, and accommodating and retreating.

Accommodations include retrofitting buildings to improve environmental functions, implementing resiliency standards and codes, and hardening critical assets.[271] Retreat includes relocation plans for vulnerable critical assets and streamlining buyout programs.[272] The relocation plans are not developed yet, and the report merely suggests that as assets must be naturally retired, opportunities exist to reconstruct in less vulnerable areas.[273] The report indicates the city will research other buyout programs and work with federal agencies to leverage funds.[274] But even these standout plans do not center the protection and preservation of vulnerable communities or ecosystems, except where already convenient.

Regarding biodiversity, there are some local efforts to protect and conserve habitat,[275] but unlike adaptation planning, species conservation is largely happening through federal leadership. While the Inflation Reduction Act has provided the U.S. Fish and Wildlife Service ("FWS") with $250 million in new funding for climate projects, only $100,000 appears to be going toward conservation in Florida.[276] Incidentally, the singular project funded with this money is a south Florida pine rocklands habitat restoration project to support recovery.[277] Pine rocklands are found in three areas of southern Florida: the Miami Rock Ridge of southeastern peninsular Florida, the Lower Florida Keys, and the southern Big Cypress pinelands.[278] These areas have been fragmented and degraded by past land use practices.[279] For

270. *Id.* at 67.
271. *Id.* at 124.
272. *Id.* at 144.
273. *Id.* at 147.
274. *Id.* at 148.
275. *Environmentally Endangered Lands Program,* MIAMI-DADE, FLA, https://www.miamidade.gov/environment/endangered-lands.asp [https://perma.cc/R8QZ-AC2Q] (Nov. 23, 2022).
276. *Inflation Reduction Act — Advancing Climate Resiliency and Conservation*, U.S. FISH & WILDLIFE SERVICE, https://www.fws.gov/initiative/directors-priorities/inflation-reduction-act-advancing-climate-resiliency-and [https://perma.cc/8LVQ-E9Z8] (last visited Jan. 8, 2024).
277. *Id.*
278. FLA. NAT. AREAS INVENTORY, GUIDE TO THE NATURAL COMMUNITIES OF FLORIDA 71 (July 2010).
279. *Id.* at 70; U.S. FISH AND WILDLIFE SERVICE, SOUTH FLORIDA MULTI-SPECIES RECOVERY

example, the north-south distribution of pine rocklands along the Miami Rock Ridge has already been reduced by over 12 miles.[280] FWS' recovery plan for the area states its goal is to restore the pine rocklands by maintaining the function, structure, and ecological processes of pine rocklands, and preventing any further loss, degradation, or fragmentation of this imperiled South Florida community.[281]

However, development pressures and climate change make the implementation of this recovery plan difficult. For example, in Miami-Dade County, only relatively small (50 hectares) patches of isolated pine rockland habitat remain in an otherwise urban landscape.[282] The Richmond tract of pine rocklands in Miami-Dade County contains 260 taxa of native plants.[283] Imperiled species that may utilize or depend upon pine rocklands in this area include the Florida bonneted bat,[284] Florida leafwing butterfly,[285] Bartram's scrub-hairstreak butterfly,[286] Miami tiger beetle,[287] eastern indigo snake,[288] rim rock crowned snake,[289] gopher tortoise,[290] white-crowned pigeon,[291] Everglades bully,[292] Florida brickell-bush,[293] Carter's small-flowered

---

PLAN at 3-174 (1999).

280. U.S. FISH & WILDLIFE SERV., *supra* note 279 at 3-173.

281. *Id.* at 3-173 to 81.

282. Dean A. Williams et al., *Genetic diversity and spatial structure of a keystone species in fragmented pine rockland habitat,* 138 BIOLOGICAL CONSERVATION 256, 257 (2007).

283. U.S. FISH & WILDLIFE SERV., *supra* note 279, at 3-162. Taxa is the plural of taxon, which is a grouping of organisms. *Taxon*, BRITANNICA, https://www.britannica.com/science/taxon [https://perma.cc/CX26-MWTZ] (last visited Feb. 25, 2024).

284. U.S. FISH & WILDLIFE SERV., *supra* note 279, at 3-168.

285. *Id.*

286. *Id.* at 3-169.

287. *Miami Tiger Beetle*, FLA. FISH & WILDLIFE CONSERVATION COMM'N, https://myfwc.com/research/wildlife/invertebrates/mtb/, [https://perma.cc/J2R9-WMMQ] (Last visited Feb. 25, 2024).

288. U.S. FISH & WILDLIFE SERV., *supra* note 279, at 3-169.

289. *Id.*

290. *Id.*

291. *Listed Species Utilizing Hardwood Hammock*, MONROE CNTY. FLA., https://monroecounty-fl.gov/194/Listed-Species-Utilizing-Hardwood-Hammoc [https://perma.cc/W2WJ-CCSX] (last visited Feb. 25, 2024).

292. *Everglades bully (Sideroxylon reclinatum ssp. austrofloridense)*, U.S. FISH & WILDLIFE SERV, https://ecos.fws.gov/ecp/species/4735 [https://perma.cc/82MK-AELR] (last visited Feb. 25, 2024).

293. FAIRCHILD GARDEN, GET THE FACTS ON PINE ROCKLANDS (2019), available at https://fairchildgarden.org/wp-content/uploads/2020/04/PR-Factsheet-2019.pdf.

flax,[294] deltoid spurge,[295] and tiny polygala.[296] In addition, the native southeast Florida slash pine endemic to the rockland ecosystem, Dade County pine (*Pinus elliottii* var. *densa)*, is redlisted by the International Union for the Conservation of Nature and Natural Resources.[297] FWS identifies acquiring lands that are threatened with development as the main tool for preventing further destruction or degradation of existing pine rocklands,[298] yet progress has been slow.[299]

IV. COASTAL COMMUNITIES MUST PRIORITIZE VULNERABLE COMMUNITIES AND ECOSYSTEMS THROUGH PROACTIVE PLANNING THAT IS TRANSPARENT AND INCLUSIVE.

The key tenets that municipal planners should faithfully follow in resiliency and adaptation planning include proactive planning, transparency, and inclusivity. A study on 138 post-settlement case studies concluded that while the "techno-managerial" typology, driven by top-down governmental directives that measure success by whether the population was resettled away from the identified risk, was the most dominant managed retreat strategy globally, planning retreat around intersectional justice is a more effective strategy for ensuring the overall well-being of relocated communities.[300] The study identified five typologies to measure managed retreat success post-resettlement: techno-managerial, eco-restorative, compensatory, reformative, and transformative.

Techno-managerial typology defines success by determining whether people were moved from the perceived harm to somewhere else.[301] It is initiated by the government and does not explicitly consider equity or

294. U.S. FISH & WILDLIFE SERV., *supra* note 279, at 3-171.
295. *Id.* at 3-170 to 71
296. *Id.*
297. A. Farjon, *Pinus elliottii var. densa Assessment,* IUCN RED LIST OF THREATENED SPECIES (2015), http://www.iucnredlist.org/details/18153818/0 [https://perma.cc/8NBJ-5CJK](the IUCN red list provides information on species' statuses). *Id.*
298. U.S. FISH & WILDLIFE SERV., *supra* note 279, at 3-178.
299. *Id.* at 3-177; Kyle Munzenrieder, *Fox Theme Park, Miami Wilds Wants $13.5 Million in County Money* (Oct. 23, 2014), http://blogs.miaminewtimes.com/riptide/2014/10/fox_theme_park_miami_wilds_wants_135_million_in_county_money.php [https://perma.cc/GD9R-9XEQ].
300. Ajibade et al., *supra* note 184 at 1.
301. *Id.* at 4.

justice.[302] Eco-restorative typology focuses on rehabilitating the natural environment impacted by climate change or other human causes, with some focus on equity and justice.[303] Compensatory typology follows a more traditional convention of buy-outs or other incentives to move away from hazardous areas, with some implicit attention paid to equity and justice.[304] Reformative typology focuses on maintaining and increasing access to social infrastructure and services and is centered on community needs and prioritizes the preservation of community.[305] Transformative typology invokes strong community participation and self-determination where the people to be resettled actively participate in all aspects of decision-making.[306]

The study determined that the compensatory, reformative, and transformative typologies were successful in not only moving people from hazards, but also in improving the ability of those people to continue to adapt to climate change by increasing access to employment and better ecological, health, and social outcomes.[307] The study also noted that the decision-making process had less of an impact on success than the typology.[308]

In proactive planning, local governments have opportunities to reframe retreat "as part of a positive and inspiring vision for the city's long-term development and success."[309] Local governments can lead by example by proactively relocating public goods and services like infrastructure and utilities.[310] Jacksonville's resilience plan intends to market its "resilient business climate" to attract new investments. In other words, it wants to make its efforts to invest in resilience to climate change a selling point to retain and attract new business.[311] The Tampa Bay Regional Planning Council's resiliency coalition lists ten guiding principles in its 2022 *Regional Resiliency Action Plan*. The first is "positive vision," which reflects the coalition's priority of framing resiliency planning as a way to

302. *Id.*
303. *Id.*
304. *Id.* at 5.
305. *Id.* at 5.
306. *Id.* at 5.
307. *Id.* at 7–9.
308. *Id.* at 8.
309. Plastrik & Cleveland, *supra* note 182, at 4.
310. *Id*.
311. CITY OF JACKSONVILLE, *supra* note 267, at 176.

"strengthen and protect" communities and create opportunities.[312] Plastrik & Cleveland of the *Innovation Network for Communities* likewise suggest that cities "should reframe retreat as not just a loss, but as part of a positive and inspiring vision for the city's long-term development and success."[313] One way local governments can kick start and, importantly - normalize - this process is by frontloading the relocation of public goods and services, including infrastructure and utilities.[314]

Transparency in decision-making and information sharing is vital to successful resiliency planning.[315] Studies suggest that managed retreat must be inclusively, strategically, and transparently designed and implemented.[316] Subjective decision-making and a lack of transparency have the potential to influence how communities adapt to climate change.[317] While managed retreat can be a valuable adaptation tool, it must be used in an inclusive, strategic, and transparent way.[318] The climate adaptation social justice cost-benefit analysis that should be centered includes "fairness in the distribution of the goods and services, rights and opportunities associated with the adaptation measure."[319]

Transparency also involves information sharing, including raw data. There must be a commitment to using and providing "FAIR data" – data that meets the widely supported principles of findability, accessibility, interoperability, and reusability.[320] Adherence to these guidelines makes data more valuable because a greater number and diversity of individuals can access it and better vet its reliability.[321]

312. TAMPA BAY REGIONAL PLANNING COUNCIL RESILIENCY COALITION, REGIONAL RESILIENCY ACTION PLAN (2022).
313. Plastrik & Cleveland, *supra* note 182, at 4.
314. *Id*.
315. Siders, *supra* note 182, at 239–57.
316. Siders, *supra* note 182, at 280–89; Hanna et al., *supra* note 184.
317. Siders, *supra* note 182, at 239–57.
318. Hanna et al., *supra* note 149.
319. Asplund & Hjerpe, *supra* note 186, at 114–29.
320. Matthias Scheffler et al., *FAIR Data Enabling New Horizons for Materials Research*, 604 NATURE 635, 635–42 (2022).
321. Alison Moore, *Data with principles: How to be FAIR, and why you should CARE*, SIMON FRASIER UNIV. (Mar. 23, 2022) https://www.lib.sfu.ca/help/publish/scholarly-publishing/radical-access/fair-and-care-data [https://perma.cc/24BM-46J8].

Inclusive planning involves community planning,[322] including making time and space for acknowledging loss.[323] Important questions must be raised and addressed like:

- What would a safe place look like, and where would it be located?
- What would life look like in the future?
- Where would people live, and what would their environment be like?
- Where would they work, and how would they sustain themselves – not just the people moving, but future generations?
- How would people who want to leave support themselves before, during, and after a move?
- How would cultural practices be maintained for future generations?[324]

A 2016 study of resilience measures in communities found that they were often developed ad hoc and not the result of a local community initiative.[325] When they did come from the government, it was typically at the highest level of municipal leadership.[326] Many involved cross-department and stakeholder group collaboration, but often community-led conversations were not prioritized.[327] A study of hazard mitigation planning indicates that

322. National Academy of Sciences, *Equity in Community Viability and Environmental Change*, *in* ASSISTED RESETTLEMENT AND COMMUNITY VIABILITY ON LOUISIANA'S GULF COAST: PROCEEDINGS OF A WORKSHOP 41 (2023) (Michael Esealuka at a NAS workshop criticizing managed retreat as something that happens "to communities and not by them").

323. Craig, *supra* note 144, at 69 ("Perhaps the most difficult aspect of climate change adaptation law, policy and planning will be the acceptance of loss."); Plastrik & Cleveland, *supra* note 147, at 4 ("[A] city's community-engagement process for resilience planning should be designed for the emotional and social aspects of considering managed retreat.").

324. Elder Rosina Phillipe posed these questions at an assisted migration workshop. Workshop, National Academy of Sciences, Equity in Community Viability and Environmental Change, in Assisted Resettlement and Community Viability on Louisiana's Gulf Coast: Proceedings of a Workshop 26 (2023).

325. NAYANEE GUPTA ET AL., CASE STUDIES OF COMMUNITY RESILIENCE POLICY. NIST GCR 16-002 iii (2016).

326. *Id.*

327. *Id.*

not all populations are even aware of or participate in such planning processes. The study found that the unemployed are less likely to report awareness of or participation in planning, and that African-Americans, mobile home residents, low-wealth, and short-term residents were less likely to be aware of planning policies and investments.[328]

Finally, a major challenge in resiliency planning is measuring or assessing success. The five leading U.S. vulnerability and resilience indices all have four factors in common: social, economic, physical, and human or community.[329] One study examining community disaster resilience assessment tools found little consistency among published methodologies.[330] The study suggests classifying indicators of community disaster resilience into domains to assess resilience: social, economic, institutional, physical, and natural.[331] It also found that there were no studies that quantified the relationships or weighed the factors, and that to do so would require a complex index.[332]

---

328. Jennifer Horney et al., *Measuring Participation by Socially Vulnerable Groups in Hazard Mitigation Planning, Bertie County, North Carolina*, 58 J. OF ENV'T PLANNING AND MGMT. 1, 14–15 (2014).

329. Laura Bakkensen, et al., *Validating Resilience and Vulnerability Indices in the Context of Natural* Disasters, Risk Analysis 37(5) (2017) (describing Susan L. Cutter, Chris Emrich & Christopher G. *Burton, Baseline Resilience Index for Communities in Disaster Resilience Indicators for Benchmarking Baseline Conditions*, 7 J. HOMELAND SEC. & EMERGENCY MGMT. 1 (2010)); COMMUNITY DISASTER RESILIENCE INDEX IN ADVANCING RESILIENCE OF COASTAL LOCALITIES: DEVELOPING, IMPLEMENTING, AND SUSTAINING THE USE OF COASTAL RESILIENCE INDICATORS: A FINAL REPORT, 27–28 (Walter Peacock ed. 2010) (creating and explaining a community disaster resilience index); Kathryn Foster, *In search of regional resilience*, in BUILDING RESILIENT REGIONS: URBAN AND REGIONAL POLICY AND ITS EFFECTS 24–59 Margaret Weir et al eds.) (developing an index based on economic capacity, sociodemographic capacity, and community connection capacity); Susan Cutter, et al., *Social vulnerability to environmental hazards*, Soc. Sci. Q., June 2003, at 246–47 (creating an index of social vulnerability to environmental hazards); Barry Flanagan et al., *A social vulnerability index for disaster management*, J. HOMELAND SEC. & EMERGENCY MGMT., no. 8, 2011, at 4–6 (2011) (explaining how social vulnerability impacts community resilience).

330. Abbas Ostadtaghizadej et al., *Community Disaster Resilience: A Systematic Review on Assessment Models and Tools*, PLOS CURR. 1, 7 (Apr. 8, 2015).

331. *Id.* "Social" is human capital, lifestyle and community competence, society and economy, community capital, social and cultural capital, population and demographics environmental, and risk knowledge; "Economic" is economic development and society and economy; "Institutional" is governance, organized governmental services, coastal resource management, warning and evacuation, emergency response, and disaster recovery; "Physical" is physical infrastructure, infrastructure, land use and structural design; "Natural" is ecosystem.

332. *Id.*

People are capable of contributing to and shaping their futures within a managed retreat framework. Studies show that when confronted with managed retreat policy as applied to their communities, communities utilized multiple decision-making frameworks, thinking like scientists, economists, prosecutors, and theologists.[333] Some suggest a coproduction approach to planning, local knowledge with institutional support mechanisms, and facilitating community-led processes of retreat and redevelopment.[334] It is clear that coastal communities "may have to relocate responsibly to sustain their economic viability and social resilience."[335] But just like the feedback loops in climate change, impacts of climate adaptation will have its own known and unknown feedback loops for communities and ecosystems alike.[336] Therefore, these policies must not only be iterative, but also founded on principles of proactive planning, transparency, and inclusivity.

333. Alexander, *supra* note 163, at 427.

334. Fiadh Tubridy, Mark Scott & Mick Lennon, *Managed Retreat and Coastal Climate Change Adaptation: The Environmental Justice Implications and Value of a Coproduction Approach*, LAND USE POL'Y 114, 1 (2022).

335. U.S. ARMY CORPS OF ENGINEERS, NORTH ATLANTIC COAST COMPREHENSIVE STUDY: RESILIENT ADAPTATION TO INCREASING RISK: MAIN REPORT at preface (2015).

336. Craig Anthony Arnold, *Adaptive Watershed Planning and Climate Change*, 5 ENV'T & ENERGY L. & POL'Y J. 417, 440 (2010).