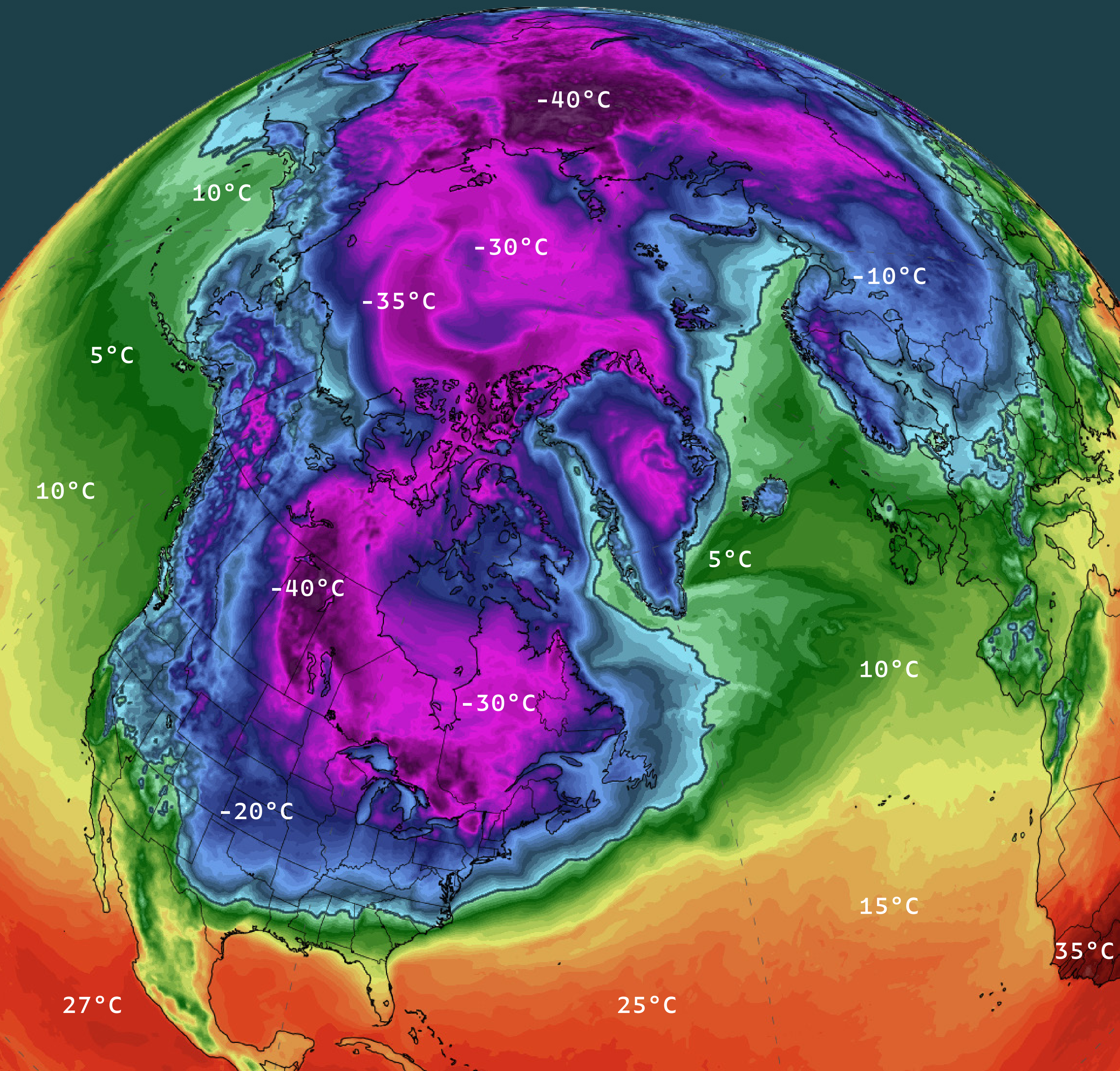
THE MAINE CLIMATE COUNCIL'S
SCIENTIFIC AND TECHNICAL SUBCOMMITTEE'S

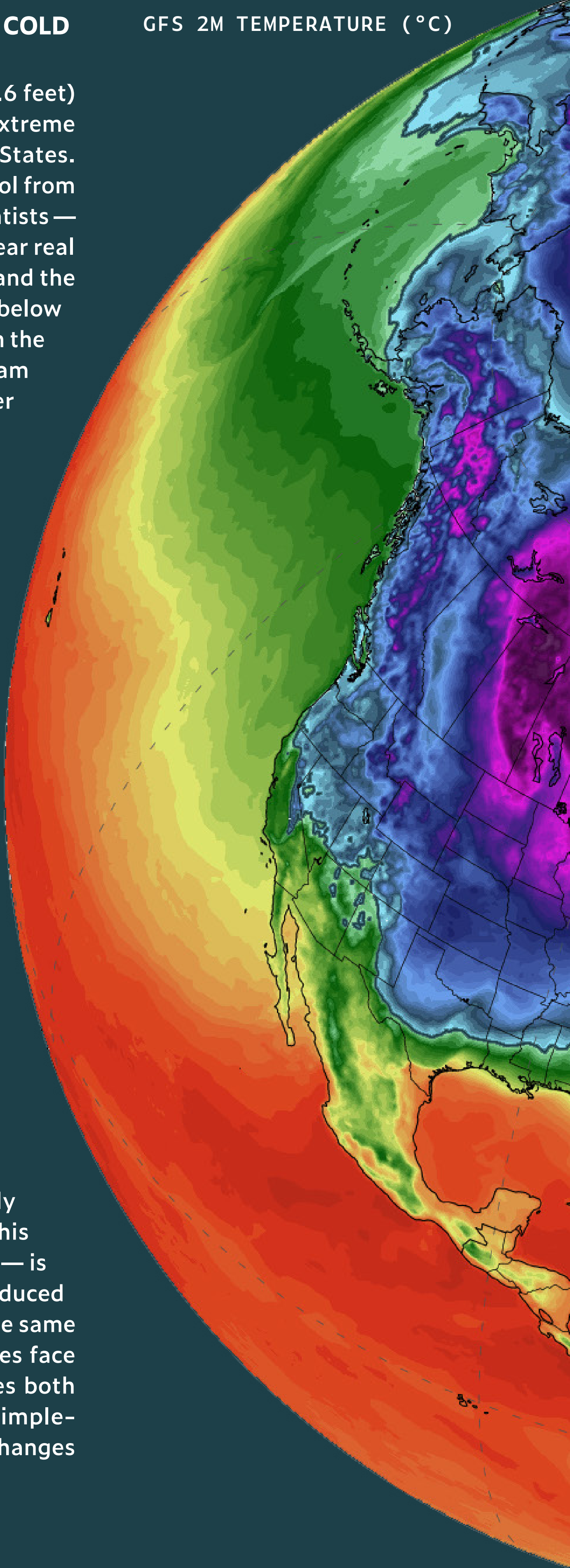
2026 INTERIM CLIMATE SCIENCE REPORT

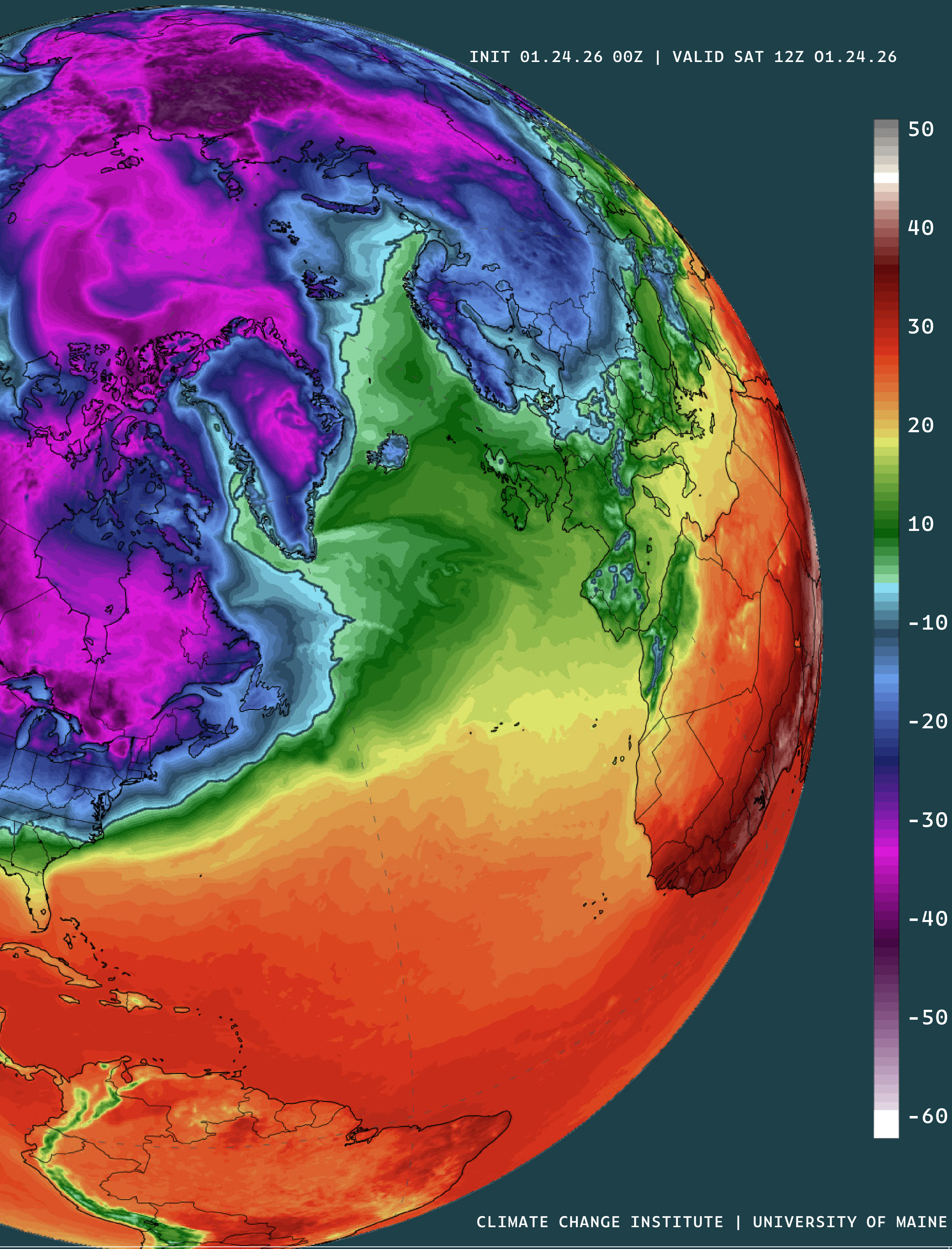


IF THE CLIMATE IS WARMING, WHY WAS IT SO BRUTALLY COLD IN MAINE IN JANUARY 2026?

The cover image shows air temperatures measured 2 meters (6.6 feet) above Earth's surface on January 24, 2026 — the peak of an extreme cold event that gripped Maine and much of the eastern United States. The data come from the Climatereanalyzer, a powerful online tool from the University of Maine's Climate Change Institute that lets scientists — and the public — visualize global weather and climate data in near real time. The deep purple and magenta colors blanketing Canada and the northeastern U.S. reveal temperatures in some places plunging below -30°C (-22°F). This cold was not "made in Maine." It originated in the Arctic and was swept southward by an unusually wavy jet stream — the flow of upper-atmosphere winds that governs weather patterns across the Northern Hemisphere. When the jet stream buckles and dips, it acts like an open door, allowing frigid polar air to spill deep into the mid-latitudes. At the same time, a sharp temperature contrast between that Arctic air mass and the relatively mild Atlantic Ocean to the east funneled the cold directly into New England. During January 24–26, 2026, the National Oceanic and Atmospheric Administration (NOAA) documented a massive winter storm bringing dangerous cold across the central and eastern U.S. The National Weather Service (NWS) issued an Extreme Cold Warning and recorded very low daytime temperatures that were subzero in northern Maine, and reaching only into the single digits across southern and central areas. So, does this brutal cold mean climate change isn't real? No — it means we need to distinguish between weather and climate. Weather is what happens on a given day; climate is the long-term pattern. A single frigid cold snap no more disproves decades of warming than a rainy day disproves a drought. In fact, science tells us that as the earth warms, severe cold outbreaks like this are becoming less frequent and less intense over time (IPCC). NCEI reports that January 2026 was 3.1°F above the 20th century average for the contiguous U.S. — ranking it among the warmest third of Januaries in 132 years of records. That is the signal of climate change: not that every day is warm, but that the overall pattern is shifting. Cold snaps can still happen; they are simply less likely and often less severe than they once were. Understanding this distinction — between a day's weather and a century's climate — is at the heart of what this report is about. The science that produced this striking image of a polar air mass sweeping over Maine is the same science that tells us our forests, farms, coasts, and communities face a fundamentally different future. Meeting that future requires both reducing greenhouse gas emissions driving the change and implementing science-informed, cost-effective adaptations to the changes already underway.

GFS 2M TEMPERATURE (°C)




INIT 01.24.26 00Z | VALID SAT 12Z 01.24.26
50
40
30
20
10
-10
-20
-30
-40
-50
-60
CLIMATE CHANGE INSTITUTE | UNIVERSITY OF MAINE

The Maine Climate Council's (MCC)
Scientific and Technical Subcommittee's (STS)
2026 Interim Climate Science Report

Susie Arnold[1] and Ivan Fernandez[2]
EDITORS AND STS CO-CHAIRS

STS MEMBERS AND CO-AUTHORS:

Linda Bacon[3], Hannah Baranes[4], Andrew Barton[5], Sean Birkel[6], Damian Brady[7], Lily Calderwood[8], Gail Carlson[9], Alix Contosta[10], Amanda Cross[11], Adam Daigneault[12], Philip deMaynadier[13], Muhammad Drammeh[14], Susan Elias[15], Alison Gardner[16], Katherine Giannakopoulos[4], Andrew Goode[7], Caleb Goossen[17], Daniel Hayes[18], Glenn Hodgkins[19], Cindy Isenhour[20], Dillon Jenkins[21], Eileen Johnson[22], Joe Kelley[6], Mark King[3], Stacy Knapp[3], Glen Koehler[8], Jason Lilley [8], Rebecca Lincoln[23], Pamela Lombard[19], Kathy Mills[4], Todd Ontl[24], Nichole Price[25], Kristen Puryear[26], Darren Ranco[27], Nicholas Record[25], Jonathan Rubin[28], Rachel Schattman[29], Peter Slovinsky[30], Sally Stockwell[31], Kanae Takunaga[4], Aaron Weiskittel[18], Andrew Whitman[32], Carl Wilson[33]

AUTHOR AFFILIATIONS

1. Island Institute
2. University of Maine, School of Forest Resources, Climate Change Institute, School of Food and Agriculture
3. Maine Department of Environmental Protection
4. Gulf of Maine Research Institute
5. University of Maine at Farmington
6. University of Maine, Climate Change Institute, School of Earth and Climate Sciences
7. University of Maine, School of Marine Sciences
8. University of Maine Cooperative Extension
9. Colby College, Environmental Studies Program
10. University of New Hampshire, Earth Systems Research Center
11. US Fish and Wildlife Service
12. University of Maine, School of Forest Resources
13. Maine Inland Fisheries and Wildlife
14. University of Maine, School of Earth and Climate Sciences (Maine Youth Rep)
15. Maine Medical Center Research Institute
16. University of Maine, School of Biology and Ecology
17. Maine Organic Farmers and Growers Association
18. University of Maine, Center for Research on Sustainable Forests, School of Forest Resources
19. US Geological Survey
20. University of Maine, Climate Change Institute, Department of Anthropology

21. Scarborough High School (Maine Youth Rep)
22. Bowdoin College, Environmental Studies
23. Maine Center for Disease Control and Prevention
24. US Forest Service
25. Bigelow Laboratory for Ocean Sciences
26. Maine Natural Areas Program
27. University of Maine, Wabanaki Center
28. University of Maine, Margaret Chase Smith Policy Center, School of Economics
29. University of Maine, School of Food and Agriculture
30. Maine Geological Survey
31. Maine Audubon
32. Maine Forest Service
33. Maine Department of Marine Resources

CITATION:

MCC STS. 2026. The Maine Climate Council's (MCC) Scientific and Technical Subcommittee's (STS) 2026 Interim Climate Science Report. Augusta, Maine. 65 pp.

Digital versions of the Scientific and Technical Subcommittee reports are available here.

ACKNOWLEDGEMENTS

The authors additionally wish to recognize the many individuals who generously provided input to the development of this report, some of whom are recognized below.

Cindy Butler, Cindy Butler Design

Parker Gassett, Maine Climate Science Information Exchange

Nathan Robbins, Maine Department of Environmental Protection

Nicky Spaulding, Maine Climate Science Information Exchange

Editors' Note: *This assessment offers analysis on a broad spectrum of climate topics by experts from a wide background of scientific disciplines. The findings included herein reflect the work product of these expert authors, not necessarily the organization they represent, the Scientific and Technical Subcommittee, the Maine Climate Council, or the Governor's Office of Policy Innovation and the Future.*

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Maine's climate is changing in ways that affect our coast, our woods and wildlife, our health, our economy, and our way of life. Key take-home messages for Maine people include:

- **Climate change is already happening in Maine.** Maine has warmed by about 3.5°F since the late 1800s, and the 10 warmest years on record have all occurred since 1998.
- **Maine is seeing bigger swings between wet and dry conditions.** Annual precipitation has increased by about 15% over the last century, but warmer air also dries soil faster and can make drought more severe, affecting farms, forests, streams, groundwater, and private wells.
- **The Gulf of Maine has cooled somewhat in the past couple of years, but that does not cancel the larger warming trend.** Gulf waters have generally remained above the long-term average since 2010, and the recent cooling is best understood as a pause in warming rather than a reversal. That nuance matters ecologically and economically for marine life, fisheries, aquaculture, and coastal livelihoods, and it also matters for public knowledge and policy conversations about what climate change looks like in Maine.
- **The coast is on the front line.** Sea level rise along the Maine coastline has nearly doubled in rate over the last 30 years, high-tide flooding is becoming more common, and rising seas are threatening homes, transportation, marshes, tidal flats, beaches, dunes, working waterfronts, and access to shellfish flats.

+3.5°F
SINCE THE LATE 1800S

91%
OF THE STATE'S GROSS GREENHOUSE GAS EMISSIONS ARE OFFSET BY MAINE'S NATURAL AND WORKING LANDS

10 WARMEST
YEARS ON RECORD HAVE OCCURRED SINCE 1998

+15% MORE ANNUAL PRECIPITATION

FORESTS

+75% IN SEA LEVEL RISE IN THE PAST 30 YEARS COMPARED TO 115 YEAR RECORD*

*Comparing short-term (1996–2025) and long-term rates reveals a 75% increase in the rate of sea level rise. Long-term rates are derived from data through 2025 at four Maine tide gauges: Seavey Island (est. 1930), Portland (1912), Bar Harbor (1947), and Eastport (1929).

- **Maine's forests are not only affected by climate change; they are also one of Maine's biggest climate solutions.** Forests remove more carbon dioxide from the atmosphere than Maine emits from all sources combined and forest carbon storage is growing. Together Maine's natural and working lands (farms, forests, grasslands, wetlands) offset 91% of the state's gross greenhouse gas emissions. Protecting forest cover and keeping forests healthy is therefore central to Maine's climate strategy.
- **Maine's woods and wildlife are changing.** Species are shifting northward and upslope, warm-adapted species are moving into the state, and forest pests such as beech leaf disease, emerald ash borer, and hemlock woolly adelgid are expanding with important ecological and economic implications.
- **Climate change is also a public health issue.** Mainers are increasingly experiencing health impacts from extreme and changing weather, such as heat-related illnesses, tick-borne diseases, broad impacts of poor air quality due to wildfire smoke events as well as longer, more severe pollen seasons, and mental health impacts related to the changing climate.
- **Mainers are already responding, but more work is needed.** The report notes that Maine is 30% below 1990 greenhouse gas emission levels. More than 263 communities and all five Tribal governments have engaged in vulnerability assessment and/or adaptation planning, and many communities are already investing in resilience. The overall message is that continued investment in good science to inform decision-making, local planning, and practical climate action will help Maine people prepare for the changes already under-way and those we know are coming.

MAINE'S ECOLOGY IS CHANGING: SPECIES ARE SHIFTING NORTH

MORE →

30%

MAINE IS 30% BELOW 1990 GROSS GREEHOUSE GAS EMISSIONS

263+

COMMUNITIES & TRIBAL GOVERNMENTS HAVE COME TOGETHER IN RESILIENCE

ARE ONE OF MAINE'S BIG CLIMATE SOLUTIONS

BACKGROUND

In 2019, Public Law 2019 (Chapter 476) "An Act To Promote Clean Energy Jobs and To Establish the Maine Climate Council" became law and established essential goals for greenhouse gas reductions and cost-effective adaptation and resilience in Maine. The 39 member Maine Climate Council (MCC) was charged with developing an integrated Maine Climate Action Plan with subsequent updates every four years. In support of the work of the MCC, the law also established Working Groups with various areas of focus that include transportation, coastal and marine systems, infrastructure, housing, natural and working lands, energy, community resilience, public health, and emergency management within an overarching framework of equity and economic development. The Working Groups were charged with developing draft strategy recommendations for the MCC that formed the basis for MCC deliberations in the development of the initial comprehensive Maine Climate Action Plan *Maine Won't Wait* in 2020, and the first quadrennial update in 2024.

In addition, the 2019 law established the Scientific and Technical Subcommittee (STS) to support the work of the MCC and the Working Groups. The STS was established to identify, monitor, study and report out relevant data related to climate change in the State and its effects on the State's climate, species, marine and coastal environments and natural landscape and on the oceans and other bodies of water. The STS is primarily composed of scientists with expertise on climate change globally and in Maine. The STS is committed to supporting the work of the MCC and Maine people with the very best science available to inform decision-making in a time of rapid change. In 2020, the STS released its initial comprehensive 370 page report Scientific Assessment of Climate Change and Its Effects in Maine to support the deliberations of the Working Groups and the MCC in the development of the initial Maine Climate Action Plan *Maine Won't Wait.* The following year STS released the short report Maine Climate Science Update 2021. In 2024, the STS released an extensive 254 page full assessment update in support of the quadrennial update of *Maine Won't Wait* later that year. These reports were preceded by Maine's Climate Future assessment reports in 2009, 2015, and 2020 led by the University of Maine.

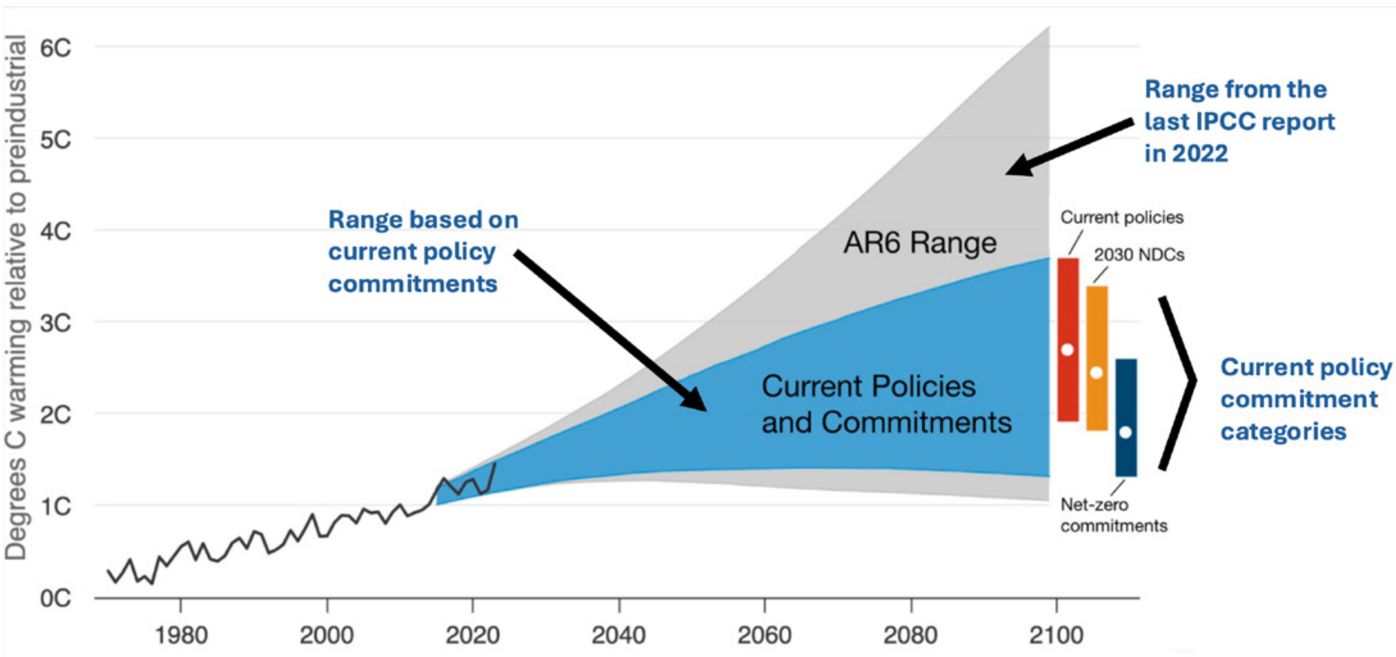
This report, the Maine Climate Council's Scientific and Technical Subcommittee's 2026 Climate Change Science Interim Report, is a short report intended to present selected key science insights regarding the ongoing development of a changing climate in Maine, and linkages between science and what Maine people are doing about it, and highlights critical local-to-international assets that are necessary to produce the science that informs local decision-making. The next full STS science assessment update will be in support of the next quadrennial update of *Maine Won't Wait* in 2028.

GLOBAL SCIENCE RESOURCES

As STS noted in our most recent 2024 science assessment report, there are a number of climate change related science resources that are developed around the world that form the foundation for decision-making from the planetary to local scales. None of these resources provide the focus on Maine that is represented by the work of the STS. However, these national and international science resources do provide essential insights into the evolution of our planet during a period of rapidly accelerating change. Some of the most recent reports in this category include the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report (AR6), the World Meteorological Organization's (WMO) State of the Global Climate 2025 Report and its associated dashboard of key climate indicators, Copernicus Climate Change Service's Global Climate Highlights 2025, The Global Carbon Project's Carbon Budget 2025, the National Oceanic and Atmospheric Administration's Global Monitoring Laboratory that tracks the rising concentrations of greenhouse gases in the atmosphere, the United Nations Emissions Gap Report 2025 and analyses by World Weather Attribution. The reader is encouraged to see the STS 2024 report for additional science resources although some of the URLs may have changed. We note that as of this writing the website addresses for the U.S. National Climate Assessment (NCA5) and U.S. Billion-Dollar Weather and Climate Disasters, have been updated.

NARROWING UNCERTAINTY AND REINFORCING FUTURE TRAJECTORIES

One of the most important ways science helps us plan for the future is by estimating how much the planet could warm under different levels of greenhouse gas emissions. Recent updates to end-of-century (2100) projections (e.g., Climate Action Tracker, Rhodium Climate Outlook 2025) reflect major shifts in the energy and policy landscape—especially cheaper renewable energy and expanding climate policies—which together have narrowed the range of plausible



Comparison of the full range of assessed global warming projections in the recent IPCC 6th Assessment Report (5th percentile of SSP1–1.9 to 95th percentile of SSP5–8.5) to a range defined by the median of the upper, central, and lower estimates of current policy and commitments outcomes in the literature. Observed annual global mean surface temperatures from WMO 2023 are shown in black. Figure from Hausfather (2025). Annotations in blue text by STS. NDCs = Nationally Determined Contributions.

outcomes. Hausfather (2025) reviews these developments and what they mean for updated warming estimates. The figure above summarizes the current best estimate: a likely warming range of about 2.3 °C to 3 °C (4.1 °F to 5.4 °F) by 2100, with a central estimate near 2.7 °C (4.9 °F). Compared with just a few years ago, the range is tighter and the odds of the highest-warming outcomes are lower, despite still being dramatically higher than the aspirational 1.5 °C (2.7 °F) warming limit hoped for in the Paris Climate Accord of 2015.

There is real progress underlying these updated projections. Falling renewable energy costs and stronger climate policies generally point toward lower future emissions, which makes the most extreme warming scenarios less likely than earlier analyses suggested. At the same time, very low warming outcomes are also unlikely, because greenhouse gas concentrations in the atmosphere are still rising—largely due to human activities. In other words, even with a clearer picture than we had before, the central message has not changed: the planet is expected to keep warming through 2100 and beyond. These new estimates also come with important caveats. It is still possible that future changes such as major policy rollbacks lead to warming above 3 °C (5.4 °F), or unexpected technological breakthroughs lead to warming below 2.3 °C (4.1 °F). For example, the emissions models considered by Hausfather (2025) predate many of the recent reversals in U.S. federal climate policy since 2025, which will slow the transition to renewable energy and increase reliance on fossil fuels.

SINCE THE 2024 STS REPORT...

Although public discourse and news coverage of our changing climate ebbs and flows over time, climate change is continuing and accelerating, with warming of Earth's atmosphere primarily attributed to human activity, the consequences of which are mounting (Forster et al. 2025, Foster and Rahmstorf 2026). We are increasingly at risk of global warming driving Earth past climate tipping points that can be irreversible and destabilizing to ecosystems and society, interacting to make additional thresholds easier to breach, creating a cascade of consequences (Lenton et al. 2025). We read in the news about changes in these tipping point systems that include worldwide dieback of coral reefs, melting polar ice, diebacks of boreal and tropical forests, and shifting patterns of major ocean currents.

We are well past the point of considering the impacts

of a changing climate as only in our future with growing evidence that we are living the consequences now (e.g., Ripple et al. 2025). At the same time, there is evidence that the rate of increase in carbon dioxide (CO_2) emissions has slowed over the last decade, but critically, societal choices will determine the future trajectory of these trends. It is noteworthy that U.S. emissions increased by an estimated 2.4% in 2025, reversing the trend of declining emissions in recent years.

These realities are consistent with recent evidence.

- Globally, 2025 was one of the three warmest years on record, with 11 of the last 11 years being the warmest years on record (WMO). 2024 was the hottest year ever recorded in the modern 175 year observational record and likely the first year with world mean surface temperature above 1.5°C (WMO).
- In 2025, Earth's energy imbalance—when more energy from the Sun is absorbed than escapes back to space—reached a record high, the largest in the observational record (WMO). This trapped excess heat is driving global warming.
- 2025 continued the "unabated" warming of the average temperature of global oceans in response to greenhouse gas concentrations and recent reductions in sulfate aerosols (Pan et al. 2026).
- The ongoing decline in Arctic sea ice resulted in the lowest winter maximum extent in the 47-year satellite record and September 2025 saw the 10th lowest minimum sea ice extent. All of the 19 lowest September minimum ice extents have occurred in the last 19 years (NOAA).
- The world is experiencing its 4th global coral bleaching event. The current bleaching-level heat stress between 2023 and 2025 has impacted a record ~84% of the world's coral reef area (NOAA).
- A warming planet has led to a sharp increase in the frequency of extreme fire conditions around the world where wildfire seasons are more often overlapping and occurring simultaneously, enhancing the human and environmental impacts and taxing firefighting capacity (Yin et al. 2026).
- In the U.S., billion dollar weather and climate disaster frequency continues to increase with 138 recorded in the 2020-2025 time interval averaging costs of $146.8 billion per year (Climate Central). The most common of these are severe storms, but the data also include tropical cyclones, flooding, drought, wildfire, winter storms, and freezing events.

And yet...

- Solar and wind energy met and exceeded global electricity demand growth in the first half of 2025, exceeding coal for the first time (Ember).
- World investment in energy rose 2% in 2025 to $3.3 trillion (US) over the previous year, with twice as much investment in renewables, nuclear, grids, storage, low-emission fuels, efficiency and electrification as is going to oil, natural gas and coal (IEA).
- Electric car sales continued to increase globally in 2024 with a sales share exceeding 20% of all vehicles sold and expected to exceed 40% by 2030 under the policies in place at the time of these analyses (IEA 2025).
- And in Maine, the Maine Climate Council reports Maine as being 30% below 1990 greenhouse gas emission levels, 91% of the way to carbon neutrality, with increasing electric and plug-in hybrid vehicles on our roads, and 263+ communities enrolled in the Community Resilience Partnership to date investing in resilience for Maine people.

Overall, the evidence points to two realities at once: climate change is ongoing and its impacts are already being experienced, and sustained progress is possible but not yet at the scale required to meet widely cited critical near- and long-term targets. The World Resources Institute's The State of Climate Action in 2025 finds that while progress has accelerated in many areas, none of the 45 indicators they track are currently on pace to meet 2030 targets.

This 2026 STS Interim Report synthesizes selected recent science relevant to Maine and highlights examples of climate-related actions underway, with the goal of supporting cost-effective, science-informed decision-making.

01

Atmospheric Temperature



WHY IT MATTERS

- Rising and falling temperatures affect people and the natural world, with real consequences for our economy and ecosystems.
- Climate change is showing up mainly as warmer conditions. As average temperatures rise, winters are getting shorter and summers are getting longer.
- Fewer freezing days in winter means less snow and ice cover. More warm-weather growing days also affect which plants and crops can thrive in Maine.

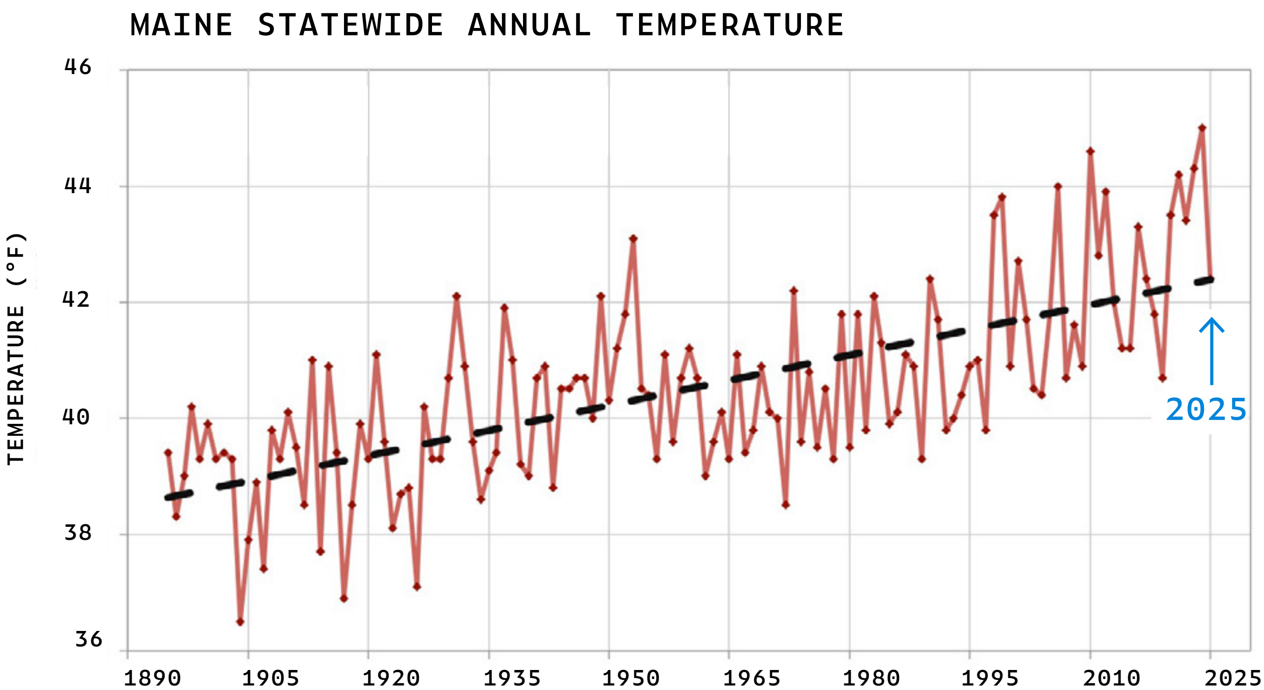


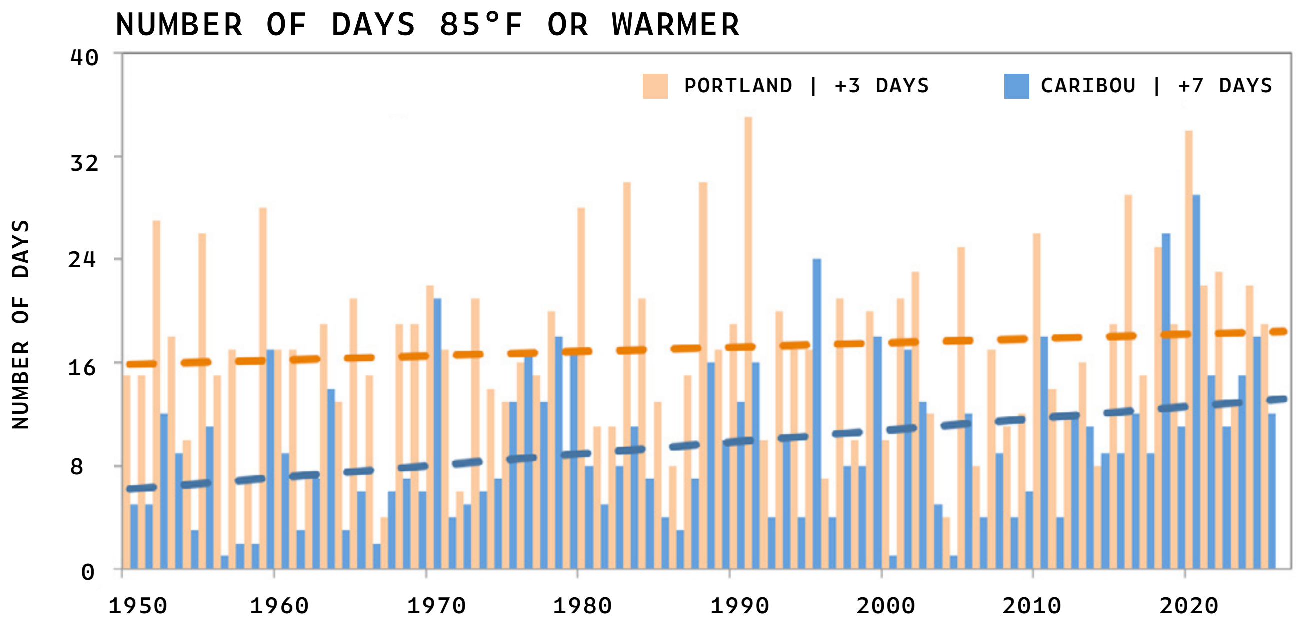
Figure 1. Maine's annual mean temperature 1895–2025 based on data from the National Centers for Environmental Information (NCEI, 2026). The black dashed line is the linear trend.

WHAT DO THE DATA TELL US?

- On average, temperature in Maine has warmed by about 3.5°F (1.9°C) since the late 1800s, but this overall increase is marked by significant year-to-year variability (Figure 1).
- The 10 warmest years on record for Maine have all occurred since 1998, with 2024 as the warmest year on record. Some of the warmest years are associated with major El Niño events, such as those peaking during the winters of 1997/98, 2009/10, 2015/16, and 2023/24 with a possible return later in 2026.
- On average since 1950, Portland and Caribou now see more days per year 85°F or warmer (3 and 7 more, respectively) and fewer days 0°F or colder (12 and 9 fewer, respectively) (Figure 2).

WHAT ARE WE DOING ABOUT IT?

- Climate adaptation, renewable energy investment, and mitigation efforts in *Maine Won't Wait*.
- Building 26-station Maine Mesonet for enhanced meteorological monitoring coverage statewide.
- Developing decision tools for agriculture that use weather data for crop models that estimate emergence of diseases and pests, changes in crop management, irrigation, mulching, other management practices.



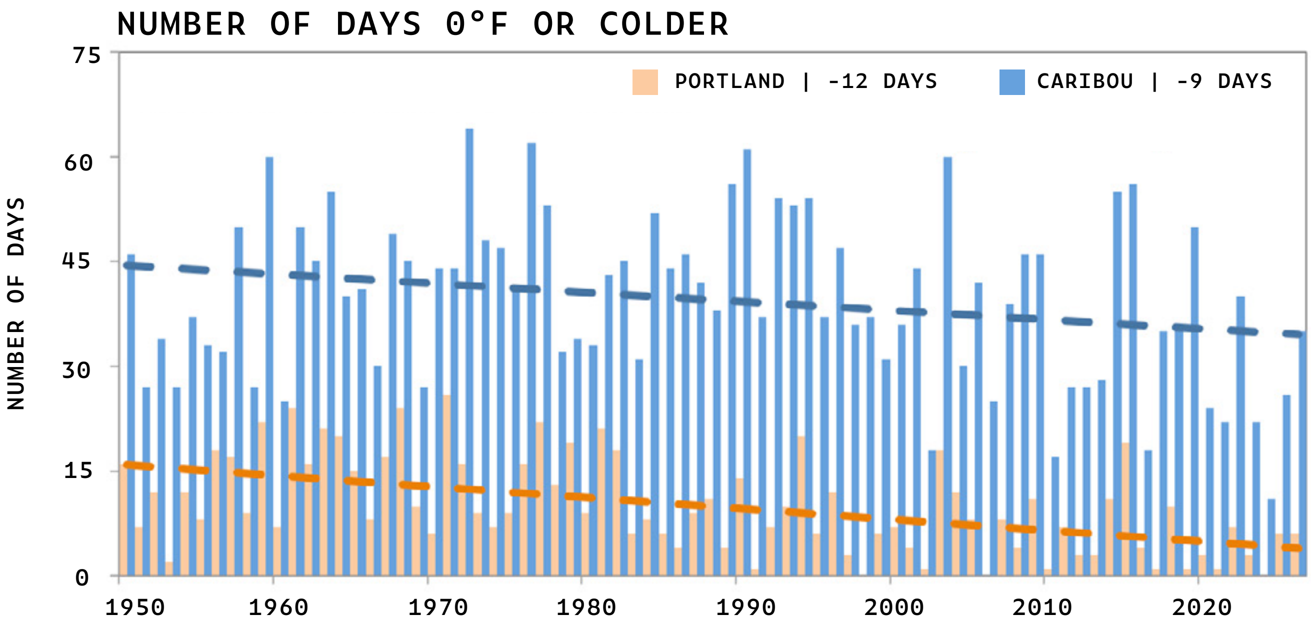


Figure 2. Number of days per year when temperature is 85°F or warmer (top) and 0°F or colder (bottom) as observed in Portland (orange) and Caribou (blue) for the period 1950 to 2025. Dashed lines are the linear trends. Data from the Global Historical Climatology Network *for station IDs USW00014764 (Portland) and USW00014607 (Caribou).*

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

- **Key science assets:** National meteorological observation systems and data products from agencies such as NOAA, National Weather Service, and NASA. State and citizen-led observational programs.
- **Assets at risk:** National products, services, and centers for which future availability, funding, or organizational structure may change, e.g., NOAA NCEI Climate at a glance, National Weather Service, and National Center for Atmospheric Research.
- **Assets needed:** Expanded meteorological observations for long-term records; subsurface temperature and moisture measurements (part of Maine Mesonet) for ground freeze/thaw and fire weather monitoring.

WHAT TO WATCH

- Upcoming state, national, and international climate reports. The Maine Climate Council STS will be releasing the next full report in 2028.
- ***Next few months:*** current ensemble model forecasts show the possibility of a major El Niño event developing in summer 2026 that would elevate global temperature and increase the likelihood of weather extremes through winter 2026/27. ***Next few years:*** indication of tipping points being passed (e.g., sea ice; ocean circulation), thresholds, convergences of phenomena.

02

Precipitation & Drought



WHY IT MATTERS

- Statewide precipitation affects Maine's water supply, forests, farms, and aquatic ecosystems.
- Drought is not just "no rain." It can show up first as shortfalls in precipitation, then as dry soils that stress plants, and later as low streamflow and declining groundwater.
- Short dry spells (six months or less) are relatively common in the Northeast, but Maine has also experienced droughts that lasted for years (including events that peaked in the mid-1960s and in the late 1990s to early 2000s). Long-term records provide essential context for understanding how unusual recent conditions are (Fig. 1).
- As the climate warms, changes in the amount, timing, and form of precipitation—together with higher evaporation—can affect how often drought develops and how severe its impacts become.

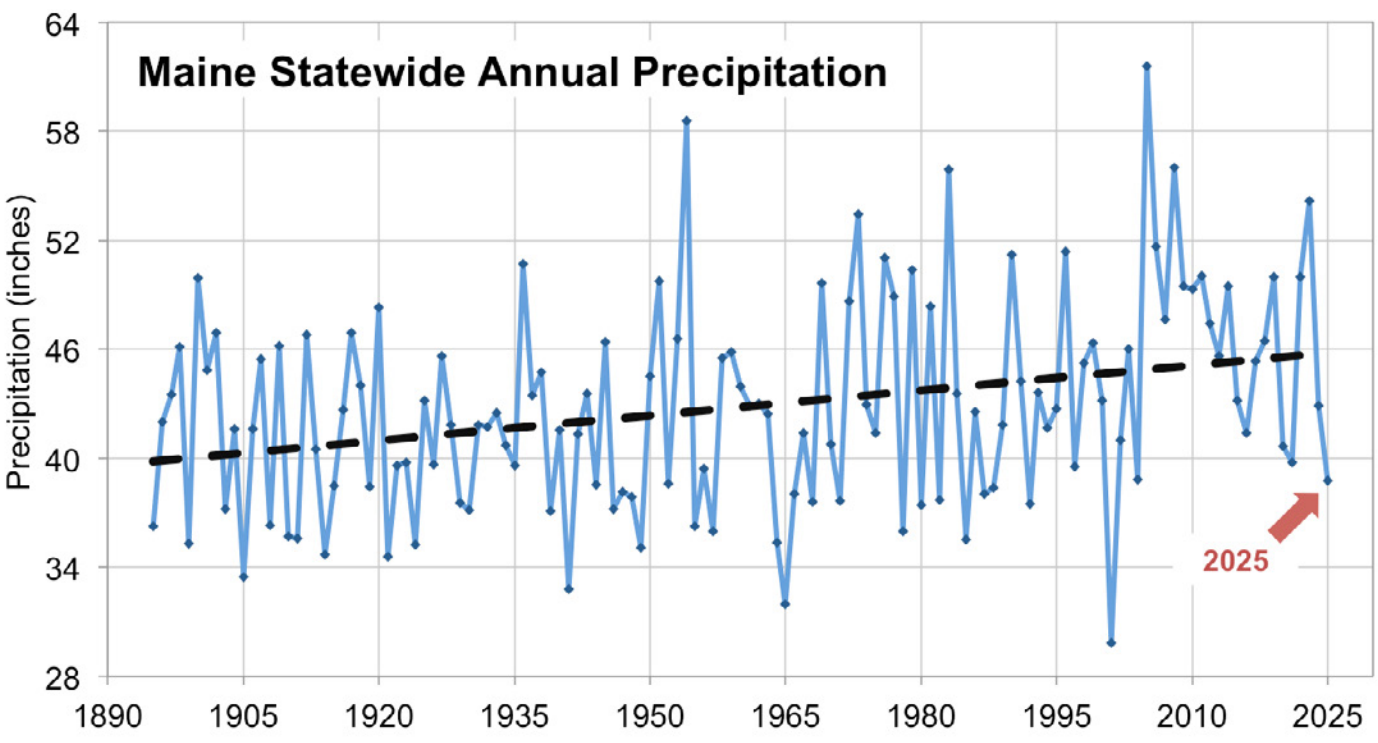


Figure 1. Maine statewide average annual cumulative precipitation 1895–2025 based on data from the National Centers for Environmental Information (NCEI, 2026). The black dashed line is the linear trend.

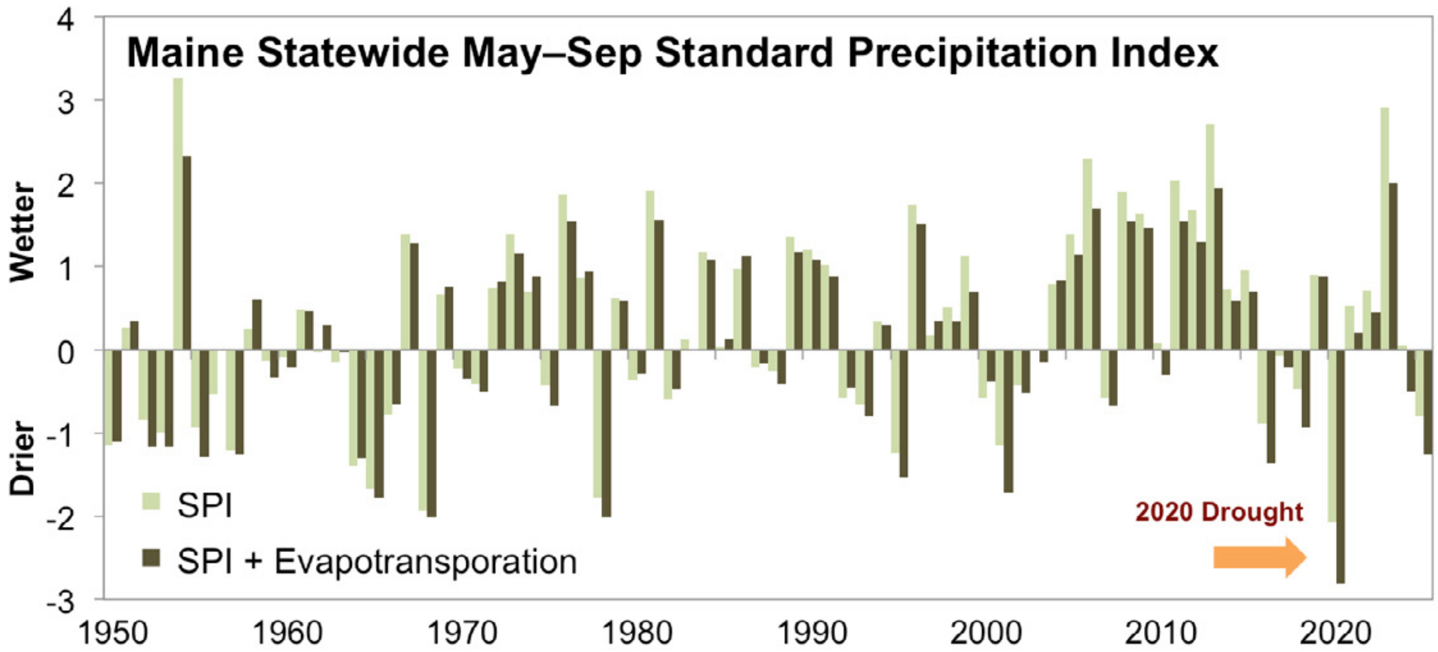


Figure 2. Some drought indicators, or "indexes", are based only on precipitation data, whereas others also include temperature to account for soil moisture losses from evaporation and plant transpiration. Here, the commonly used [Standardized Precipitation Index](#) (SPI; light green) is shown in comparison to the SPI + temperature-driven evapotranspiration (SPEI; dark green) for the period May to September (approximate growing season) each year since 1950. The orange arrow identifies the 2020 drought as an example. SPEI was calculated using the Hargreaves method, where evapotranspiration is estimated from latitude and monthly temperature (e.g., NCAR, 2025). The climatology reference period is 1901–2000. Input data from the National Centers for Environmental Information (NCEI, 2026).

WHAT DO THE DATA TELL US?

- On average, locations in Maine receive about 6 inches (15 cm) more precipitation in a given year than a century ago, but this overall increase is marked by decadal, annual, and seasonal variability (Fig. 1).
- Weather station records show that heavy precipitation events have become more common since 1950, where on average there are now 2–3 additional days in a given year with precipitation totaling 1 inch or greater and 1–2 additional days with precipitation totaling 2 inches or greater (MCC STS, 2024).
- A period of wetter-than-usual years occurred 2003–2015, followed by a series of mostly dry years 2016–2021, with the driest being 2020 (e.g., Lombard et al., 2021; McCarthy et al., 2023). This was followed in 2023 by an extremely wet year, and an unusually dry year in 2025.
- Higher temperature can intensify drought impacts. This is highlighted in Fig. 2 where the difference between the two indices is especially large over the past 25 years due to warming. These measures suggest that high temperatures exacerbated drought in 2016, 2020, and 2025.

WHAT ARE WE DOING ABOUT IT?

- Expanding precipitation monitoring (e.g., building new statewide weather station network, Maine Mesonet) and research to better understand precipitation trends and future drought variability.
- Drought mitigation programs to promote adaptive measures to enhance crop resilience and research into reducing irrigation costs and efficiency.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

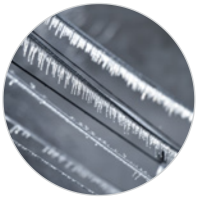
- Key science assets include precipitation, stream, and groundwater gauges that are monitored throughout the state and are critical for hydrological monitoring.

WHAT TO WATCH

- Maine has been experiencing drought since the summer of 2025. With this and other droughts, spring snowmelt, rainfall, soil moisture and groundthaw should be monitored to prepare for wildland fire mitigation and irrigation needs.

03

Winter Storms



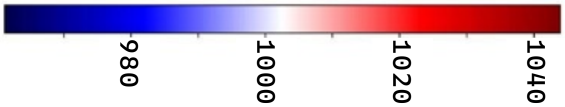
WHY IT MATTERS

Three major winter storms in December 2023 and January 2024 caused severe flooding, erosion, power outages, and wind damage across Maine. These storms showed that damaging winter storms do not always arrive as classic nor'easters. Some approach Maine from a different direction, bringing strong wind from the southeast and enhanced coastal impacts along southeast-facing shorelines. Researchers are now studying these "sou'easters" to understand how often they occur, what atmospheric patterns make them more likely to occur, and whether climate change may be affecting their impacts.

WHAT DO THE DATA TELL US?

- Sou'easters and nor'easters tend to follow different paths. Sou'easters more often track inland, west of Maine's coast, while nor'easters more often track along or just offshore.
- Damaging "sou'easters" are not new. Historical weather records show that these storms have affected Maine for decades.
- Because sou'easters can bring strong onshore winds, heavy rain, and coastal flooding, they can create serious impacts even when they do not look like a "typical" Maine winter storm.
- It remains uncertain how climate change may alter the frequency of these storms. However, impacts are expected to be more severe, particularly as strong onshore winds can cause coastal flooding on the backdrop of warming-driven sea-level rise.

FIG 1. KEY



SEA LEVEL PRESSURE (MILLIBARS)

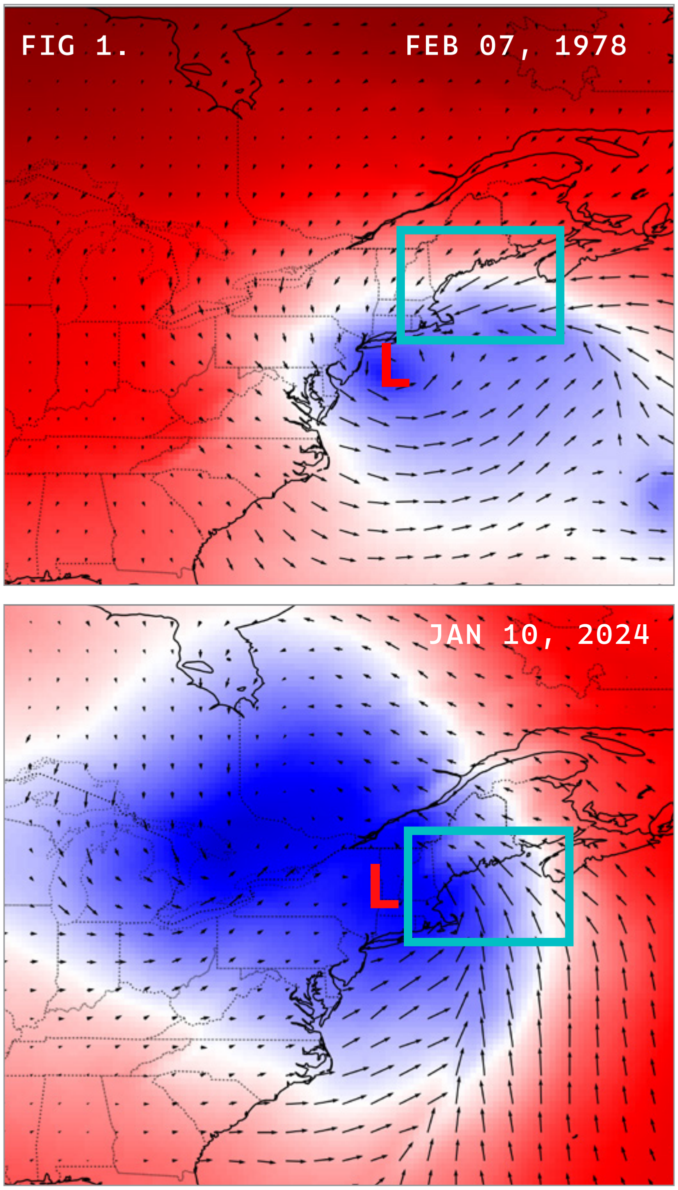


Figure 1. Surface pressure and wind patterns for two major extratropical cyclones: the Blizzard of 1978 nor'easter (left) and the recent 2024 sou'easter (right). Colors show sea level pressure, with blue shading and the letter "L" marking the storms' low-pressure centers. Black arrows show wind direction and relative speed. Teal rectangles highlight how storm track influences wind direction along Maine's coast: offshore lows drive northeasterly winds, while inland lows produce southeasterly winds. Data source: Hersbach et al., 2020

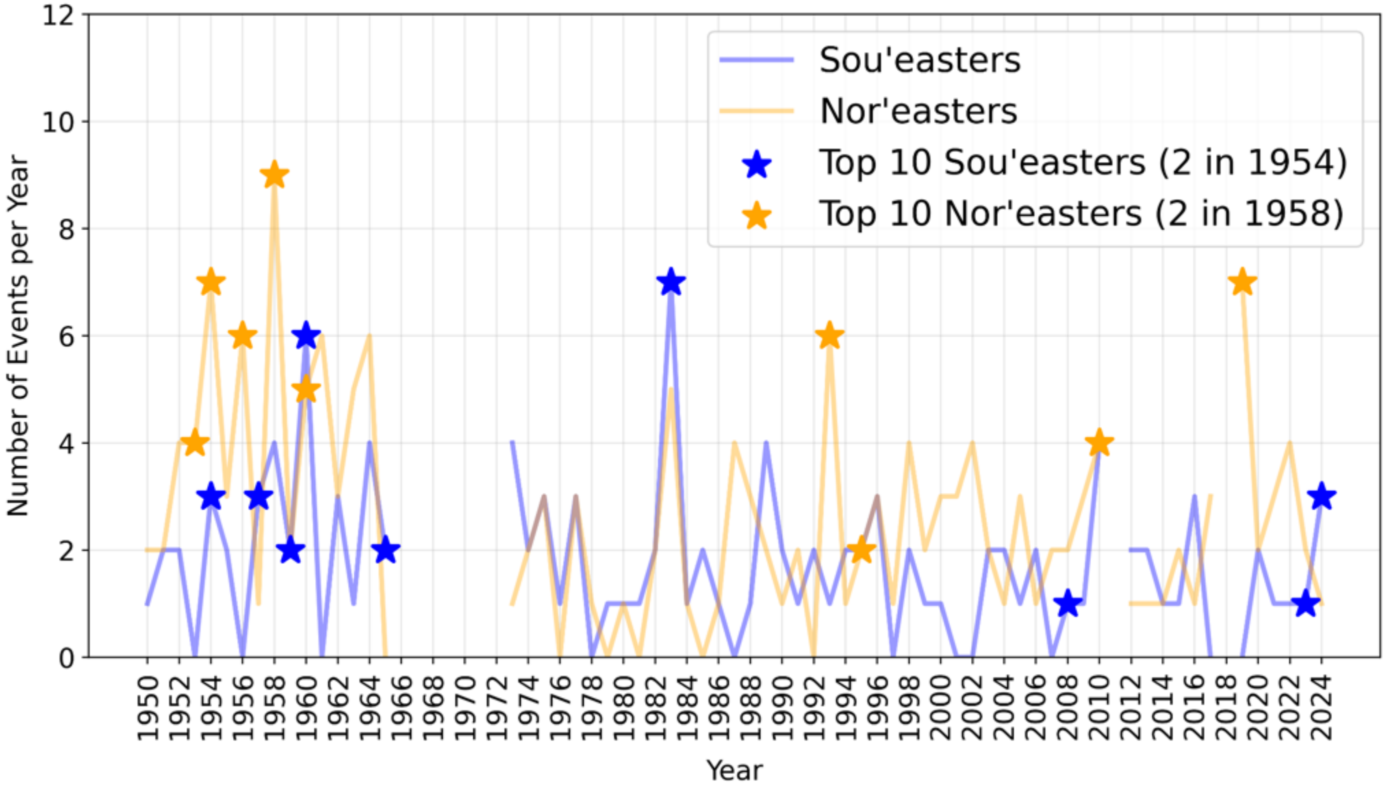


Figure 2. Number of [extratropical cyclones]() per year impacting the Portland Jetport wind station since 1950. Sou'easters are shown in blue (119 total events), and nor'easters are shown in yellow (179 total events). The years 1966-1973, 2011, and 2017 are not included because of gaps in the wind station data. The sou'easters and nor'easters driving the top 10 fastest sustained wind speeds are marked with stars. Preliminary results provided by the Gulf of Maine Research Institute, National Weather Service, and City College of New York; analyses are ongoing and subject to revision.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

- Key science assets: coastal weather stations, offshore wave buoys, tide gauges, precipitation records, and storm track datasets
- Assets at risk: roads, homes, working waterfronts, beaches, dunes, utilities, and other infrastructure
- What is needed: continued investment in coastal monitoring, long-term data records, and impact assessments that connect storm characteristics with flooding, erosion, and damage

WHAT TO WATCH FOR

- Further research on atmospheric circulation patterns, teleconnections, and impacts (waves, storm surge, wind, and precipitation) associated with each storm type
- Implementation of "An Act to Increase Storm Preparedness for Maine's Communities, Homes and Infrastructure" (LD 1) passed in 2025. It includes 1) the establishment of a State Resilience Office & Flood Map Updates, 2) ~$10 million in revolving loan funds through the STORM program for municipal hazard mitigation, and 3) $15 million in funding to launch a new program to help homeowners strengthen roofs and floodproof basements, and 4) enhanced emergency planning.

04

Gulf of Maine Temperatures

WHY IT MATTERS

Ocean temperature has far-reaching impacts, including those to marine ecosystems, fishing and aquaculture industries, recreation, and even transportation.

WHAT DO THE DATA TELL US?

The last two years have seen a pause in warming (Koul et al. 2024); however, it is important to put this recent cooling in context. Temperatures are still warmer than in preceding decades (Figure 1). Baselines matter. The 2025 temperatures seem cool compared to recent years. However, the 2025 annual average temperature was on par with those experienced in 2010 and 2002. Given that temperatures from 1982-2010 were generally cooler, 2002 and 2010 felt warm in comparison to this year.

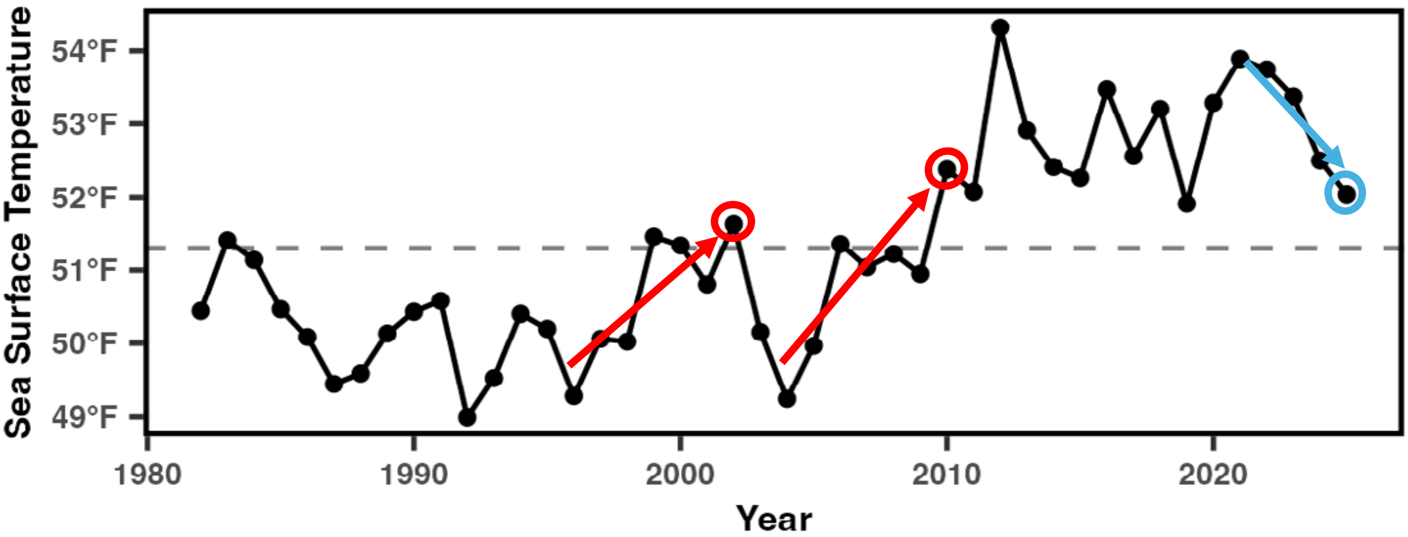
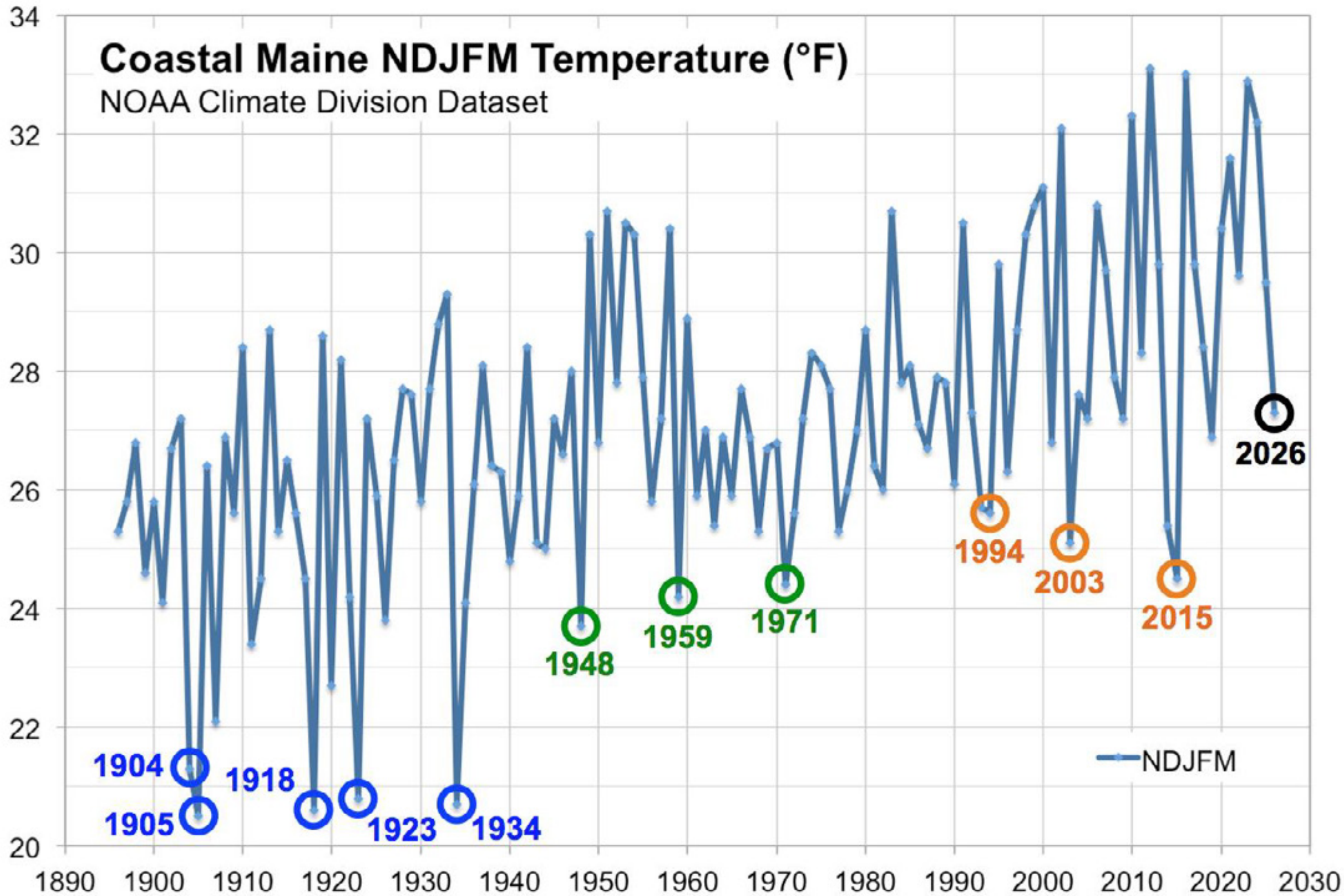


Figure 1. Annual average sea surface temperature for the Gulf of Maine, 1982 to 2025 (black dots), relative to the average over a 1991-2020 reference period (dashed gray line). The 2025 temperature (blue circle) was similar to temperatures in 2002 and 2010 (red circles), though they come at the end of warming (red arrows) versus cooling (blue arrow). Data Source: NOAA Optimal Interpolation Sea Surface Temperature V2 High Resolution Dataset.

Cooler water brought many observable changes. We saw more sea ice than in recent memory. Yet, when comparing temperatures to the early 1900s and sea ice extent between the two periods, 2026 was quite warm. Sea ice was thin and patchy relative to the ice in the early 1900s when people could walk, ice skate, drive a car, or even pull a house across Casco Bay during many winters (Figure 2).

A



B

C

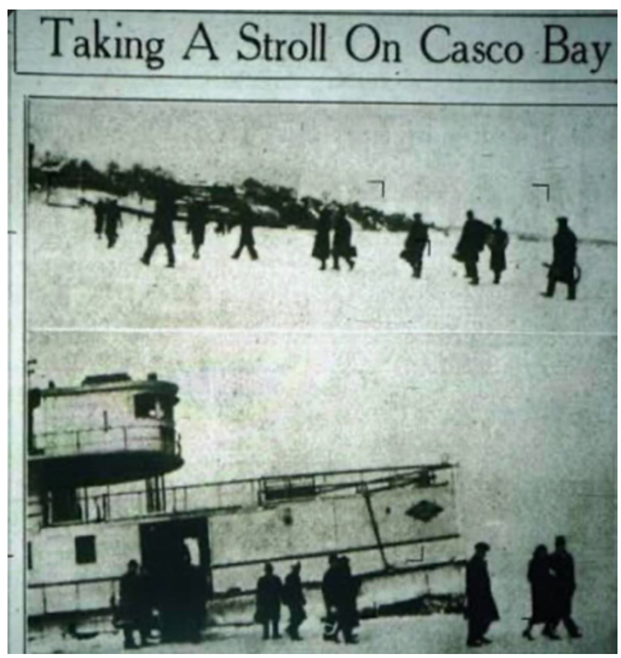


Figure 2. Coastal Maine air temperatures in months November – March from 1897 to 2026 (a). Pictures of sea ice from 2026 (Source: Island Institute) (b), when the Chebeague Island ferry was able to easily plow through, juxtaposed with a photograph from 1934 (Source: Portland Press Herald archives) (c), when a Casco Bay Lines ferry got stuck in the ice and passengers were forced to walk the rest of the trip across the ice to Peaks Island. 1934 was the last year Casco Bay froze all the way out to Chebeague Island.

Gulf of Maine conditions are a balance of different water masses, such as the Warm Slope Water derived from the Gulf Stream, and the colder, fresher Labrador Slope Water (Townsend et al. 2015). In late 2023, source waters shifted in favor of Labrador Slope Water, producing the recent cooling (Figure 3, Record et al. 2024, Seidov et al. 2025). Deep water masses give early warnings of changes in the broader Gulf of Maine conditions. Models predict a pause in warming until 2030 (Koul et al. 2024, Chen 2025). These changes have major impacts on species including cod, lobster, right whales, northern shrimp, seabirds, blue mussels, green crabs, longfin squid, black sea bass, and many others (Pershing et al. 2015; Sorte et al. 2017, Le Bris et al. 2018, Reardon et al. 2019, Record et al. 2019, McMahan et al. 2020, Richards and Hunder 2021, Scopel et al. 2021, Mills et al. 2024).

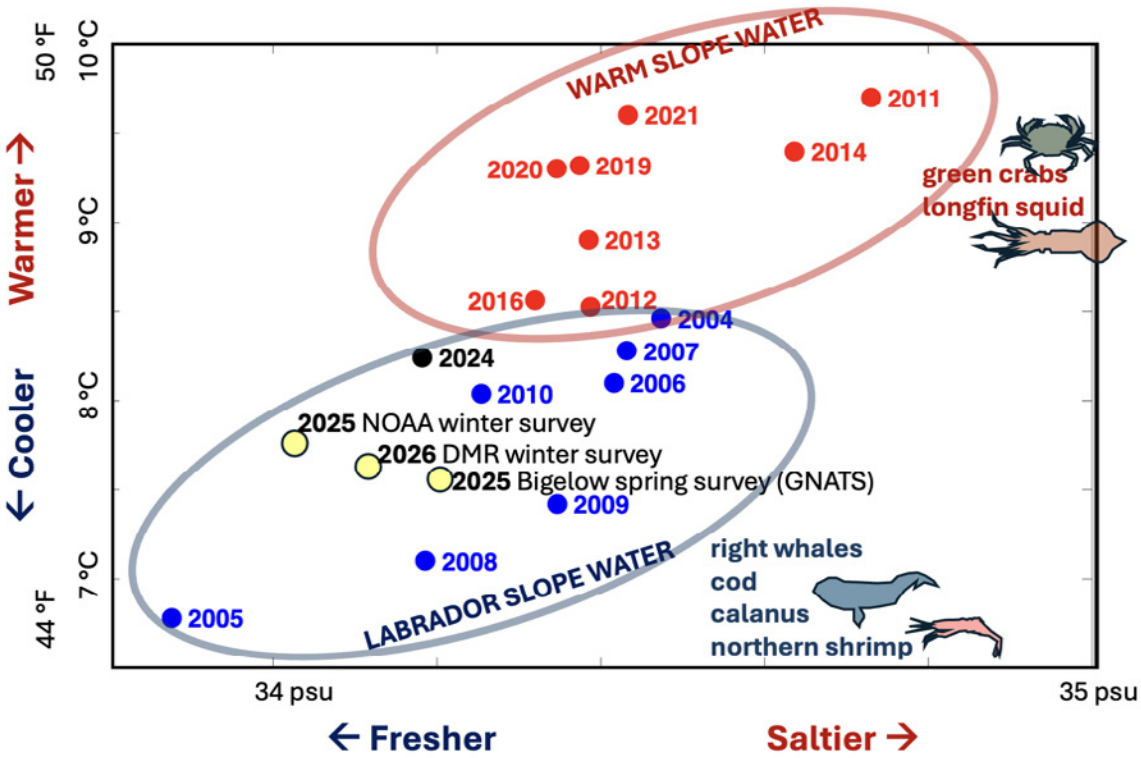


Figure 3. Deep water conditions (below 200 m or 656 ft) in the Gulf of Maine's Jordan Basin, with updated data. Each year indicates average conditions from January to March for that year, for temperature (vertical) and salinity (horizontal) from NERACOOS Buoy M. Buoy M went offline in 2024, and new data use profiles from oceanographic surveys. Influence of Warm Slope Water and Labrador Slope Water indicated by ovals. These water masses set up environments favorable to different species (adapted from Record et al. 2024).

PROGRESS, CRITICAL SCIENCE ASSETS, AND WHAT TO WATCH FOR

The Maine Department of Marine Resources has expanded year-round monitoring, and research groups produce data products and early warnings of oceanographic changes. Critical assets include: NERACOOS buoys, NOAA OISST v2 (Optimum Interpolation Sea Surface Temperature), GLORYS12v1 Ocean Reanalysis, MOM-6 COBALT model for the Northwest Atlantic, eMOLT (Environmental Monitors on Lobster Traps), DMR Boothbay Harbor Environmental Monitoring Program sea water temperature record, Gulf of Maine North Atlantic Time Series (GNATS), NOAA's Northeast Fisheries Science Center's bottom trawl surveys and ecosystem monitoring surveys.

Oceanographic changes set up the possibility of new and unexpected conditions that impact management of fisheries, aquaculture, protected species, marine recreation and transportation, and there is an increased possibility of surprising or unprecedented conditions (Record et al. 2023). For example, changes in temperature and salinity impact ocean acidification, which could be exacerbated due to the reduced buffering capacity of Labrador Slope Water (Stewart et al. 2025, Wang et al. 2025). Cooler ocean waters may also delay the spring arrival of migratory fish and the seasonal uptick in lobster landings. While some warm-water species may decline, short-term cooling does not necessarily imply an immediate and sustained return to pre-2010 conditions.

05

Sea Level Rise Impacts to Coastal Environments

WHY IT MATTERS

Sea level rise (SLR) will continue to impact Maine's coastal environments like marshes, tidal flats, dunes and bluffs. Environmental response to sea level rise is complex and dependent upon various factors, including but not limited to: rate of SLR; coastal storms; sediment transport; erosion and accretion; human modifications; and available migration space. As the rate of SLR increases, these environments will be stressed and may substantively change or be lost.

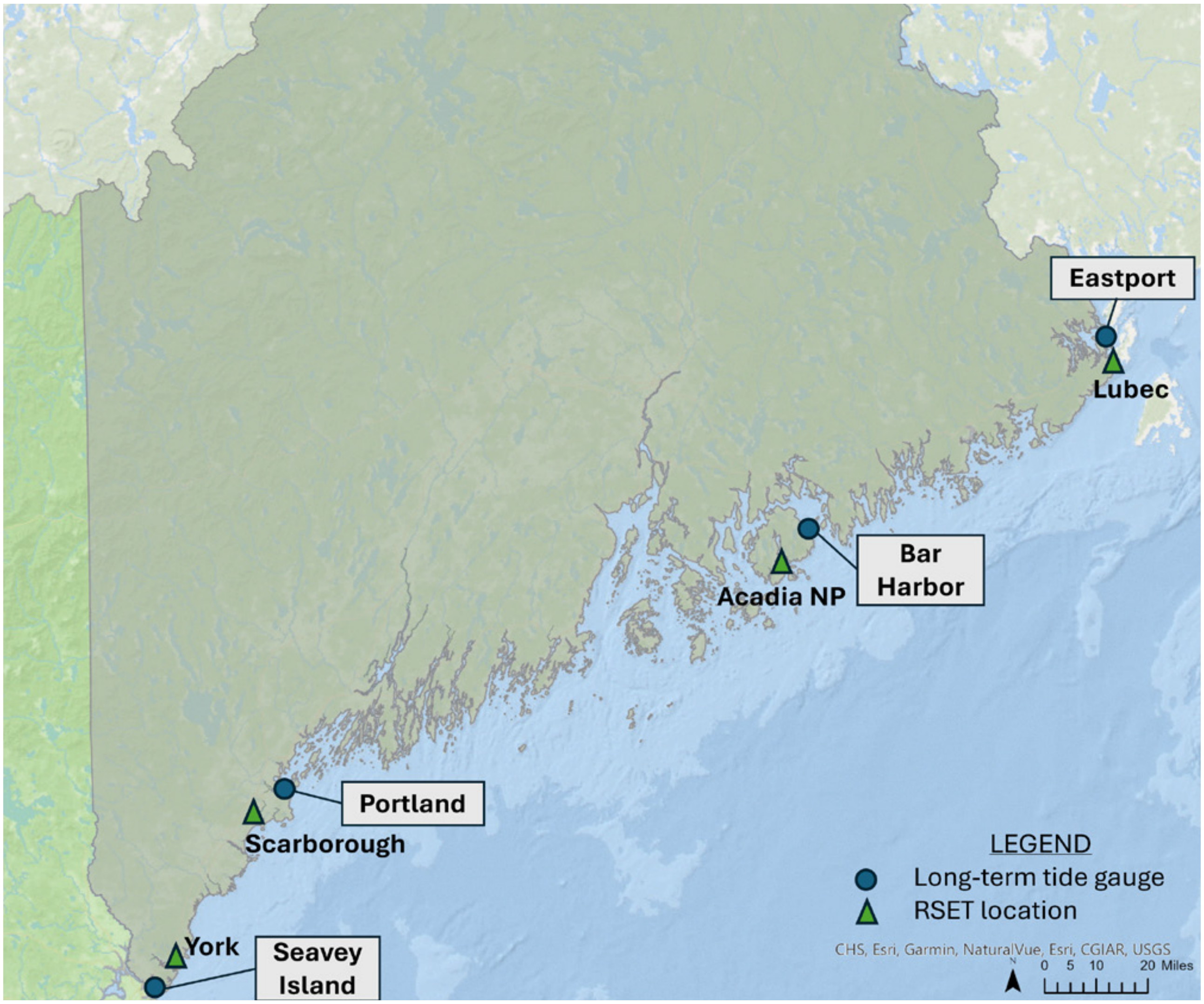


Figure 1. Location of long-term tide gauges and Rod Surface Elevation Table (RSET) locations along the coast of Maine used for this analysis.

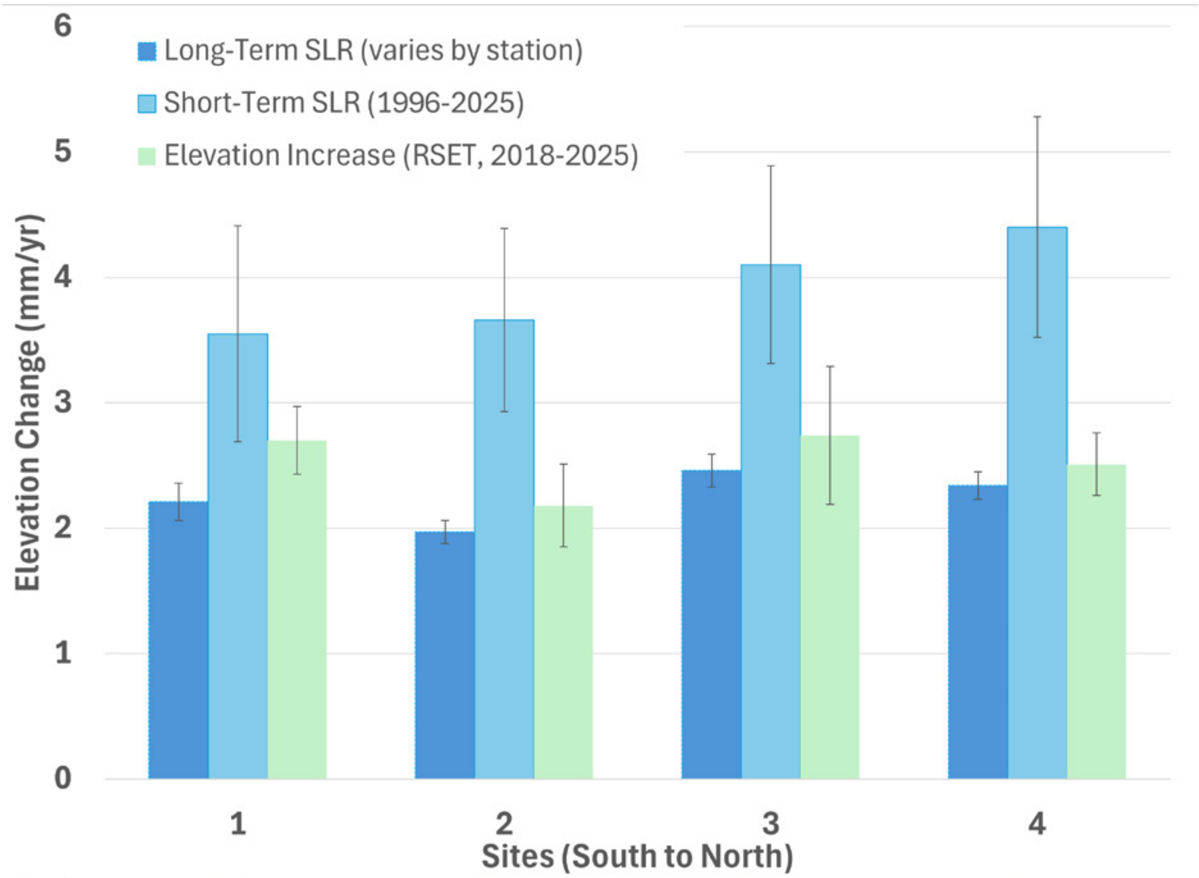
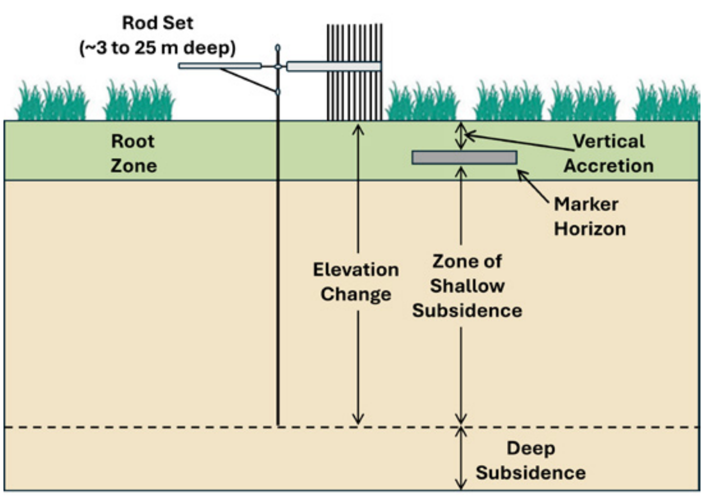


Figure 2. Long (dark blue) and short-term (light blue) SLR for Seavey Island (1), Portland (2), Bar Harbor (3), and Eastport (4) in relation to measured surface elevation change (light green, from Rod Surface Elevation Tables, or RSETs) at marshes in York (1), Scarborough (2), Acadia National Park (3), and Lubec (4). Marsh data for York, Scarborough and Lubec are from Maine Coastal Program and Maine Natural Areas Program and Acadia National Park from the Bass Harbor USNPS.



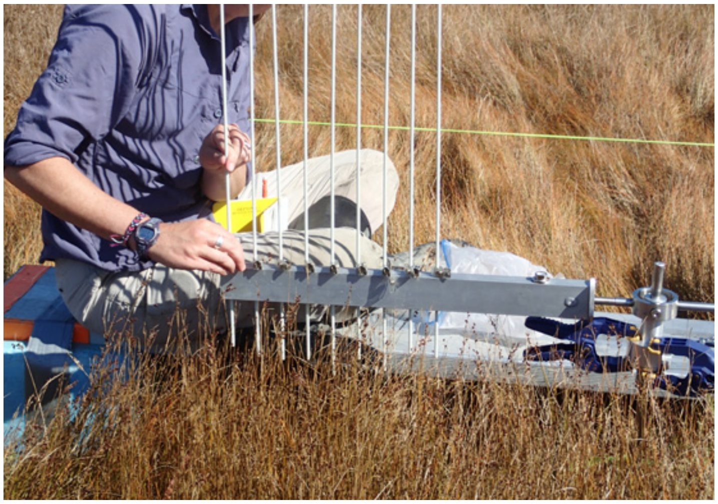


Figure 3. Images show a cross-section of an RSET (left, USGS) and RSET install (right).

WHAT DO THE DATA TELL US?

Coastal marshes' ability to build elevation and keep pace with SLR varies spatially and depends on sediment supply, vegetation productivity, subsurface dynamics, human modifications, local hydrodynamics, and geomorphic conditions. Recent (2018-2025) elevation data in Maine indicate that marshes are building elevation to keep up with slower, long-term historical rates of SLR, but not with accelerated rates measured over the last 30 years (Figure 2). With the exception of York marshes, marsh elevation increases are within the standard error of long-term SLR rates. A recent study indicates that marshes in northern New England may be stable until SLR reaches 5 mm/year, a threshold that rates in Maine are approaching or may already be exceeding.

Tidal flats depend heavily on sediment to maintain their elevation as sea level rises. Higher mean sea levels and above-average low tides in 2023-2024 (see "Sea Level Rise and Coastal Flooding") led to a reduction in the time tidal flats were above water and reduced access for shellfish harvesting. Increasing rates of sea level rise threaten these environments, and more work is needed to understand how these systems may adjust (erode or accrete) as sea level rises.

Because of unprecedented high sea levels, coastal storms of 2023 and 2024 led to erosion of **coastal beaches and sand dunes.** Maine Beach Mapping Program (MBMAP) showed an average of 26 feet of dune recession from 2024 winter storms (Figure 2). Surveys in 2025 showed dunes underwent partial recovery of about 10 feet (39%). Maine's beaches eroded about 14 feet from 2024 storms and about 11 feet (79%) returned in 2025. Dune and beach recovery showed high spatial variability; recovery was better in areas where dune restoration and beach scraping activities were undertaken.

MAINE BEACH MAPPING

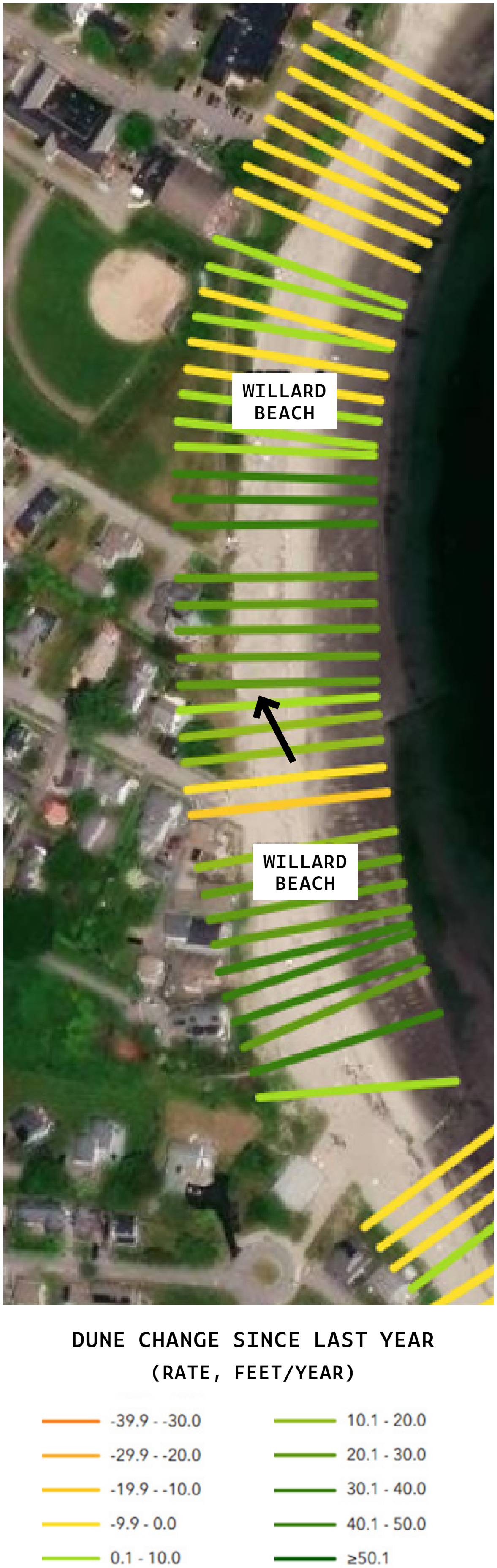


Figure 4. Dune changes relative to the previous year (2024-2025) at Willard Beach, South Portland from MBMAP indicate significant recovery since the 2024 storms. Photos above show post-storm eroded (left photo) and recovered dunes (right photo) near the black arrow shown in the image on the previous page. Photos by P. Slovinsky, MGS.

WHAT ARE WE DOING ABOUT IT?

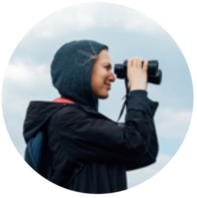
- Marsh restoration projects are underway in Scarborough and Addison to open tidal restrictions, enhance marsh growth, and conserve upland areas for marsh migration.
- Manomet Conservation Sciences is conducting participatory mapping with harvesters to document how Maine's tidal flats are changing and collaborating with Gulf of Maine Research Institute and University of Massachusetts Amherst to understand how tidal flats are responding to sea level rise.
- Maine passed regulations allowing expedited permits for beach scraping and dune restoration activities.
- New coastal sand dune maps were released in 2024 and will be updated and expanded regularly. MGS also released a viewer for Maine's Coastal Barrier Resource Systems (CBRS).
- Maine Beach Mapping Program (MBMAP) data collection continues to monitor beach and dune change.
- Updated coastal bluff stability maps are being released for Casco Bay that describe stability, sediment supply and adjacent habitat. The remainder of the coastline is to be mapped in the next three years.
- A Maine Beach Scoring System is being released in 2026 that pinpoints vulnerable beach areas and highlights areas most in need of restoration or management actions.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

- Unconsolidated coastal bluffs make up 40% of the Maine coast yet no program exists that tracks change rates.
- A better understanding of tidal flat response to sea level change.
- Continuation of Maine's marsh monitoring network to understand marsh growth and sea level rise.
- Funding for marsh and tidal crossing restoration projects (e.g., $9M in federal grant funds were cut for Addison).
- Topobathymetric LIDAR datasets (e.g., NOAA in 2022-2023) to support mapping of at-risk coastal environments.
- Funding to continue to support Maine Beach Mapping Program and expanded UAV habitat monitoring efforts.
- Maintenance of Maine Coastal Sand Dune Restoration and Protection Fund to support municipal resilience.

06

Sea Level Projections



WHY IT MATTERS

The rate of sea level rise is projected to accelerate this century and could fundamentally reshape Maine's tidally influenced coast. Sea level projections evolve as new observations, improved models, and changes in policy and technology related to global emissions refine our understanding of future sea level rise. Maine monitors these updates to support planning and decision-making using the best available science.

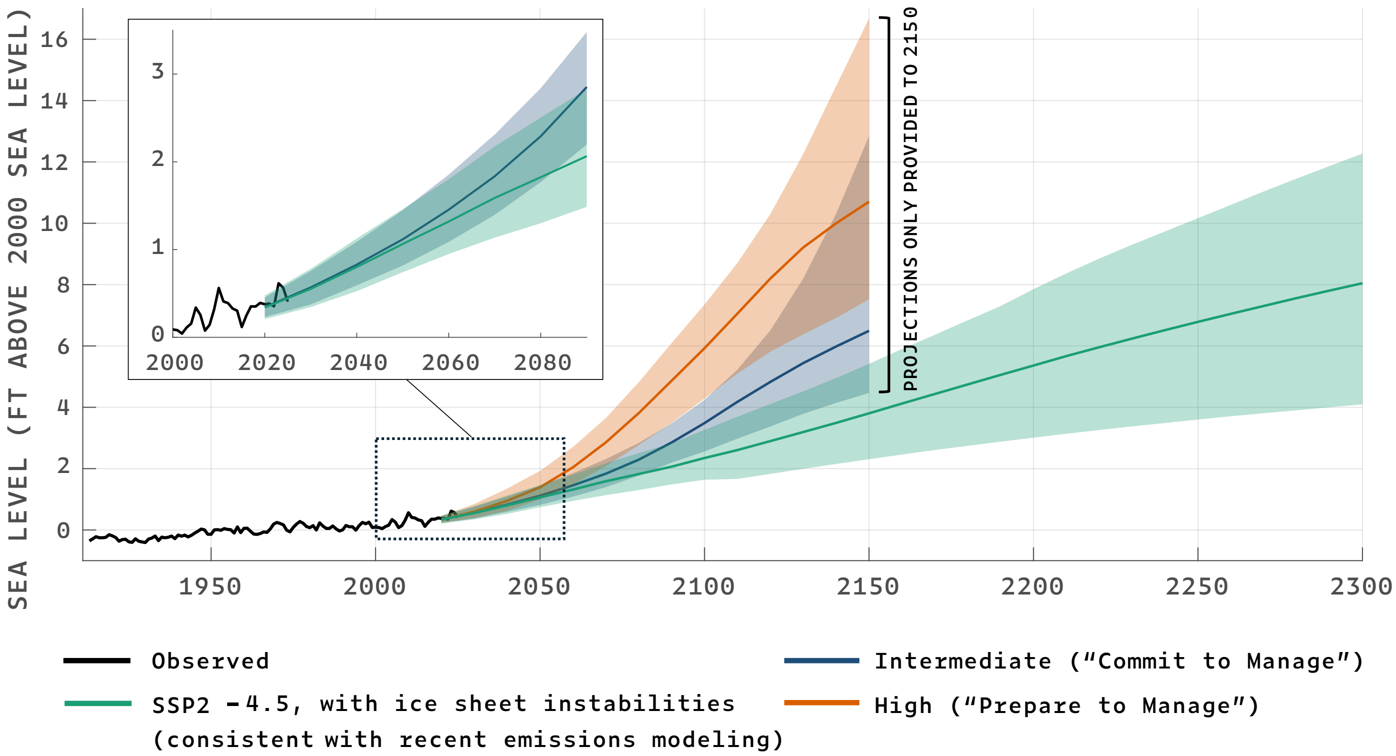


Figure 1. Observed and projected sea level rise in Portland, Maine's longest serving tide gauge. Note that sea level rise projections are similar along the entire coast. The black line shows 1912-2025 measured annual mean sea level from the Portland NOAA tide gauge. Blue- and red-colored lines with shading show projected future sea level rise for Maine's "Commit to manage" and "Prepare to manage" scenarios, respectively (U.S. Interagency Task Force Intermediate and High scenarios; Sweet et al. 2022). Lines show the median projections, and shading shows the 17th-83rd percentile "likely" range. The green line and shading shows the Intergovernmental Panel on Climate Change (IPCC) scenario consistent with 2.7 °C of warming in 2100, including ice sheet instabilities (SSP2-4.5 Low Confidence; Fox-Kemper et al. 2021; Kopp et al. 2023, Garner et al. 2021). The inset shows that the "Commit to Manage" (Intermediate) scenario is consistent with SSP2-4.5 Low Confidence through 2090, before diverging at the end of the century.

WHAT DO THE DATA TELL US?

- The current best estimate of future warming above preindustrial levels is a likely range of 2.3 to 3 °C by 2100, with a central estimate near 2.7 °C (see Introduction). Following Kopp et al. (2025), we show IPCC sea level rise projections most closely aligned with 2.7 °C of warming (SSP2-4.5). We choose to show the version of the projections that include ice sheet instabilities (called "SSP2-4.5 Low Confidence," where Low Confidence indicates that ice sheet instabilities still cannot be precisely modeled) because recent studies indicate ice sheet instabilities are possible (e.g. Kopp et al. 2025), and Maine's currently adopted sea level rise scenarios (the U.S. Interagency Task Force Intermediate and High scenarios) similarly assume contributions from ice sheet instabilities.
- The median of Maine's "Commit to Manage" scenario falls within the likely range of SSP2-4.5 Low Confidence through approximately 2090 (see Figure 1 inset). The median of the "Prepare to Manage" scenario remains within the likely range only through about 2050.
- Under the SSP2-4.5 Low Confidence scenario, sea level continues to rise for centuries, underscoring the need for long-term adaptation.

WHAT ARE WE DOING ABOUT IT?

- The Maine Coastal Flood Risk Model (ME-CFRM), which provides a detailed assessment of present and future coastal flood risk along Maine's entire coast, will be available in late-2026. The ME-CFRM is a dynamic (physics-based) and probabilistic (multi-scenario) model that includes sea level rise, tides, and storm surge, waves, and river flow from storms of varying types and strengths. The model is being developed by Woods Hole Group, in partnership with Maine Department of Transportation.
- A new saltwater intrusion monitoring network is tracking the spatial extent of saltwater intrusion into coastal wells and aquifers along the Maine coast.
- The Chapter 600 Oil Discharge Prevention and Pollution Control Rules for Marine Oil Terminals were the first state rules updated in accordance with the statutory requirement that state agencies "Commit to Manage" Maine's adopted sea level rise scenario (effective in 2023). Maine Department of Environmental Protection's (DEP) Bureau of Remediation and Waste Management recently released technical guidance for marine oil terminal owners and operators conducting Natural Hazard Risk Assessments (required for licensing) that consider sea level rise and increased precipitation.
- In 2022, Site Location of Development laws and Solid Waste Facility laws were amended to authorize the Maine DEP to consider the effect of 1.5 feet of relative sea level rise by 2050 and 4 feet of relative sea level rise by 2100 in determining whether this infrastructure fits harmoniously into the existing natural environment.
- In May 2025, the Maine Legislature signed into law "LD 228 An Act to Allow Coastal Seawalls to Be Raised by up to 2 feet in Order to Accommodate Predicted Sea Level Rise" which allows for 1) focused dune restoration activities; and 2) existing structures that meet a narrow set of conditions (including lot size, distance of structure from seawall and inability to move the structure, among others) to raise existing seawalls by up to 2 feet.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

Key Science assets:

- Global climate and Earth system modeling: Coupled Model Intercomparison Project (CMIP), National Center for Atmospheric Research (NCAR), NOAA Geophysical Fluid Dynamics Laboratory (GFDL)
- Ice sheet modeling: U.S. Antarctic Program, NASA Cryosphere Program
- Decision-relevant projections: Intergovernmental Panel on Climate Change (IPCC), U.S. Interagency Task Force on Sea Level Rise, NASA Sea Level Change Program

Assets at risk:

- Coastal ecosystems, critical infrastructure, transportation networks, working waterfronts, and homes

What is needed:

- Continued investment in global climate and earth system modeling and Arctic/Antarctic research programs; continued amendment of state rules to consider the effects of sea level rise; climate-resilient infrastructure and social systems; community-led sea level rise adaptation strategies

07

Recent and Near-Term Future Sea Level and Coastal Flooding



WHY IT MATTERS

Sea level rise is making coastal flooding along Maine's coast and tidal rivers more frequent and severe. It is threatening coastal ecosystems, critical infrastructure, transportation networks, working waterfronts, and homes. Understanding the drivers of recent flooding can help communities prepare for the future. Maine is also developing decision-support tools and forecasting capabilities to improve near-term management of coastal flood hazards.

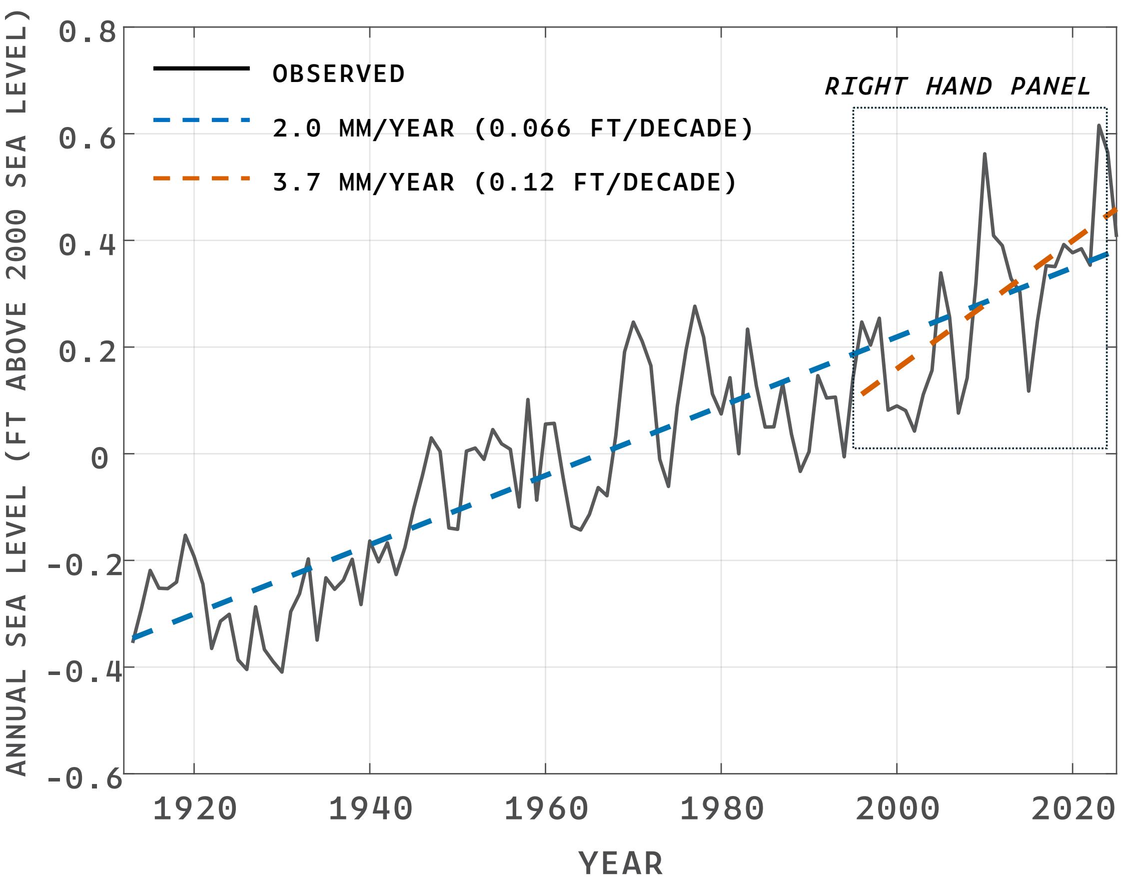
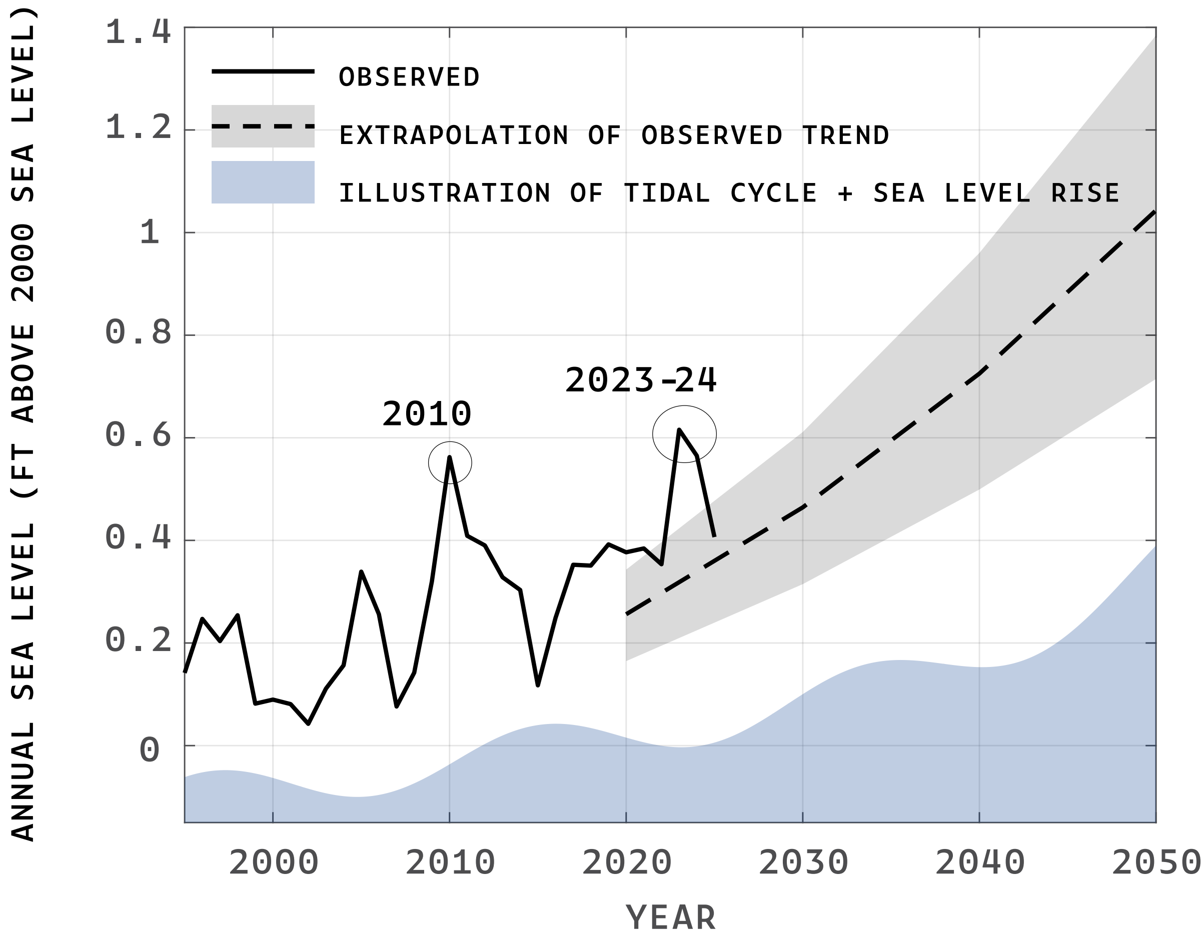


Figure 1. 1911-2025 annual mean sea level, measured at the [Portland NOAA tide gauge](). The average rate of sea level rise over the past 115 years is 2.0 mm/year (0.066 ± 0.003 feet/decade, blue line). Sea level rise is accelerating, and the rate over the last 30 years (1996-2025) is 3.7 mm/year (0.12 ± 0.034 feet/decade, red line), nearly double the historical rate. (Right) Observed annual mean sea level (black line), with 2010, 2023, and 2024 high sea level years circled. The black dashed line extrapolates the measured, accelerating trend in sea level into the future, through 2050 ([Sweet et al. 2022;]() shading shows 17th-83rd percentile "likely" range). The blue shaded area **illustrates** *(note, these are not quantitative projections) the combined effect of the 18.6-year lunar nodal cycle and sea level rise on high tide levels.*



WHAT DO THE DATA TELL US?

- The rate of measured sea level rise in Maine has nearly doubled over the past 30 years when compared to the rate over the last 115 years. The global average rate of sea level rise, measured by satellites, has also accelerated from 2.1 mm/year in 1993 to 4.5 mm/year in 2023 (Hamlington et al. 2024).
- Variations in wind, atmospheric pressure, and ocean temperature, salinity, and currents cause sea level to vary year-to-year. High sea level in 2010 and 2023-2024 caused a record-breaking number of days with high tide flooding. For example, water level exceeded Portland's minor flood threshold (12 ft above mean lower low water) on 20 days in 2010 and 15 days in 2024. By comparison, the average annual number of high tide flooding days from 2000-2025 was 6 (NOAA CO-OPS Coastal Inundation Dashboard).
- Sea level decreased in 2025, but extrapolating the recent sea level rise trend into the future shows that the severe flood years in 2010 and 2024 offer a preview of the conditions Maine will experience as sea level continues to rise.
- Tidal range varies on an 18.6-year cycle, due to changes in the moon's orbit (known as the "lunar nodal cycle"). The cycle reached a minimum in 2023-2024, lowering the height of high tides and partially offsetting flood hazard from elevated sea levels during those years. Tidal range will now increase through the mid-2030s (causing high tides to get higher and low tides to get lower). Higher tides will combine with ongoing sea level rise to increase flood hazard.

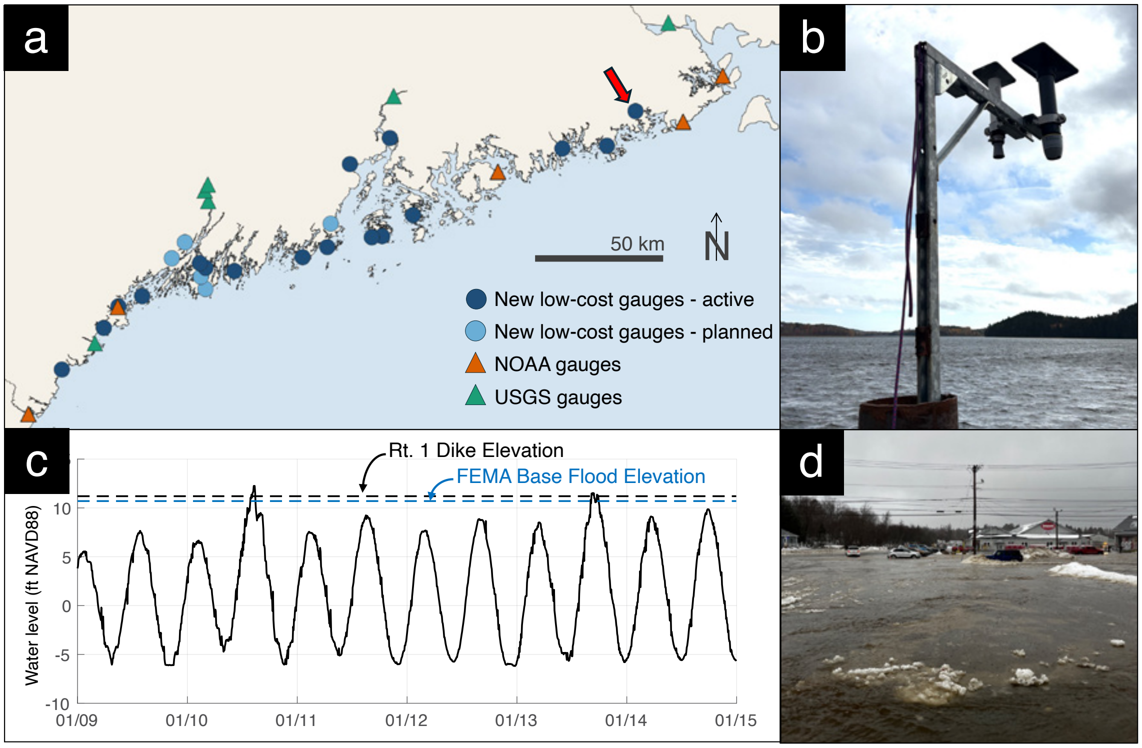


Figure 2. (a) Map of Maine's expanding tide gauge network; (b) New tide gauge installation in Machias (installed September 2024), with co-deployed ultrasonic (left) and radar (right) Hohonu gauges; location denoted by red arrow in panel a; (c) Measured water levels from the Machias tide gauge during the January 10 and 13, 2024 storms; (d) Image of flooding in Machias on January 10, 2024 (source: GMRI Ecosystem Investigation Network).

WHAT ARE WE DOING ABOUT IT?

- Maine is leveraging low-cost tide gauge technology to expand its network beyond the existing NOAA and USGS gauges. These new gauges enable the National Weather Service to provide coastal water level forecasts at new locations. They are also being used by communities for near-term event response and long-term climate planning and adaptation projects (e.g. Baranes et al. 2026).
- The new Coastal Elevation and Flood Level Tool enables users to view a location's elevation relative to FEMA base flood elevation, highest astronomical tide (HAT), and mean lower low water (MLLW).
- The new Coastal Structure and Dune Crest Inventory and Overtopping Potential Tool enables users to understand the relationship between FEMA base flood elevations and current dune and wall elevations.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

Key science assets:

- Sea level observations: NOAA CO-OPS National Water Level Observation Network, USGS Streamgage Network, Northeast Regional Association of Ocean Observing System (NERACOOS), NASA and ESA satellite altimetry missions
- National Geodetic Survey / Maine Department of Transportation Continuously Operating Reference Station (MaineDOT CORS) Network
- Coastal flood forecasting: National Weather Service, Gray and Caribou Weather Forecast Offices; NOAA coastal flood modeling programs (Meteorological Development Laboratory, Coast Survey Development Laboratory)

Assets at risk:

- Coastal ecosystems, critical infrastructure, transportation networks, working waterfronts, and homes
- What is needed: Continued investment in forecasting capabilities and resilient infrastructure and social systems; community education

08

Forest Carbon & Productivity



WHY IT MATTERS

Maine's 17.4 million acres of forestland make it the most forested state in the nation. These forests are the state's most important climate asset, removing more carbon dioxide from the atmosphere than Maine emits from all sources combined. The State Carbon Budget (v2) found that forestland removes 22.2 MMTCO2e/yr (million metric tons CO_2 equivalent) while gross emissions total 16.1 MMTCO2e/yr. Tracking these trends is essential for *Maine Won't Wait* and the $8.3 billion forest products economy.

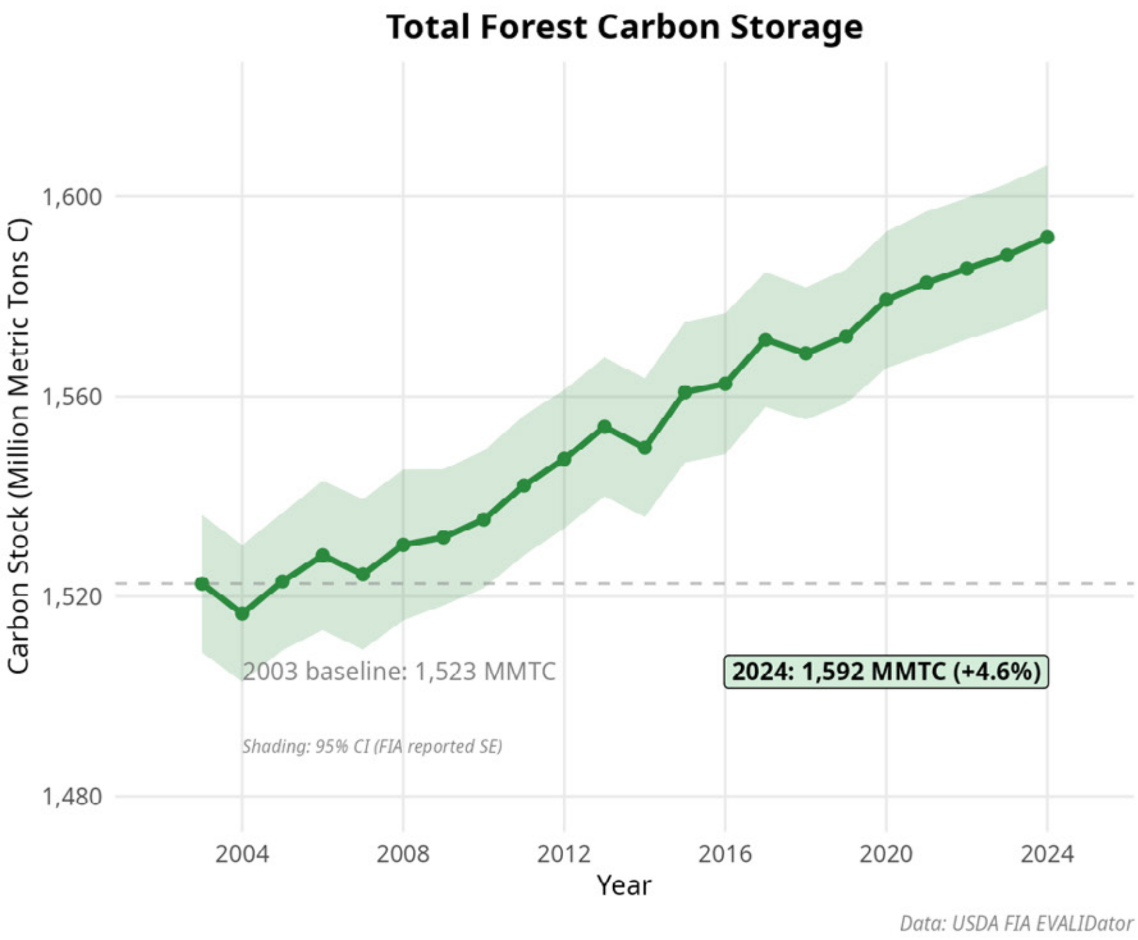


Figure 1. Carbon storage increased 4.6% since 2003.

WHAT DO THE DATA TELL US?

- Carbon storage is growing. Maine forests store 1,592 million metric tons of carbon, up 4.6% since 2003. Annual carbon removal averages 13.5 MMTCO2e, equivalent to taking 2.9 million cars off the road each year.
- Harvest is highly sustainable. Maine's Growth:Harvest ratio was 1.72 in 2024, up from 1.0 in 2008. Forests now grow 72% more wood than is harvested, providing increasing flexibility for active management.
- Tree mortality is declining. Annual tree mortality declined 14% since 2008, from 1.27% to 1.09%. However, the rate has edged upward since a 2017 low of 0.82%, which warrants continued monitoring for emerging stressors such as beech leaf disease, emerald ash borer, and hemlock woolly adelgid.
- Forest area is stable. Maine retains 17.4 million forested acres (87.8%), the highest percentage in the nation. The gradual decline of 1.4 percent since 2003 reflects modest development pressure, primarily in southern Maine. Every forested acre lost permanently reduces the state's carbon removal capacity.

KEY TAKEAWAYS

- Forests are Maine's #1 climate asset, absorbing more CO_2 than the state emits from all sources.
- Carbon storage is up 4.6%, harvest is highly sustainable (G:H = 1.72), and mortality is declining.
- Forest cover remains stable at 87.8% (17.4 million acres), the highest of any U.S. state.
- Maine is among the closest states to carbon neutrality-natural lands offset 91% of gross emissions.

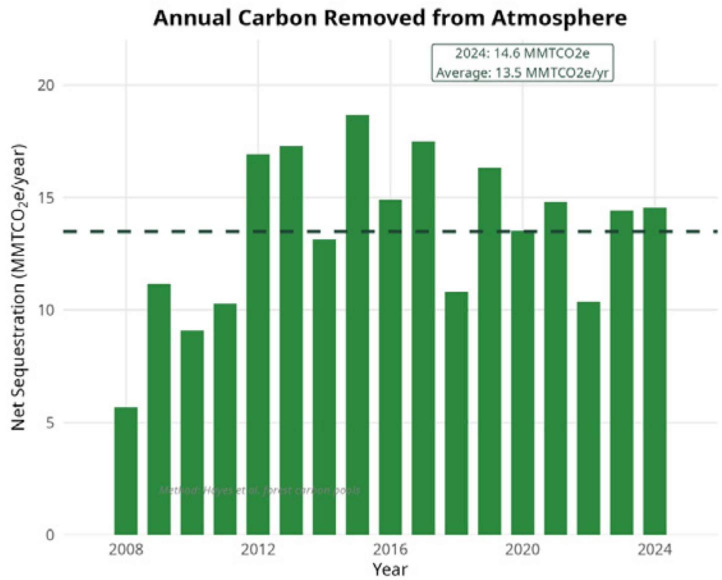


Figure 2. Maine forests remove an average of 13.5 MMTCO2e/yr from the atmosphere.

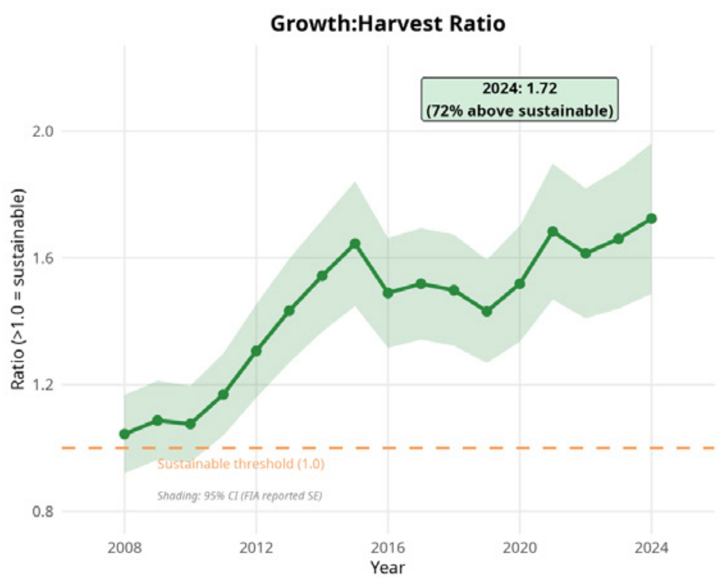


Figure 3. Forests grow 72% more wood than is harvested.

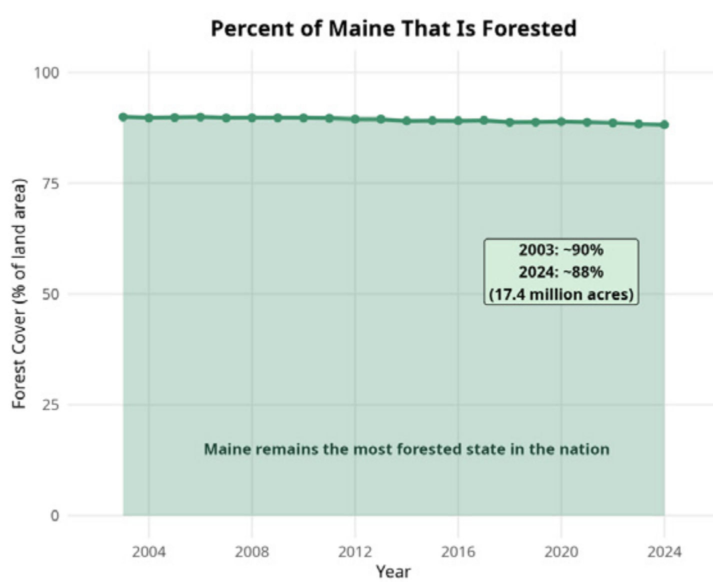


Figure 4. Forest cover remains stable at 87.8%, or 17.4 million acres.

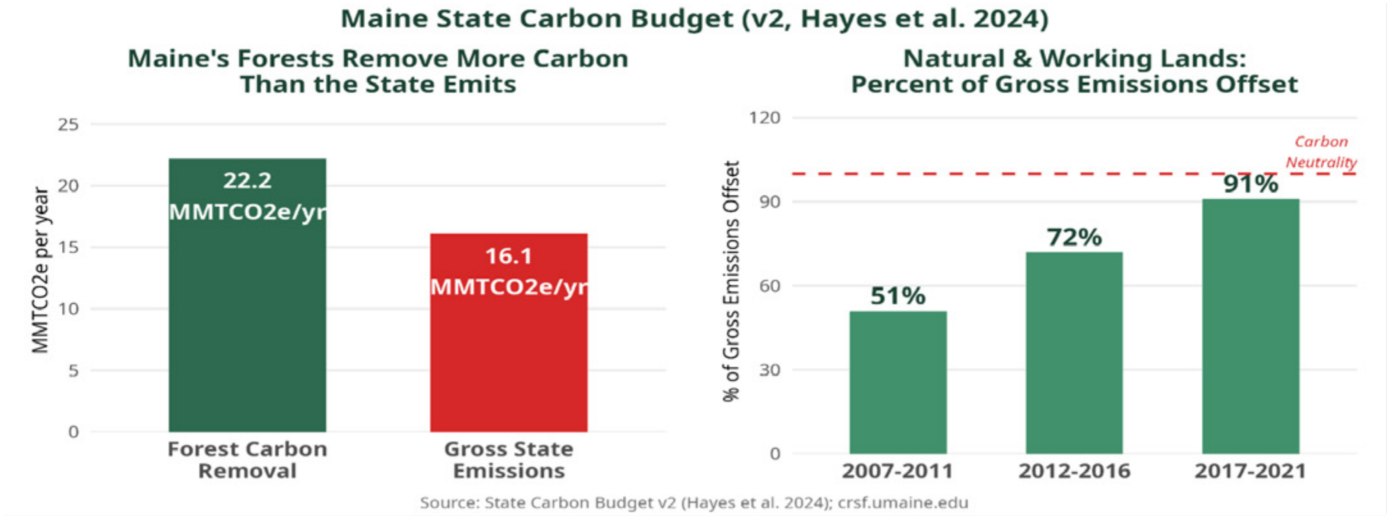


Figure 5. Forests remove more carbon than Maine emits. Natural and working lands offset 91% of gross emissions (2017–2021), up from 51% a decade earlier (Hayes et al. 2024).

WHAT ARE WE DOING ABOUT IT?

- Monitoring: USDA Forest Inventory and Analysis (FIA) provides systematic data through over 3,500 permanent plots. Maine Forest Service coordinates state assessments and the biennial State of the Forest report. Remote sensing and lidar are expanding spatial resolution.
- Management: Thinning dense stands increases wood product storage and creates growing space. Current carbon removal puts Maine on a path toward its 2045 carbon neutrality target. Climate adaptive forest management can enhance both timber value and carbon storage.
- Certification & markets: About 8.5 million acres are third party certified (FSC/SFI). Emerging carbon and ecosystem credit markets create incentives for landowners to maintain and enhance carbon stocks.
- Research & policy: UMaine's a leader in carbon dynamics and climate adaptation research. The State Carbon Budget provides an accounting framework for MEDEP's GHGs and the 2045 carbon neutrality target.

CRITICAL SCIENCE ASSETS

- Supporting: USDA FIA inventory; Maine Forest Service; UMaine/CFRU/CRSF; State Carbon Budget; Penobscot Experimental Forest; long term research plots.
- At Risk: FIA funding and plot density; EPA state GHG reporting; Penobscot Experimental Forest; Bear Brook Watershed; long term monitoring continuity.
- Needed: Enhanced FIA plot density; remote sensing integration; improved harvested wood products accounting; Carbon Budget v3; statewide lidar carbon mapping.

WHAT TO WATCH

- Thresholds: G:H ratio <1.0; mortality >1.5%/yr; forest cover <85%; carbon removal <10 MMTCO2e/yr.
- Upcoming: FIA 2025 data release; Carbon Budget v3; ecosystem markets development; updated state GHG inventory; climate vulnerability assessments.

CITATIONS

USDA Forest Service FIA EVALIDator (2024). Hayes et al. (2024). State Carbon Budget v2 (2024). Maine Forest Service (2024). Weiskittel et al. (2025). Data from 1999–2003 forward per MFS/FIA methodology.

09

Forest Health & Diversity



WHY IT MATTERS

Forest health determines whether Maine's forests can continue serving as the state's primary climate asset. Key indicators include stand density, tree mortality, species and structural diversity, pest threats, and wildfire risk. Relative Density (RD) measures how crowded a forest is relative to its maximum carrying capacity. Maine's forests have become about 10% more densely stocked since 1999, moving from mid-optimal toward the upper boundary where competition stress and vulnerability to disturbance increase.

Mortality Rate	Relative Density	Species Diversity	Wildfire
↓ -14%	↑ +9%	↑ +4%	✓ Low
(1.09%)	(0.57)	(6.25)	(531 acres/yr)

Figure 1. Tree mortality declined 14% since 2008.

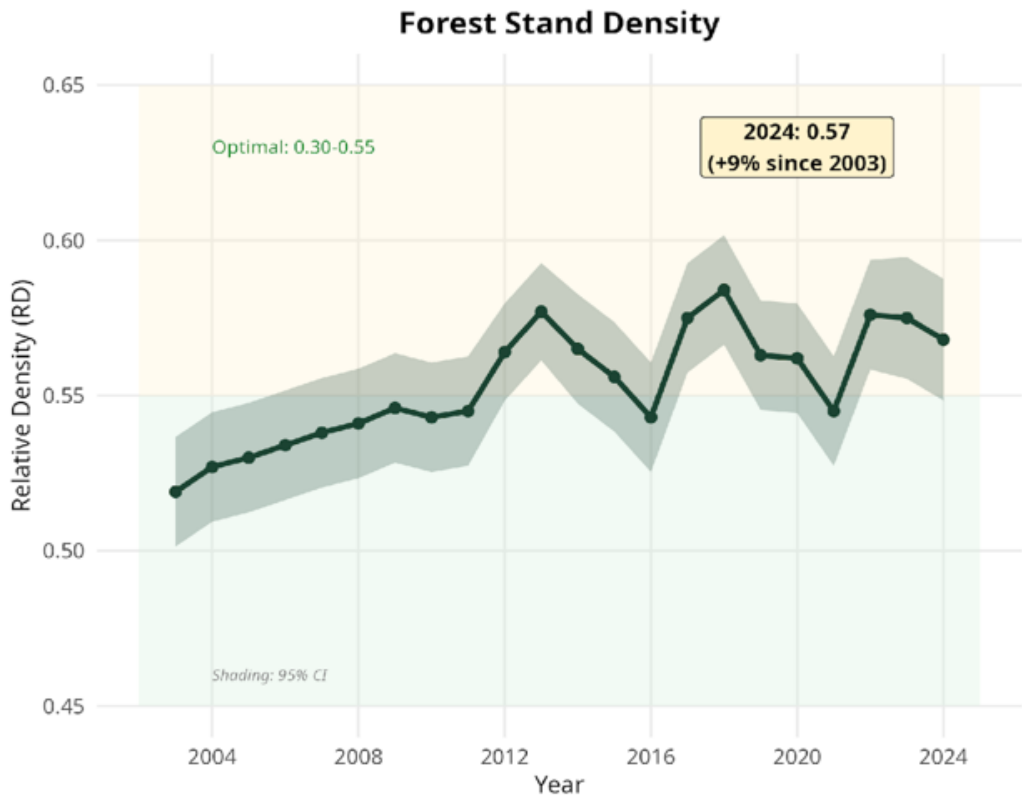


Figure 2. Relative density rose ~10% to 0.57, the upper edge of optimal.

WHAT DO THE DATA TELL US?

- Stand density is increasing. Relative density rose ~10% to 0.57, now above the optimal management zone of 0.30–0.55. Higher density increases competition for light, water, and nutrients, and leaves trees more vulnerable to drought and pests. Strategic thinning can reduce this stress and improve resilience while producing valuable wood products.
- Diversity is stable. Species diversity (Hill's diversity numbers) and structural diversity (Gini index=the variety of tree sizes in a stand) have remained essentially stable since 1999, providing a solid ecological foundation for forest health and resilience. Gini index is up 1.6% over the period.
- Pest pressure is escalating. Beech leaf disease (BLD) has spread to all 16 counties since 2021. Emerald ash borer (EAB, 11 counties) and hemlock woolly adelgid (HWA, 9 counties) continue expanding. Climate warming is expected to increase pest range and overwintering survival.
- Wildfire risk remains low. Maine averages roughly 530 acres burned per year, among the lowest nationally. Area burned has declined 97% since the early 1900s due to improved detection and suppression. Increasing drought frequency under climate change warrants continued vigilance.

INVASIVE PESTS: 3 MAJOR THREATS

BEECH LEAF DISEASE	EMERALD ASH BORER	HEMLOCK WOOLY ADELGID
16/16 COUNTIES	11/16 COUNTIES	9/16 COUNTIES
SINCE 2021	SINCE 2018	SINCE 1999

Figure 3. Three major invasive pests threaten Maine's forests. BLD now affects all 16 counties; EAB (11) and HWA (9) continue expanding.

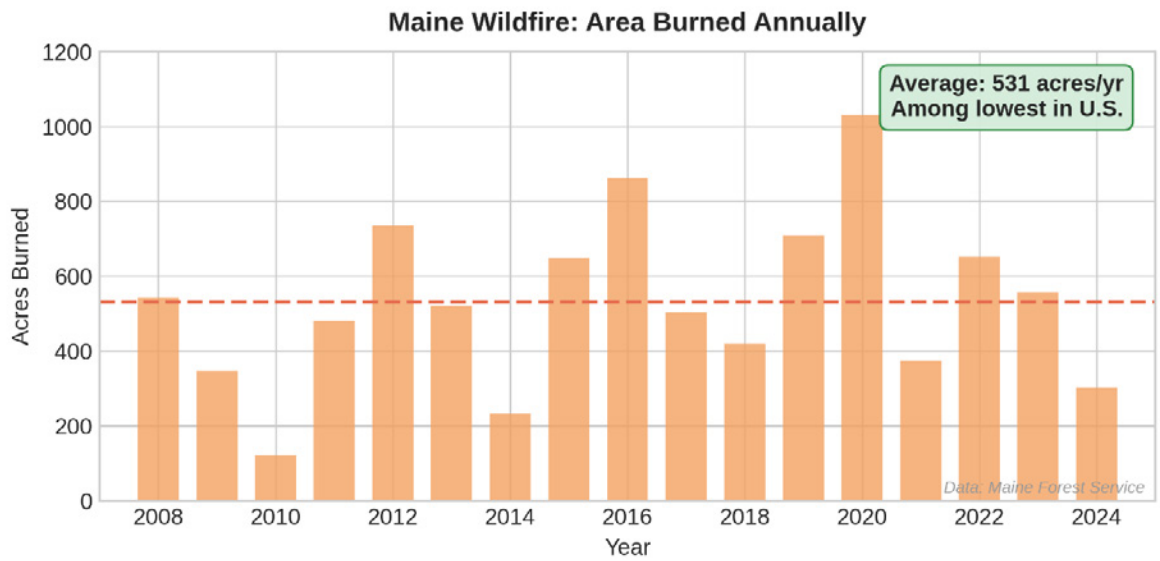


Figure 4. Maine wildfire risk remains steady and area burned is among the lowest in the US.

KEY TAKEAWAYS

- Stand density is approaching concerning levels (RD = 0.57). Strategic thinning would improve resilience.
- Species and structural diversity remain stable, but three invasive pests threaten major tree species.
- BLD is now statewide; EAB and HWA continue expanding. Climate warming will accelerate pest impacts.
- Wildfire risk is low compared to the national average, but drought risk is increasing under climate change (for more about wildfire, see: https://wildfire-risk.org/understand-risk/).

WHAT ARE WE DOING ABOUT IT?

- Monitoring: USDA Forest Inventory and Analysis (FIA) provides systematic data; Maine Forest Service coordinates annual pest surveys, Forest Health Highlights, and wildfire tracking.
- Conservation: About 22% of Maine's forests are under conservation protection; Forest management and harvests occur on about 85% of forest easement areas.
- Pest management: Biological control agents are being tested for EAB and HWA. BLD management remains limited. Maine Forest Service tracks pest spread annually.
- Research: UMaine & CFRU lead work on forest health, pest impacts, and climate adaptation.

CRITICAL SCIENCE ASSETS

- Supporting: USDA FIA inventory; Maine Forest Service pest surveys; UMaine/CFRU research programs.
- At Risk: FIA funding; long term research plots; pest monitoring program continuity.
- Needed: Enhanced FIA plot density; statewide RD mapping; expanded pest surveillance; spruce budworm early warning.

WHAT TO WATCH

- Thresholds: Relative density >0.65 (overstocked); species richness declining >5%; pest spread to all 16 counties.
- Upcoming: FIA 2025 data release; climate vulnerability assessments; spruce budworm monitoring expansion, 2026 Maine Forest Service State of the Forest report.

CITATIONS

USDA Forest Service FIA EVALIDator (2024). Maine Forest Service (2024). DeSantis et al. (2013). Paradis et al. (2008). Goraya et al. (2024). Weiskittel et al. (2025). Data from 1999–2003 forward per MFS/FIA guidance.

10

Forest Biodiversity



WHY IT MATTERS

A climate change indicator for Maine wildlife and habitats, forest biodiversity depends on maintaining a shifting mix of older, younger, and connected habitats. Maine remains heavily forested, but most stands are now middle-aged, while both late-successional/old forests and very young forests are scarce.

- Forest age, structure, and patch size strongly influence which species live and breed there, and how fish and wildlife move across the landscape.
- About 71% of Maine vertebrates use older forests, while about 48% use young forests; both ends of the age spectrum matter for biodiversity.
- Older, structurally complex forests generally support more biodiversity and store more carbon, while very young forests provide habitat for shrubland and regenerating-forest specialists.

AT A GLANCE

Older forests
Support many vertebrates, store more carbon, and harbor specialized mosses, lichens, beetles, and fungi.

Young forests
Essential for species such as New England Cottontail, American Woodcock, and Eastern Towhee.

Age imbalance
Today's forests are dominated by 20-80 year classes rather than mostly older forests as was historically the case.

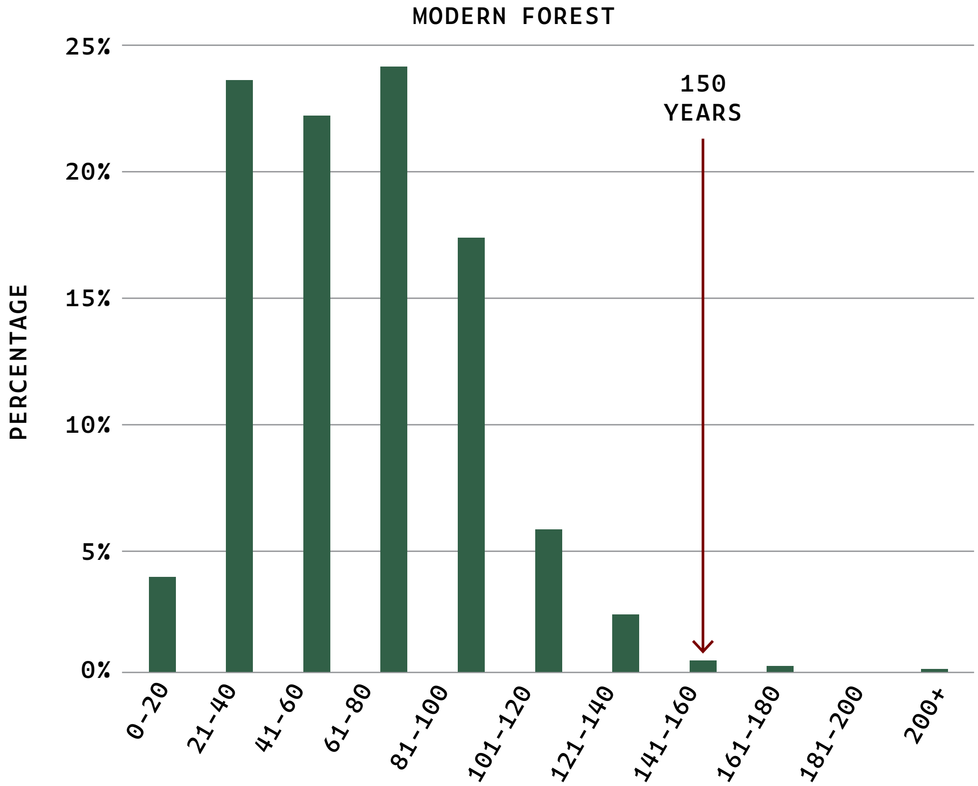


Figure 1. Most of today's forests fall in the 20–80 year classes, with very little forest older than 150 years. That contrasts sharply with an estimated pre-European pattern of roughly 75% older than 150 years and 25% younger than 25 years. Graph adapted from Barton, USDA FIA, and Lorimer and White.

A. Gap in the forest created by a natural disturbance resulting in standing and downed deadwood. Increased light conditions will promote the release and establishment of young trees. These gap-scale events generate the spatial heterogeneity in tree densities and sizes that is a key characteristic of old-growth forests.

B. Large-diameter (20″+ DBH) standing dead tree (snag).

C. Large-diameter (20″+ DBH) overstory trees.

D. Seedlings and saplings from a previous gap create multiple canopy layers, variation in tree size and density, and species diversity.

Figure 2. Old-growth characteristics—large trees, layered canopies, standing dead wood, and small gaps—support high biodiversity over time. From D'Amato and Catanzaro

WHAT DO THE DATA TELL US?

- In northern and Downeast Maine, LiDAR reveals late-successional/old-growth forest (150+ years) covers only about 3% of the Unorganized Territories, while another 16% is 100–150 years old and transitioning toward older conditions. Many remaining older stands are concentrated in riparian corridors rather than large connected interior blocks.
- In southern Maine, intermediate-age forests dominate and young forest covers less than 3% of the landscape.
- Comparable LiDAR-based mapping of older and younger forests has not yet been completed for organized towns or forested wetlands.

WHAT ARE WE DOING ABOUT IT?

- Research and landowner guidance materials in Maine and neighboring states show how forest management can retain or help develop old-growth characteristics over time.
- The Maine Forest Service is studying the importance of older forests and options for conserving current and future older forests; its report to the Legislature is due in November 2026.
- Appalachian Mountain Club, New England Forestry Foundation, Maine Audubon, local land trusts, foresters, loggers, and landowners are all working together to integrate wildlife- and carbon-friendly practices on small woodlands and working forests.
- Partners are also creating early-successional habitat in southern Maine; New England Cottontail increased from fewer than 300 animals in 21 patches in 2017 to about 400 animals in 45 patches in 2025.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

- LiDAR mapping in the Unorganized Territories and practical landowner guidance materials now provide a strong starting point for identifying and stewarding older forests.
- Older forests are under pressure because they contain valuable timber, yet the structural features that support biodiversity can take centuries to recover once lost.
- Early-successional shrub habitat continues to shrink, and many mosses, lichens, fungi, snails, beetles, and other insects tied to older forests remain poorly inventoried.

WHAT TO WATCH

- Whether conservation groups can scale tools such as fee purchase, delayed-harvest incentives, and policy approaches to conserve the remaining oldest forests.
- Repeated tracking of late-successional/old-growth areas and early successional forest extent statewide.
- Results of the Maine Forest Service study, due to the Legislature in November 2026.

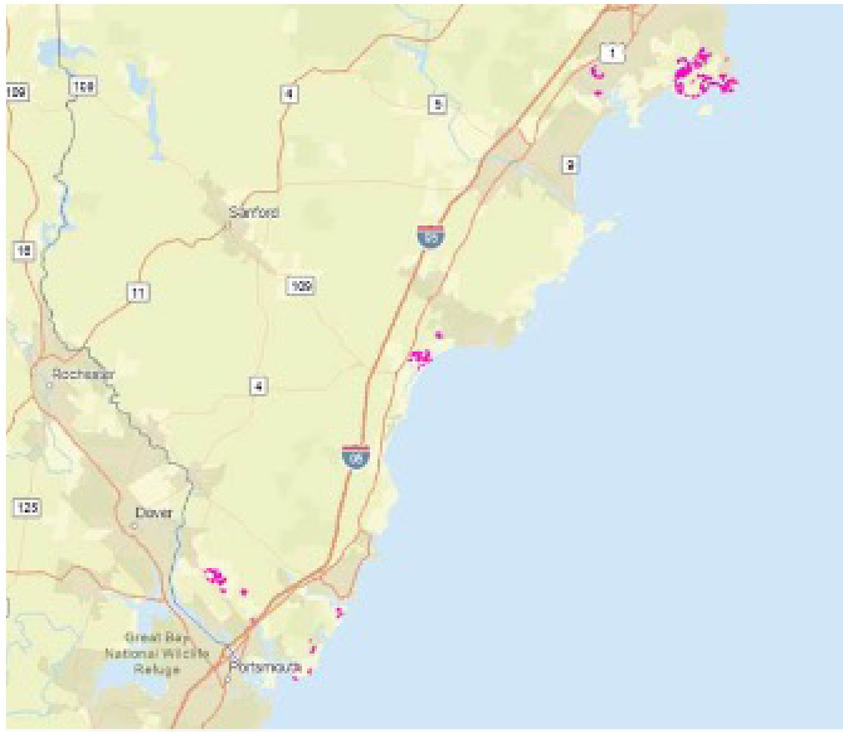


Figure 3. New England Cottontail are expanding after reintroduction but are restricted to a few patches of young forest in southern Maine (note pink blobs per C. Stearns, DIFW).

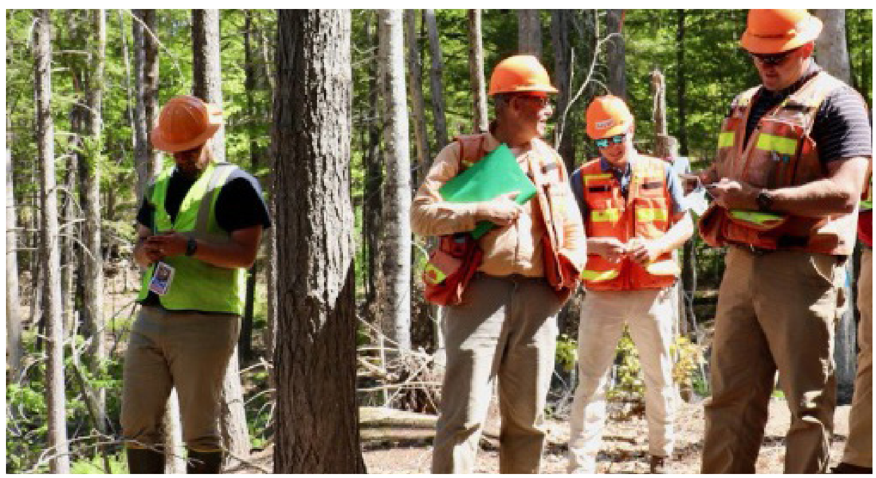
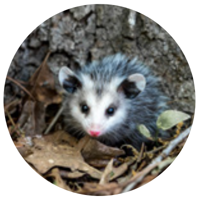


Figure 4. Forestry for Maine Birds and Forests for Maine Fish help loggers, foresters and landowners integrate wildlife- and climate-friendly practices on managed forests.

Species Occurrence and Range Shifts



WHY IT MATTERS

As Maine warms, species are changing where they occur, how far north they can persist, and whether they remain through the winter. These shifts are among the clearest biological signals of climate change because they reveal changes in geographic ranges for both new arrivals and species under stress.

- Range shifts show that climate change is already reshaping Maine's ecological communities. As temperature, snow cover, hydrology, and sea level changes, species redistribute and new assemblages of plants and animals emerge.
- Some of these changes reflect adaptation, but others signal growing stress or decline. Over time, gains and losses of species may alter food webs, ecosystem function, and wildlife management priorities.

AT A GLANCE

Northward / upslope shifts

Cold-adapted species, such as Boreal Chickadee, are pushed toward cooler conditions in northern Maine.

New arrivals

Warm-adapted species such as Carolina Wren, Opossum, and Gray Fox have moved into the state from the south.

Winter persistence

Some birds now remain through the winter in much higher numbers than they did historically.

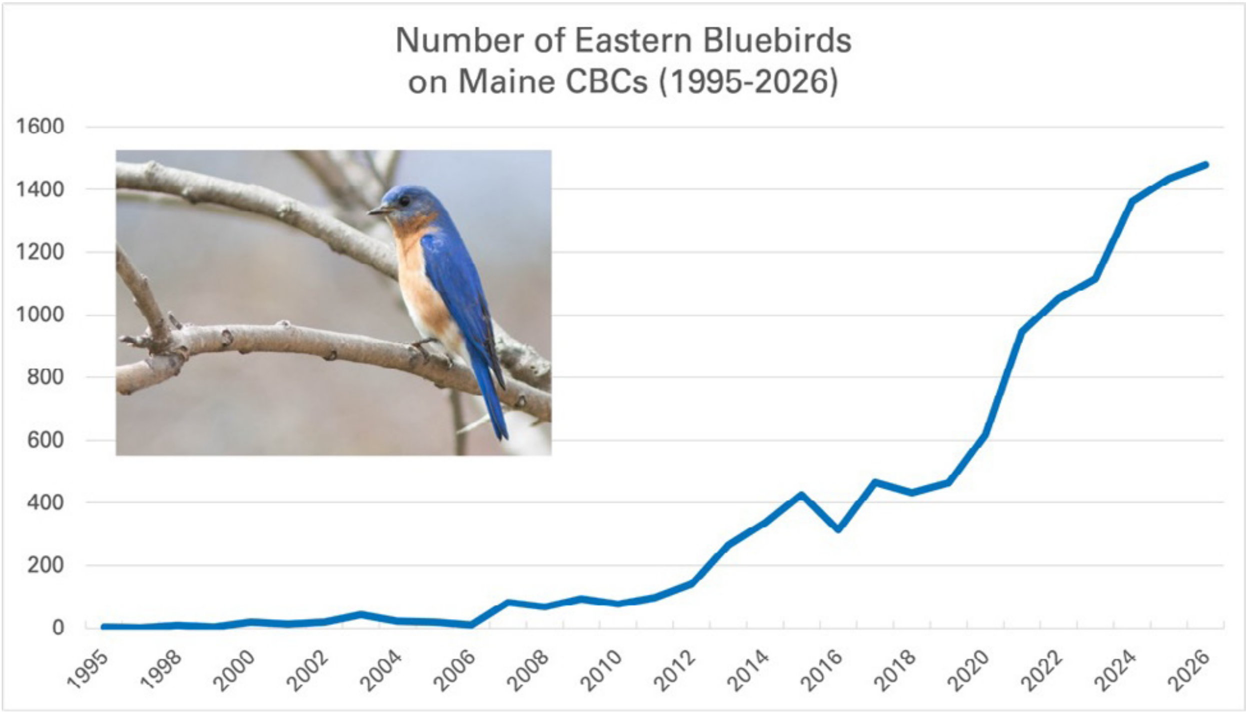


Figure 1. Eastern Bluebird counts during Maine Christmas Bird Counts rose sharply after 2012, illustrating how milder winters can change seasonal occurrence. Source: Doug Hitchcox, Maine Audubon

WHAT DO THE DATA TELL US?

- Species that are less mobile, heat-sensitive, or tied to shrinking habitat are often the least able to adapt. In Maine, examples include rare Saltmarsh Sparrows and Margined Tiger Beetles in tidal marshes, bumble bees vulnerable to overheating, and hibernating bats affected by white-nose syndrome (a deadly exotic fungus).
- Warmer conditions are also enabling northward expansion. Virginia Opossum and Gray Fox now occur as far north as Bangor, with at least one Gray Fox report from Patten, and invasive Eastern Cottontails have advanced north to Portland, where they may compete with native New England Cottontails.
- Rigorous monitoring data is still thin. Strong long-term population information exists for only a limited set of species; many shifts in plants, insects, fish, and wildlife are likely going undetected.

Figure 2. At Saddleback, seasonal exterior screens help reduce collision risk for Bicknell's Thrushes and Blackpoll Warblers at MidMountain Lodge.

Figure 3. Saltmarsh restoration and nesting experiments are aimed at reducing flood risk for Saltmarsh Sparrow nests and chicks.

WHAT ARE WE DOING ABOUT IT?

- Statewide surveys and atlases are building the baseline needed to detect change, including the Maine Butterfly Survey, the Maine Amphibian and Reptile Atlas, and the 2018-2022 Maine Bird Atlas.
- The updated Maine State Wildlife Action Plan identifies 721 Species of Greatest Conservation Need and outlines habitat and management actions that can reduce climate stress alongside other threats.
- Conservation interventions are already underway, including habitat protection and window collision-reduction measures for rare Bicknell's Thrush and Blackpoll Warblers and saltmarsh restoration efforts that can improve nesting success for endangered Saltmarsh Sparrows.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

- New and on-going wildlife assessment efforts are providing an opportunity for future comparisons, including the long-standing Maine Amphibian and Reptile Atlas and a new Maine Flower Fly Atlas.
- Monitoring range shifts remains labor-intensive and underfunded, especially for insects, plants, and other lesser-studied taxa that are foundational to food webs and ecosystem resilience.

WHAT TO WATCH

- Over the next decade, agencies and partners will begin implementing Maine's 2025 Wildlife Action Plan recommendations across conservation lands, working lands, and restoration projects.
- Continental bird losses and accelerated declines in many species suggest that ecological effects may extend beyond wildlife to pollination, pest control, and other ecosystem services.
- Publication of the updated 2025 Wildlife Action Plan will provide important new goals and benchmarks for tracking future conservation success.

12

Species Endangerment Status

WHY IT MATTERS

Maine has more than 16,000 inland (nonmarine) wildlife species. Of these, 57 (<0.5%) are currently listed as State Endangered or Threatened, reflecting risk of extinction within Maine. Many wildlife species or viability have yet to be assessed. There are another ~2,600 vascular plant species, of which 183 (7%) are similarly listed. Listed species range from well-known birds such as Peregrine Falcon to less conspicuous species such as the Ringed Boghaunter dragonfly, though we have limited or no data on many others. Climate change is now one of the most significant stressors on these species, often compounding long-standing pressures such as habitat loss, fragmentation, disease, and invasive species. Tracking status and reducing threats are central to conserving Maine's biodiversity.

WHAT DO THE DATA TELL US?

- The number of listed inland wildlife species increased from 11 in 1987 to 57 in 2023, in part because climate change is an increasing risk for climate-sensitive species.
- Climate change affects nearly half (27) of Maine's 57 listed inland wildlife species, second only to habitat loss and fragmentation, which affects 44 species.
- Threats often magnify one another: warming can shrink suitable habitat while development and fragmentation reduce the ability of plant and animal species to disperse to newly suitable areas.

WHAT ARE WE DOING ABOUT IT?

- State and federal agencies, with partners such as Maine Audubon and the Biodiversity Research Institute, monitor occurrence, abundance, and trends of at-risk species across Maine.
- These data are used to assign statuses such as Endangered, Threatened, Special Concern, and Species of Greatest Conservation Need.
- Conservation actions range from landscape scale measures such as land protection, and municipal planning guidance, to finer scale interventions such as aquatic organism passage restoration and forestry best practices.
- Maine's 2025 State Wildlife Action Plan provides a state blueprint for conserving vulnerable species and habitats

240

state-listed inland wildlife and plant species

~1.2%

are listed of Maine's >18,000 inland wildlife and plant species

11 → 57

listed wildlife species since 1987

#2

climate change among documented threats

Figure 1. At a glance: listed inland wildlife include birds, mammals, reptiles, fish, insects, and mollusks. Separate state or federal lists are maintained for plants, marine animals, and federally listed species.

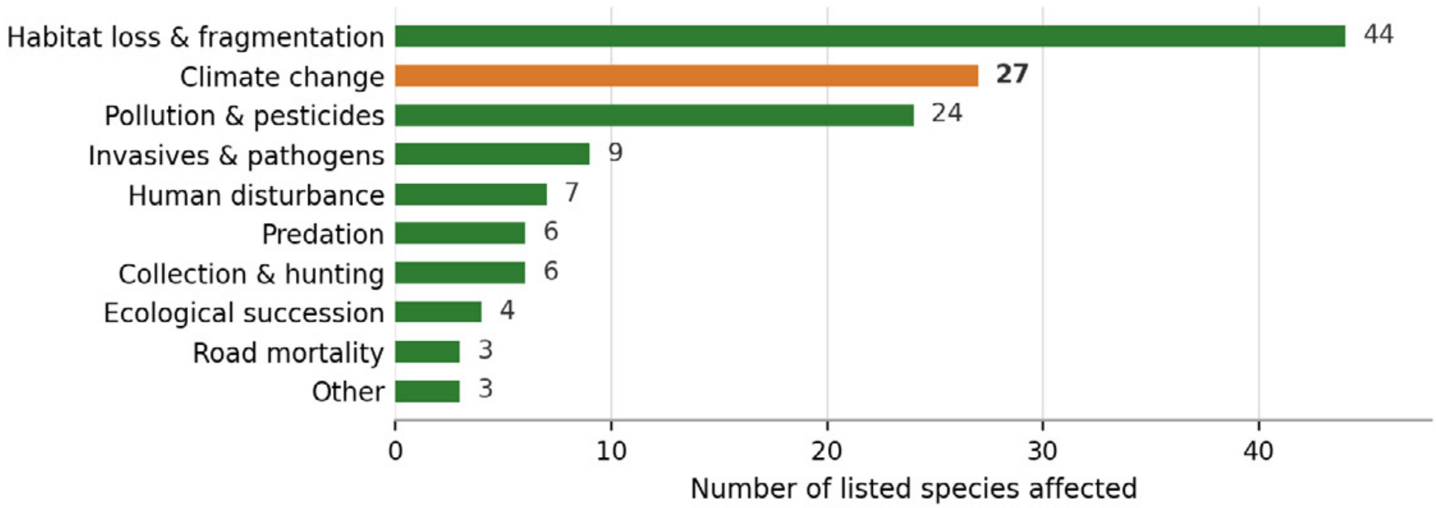


Figure 2. Leading threats to Maine's 57 state-listed inland wildlife species. Many species face more than one threat, so totals exceed 57; climate change ranks second.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

- Biologists invest substantial time in surveys and research, but it remains difficult to cover the full range of inland, aquatic, and marine fauna and flora.
- Ongoing surveys, status assessments, and habitat data are essential, but staff capacity and dedicated funding remain insufficient to cover the full range of at-risk taxa.
- Long-term investment is needed to understand life-history needs, limiting factors, and climate vulnerability, especially as Maine's list of at-risk species grows while federal nongame funding remains flat or declines.

Figure 3. Bicknell's Thrush (left) and Arctic Fritillary (right) are climate-sensitive state-listed species tied to cool, boreal, or high-elevation habitats that are expected to decline as Maine warms.

WHAT TO WATCH

- Changes in the size of Maine's at-risk species list and status categories over time; MDIFW and MNAP typically recommend additions or removals every 4–8 years after expert and public review.
- Progress toward the nearly 1,300 conservation actions identified in the 2025 State Wildlife Action Plan.
- Regional context: NatureServe and the National Wildlife Federation estimate roughly 30–40% of North American fish and wildlife are vulnerable to extinction.

CITATIONS

AFWA. 2025., *deMaynadier et al. 2023.*, *Maine Department of Inland Fisheries and Wildlife. 2025*., *McCollough et al. 2003*., *NatureServe. 2023.*, *Stein et al. 2018.*

13

Land Conservation



WHY IT MATTERS

Land conservation plays a significant role in the protection of species, habitats, clean water, recreation, and traditional uses. As the climate changes, land and water conservation plays an even greater role to mitigate impacts and allow species to move, adapt and remain resilient.

- Maine's Climate Action Plan includes the goal to increase the total acreage of conserved natural and working lands in the state to 30% by 2030, with a specific focus on lands that are biodiverse, have high potential to sequester and store carbon, and promote ecosystem connectivity, among other priorities. Maine's land trusts and land conservation agencies work with willing landowners to protect natural and working lands both through fee purchase and conservation easements, including working forest easements. Just over 4 million acres of land are conserved in Maine, of which 10% is fee-owned and 12% is protected by conservation easement.
- Studies continue to show that ecological reserves and similarly managed lands (e.g. no resource extraction) provide habitat for species requiring mature forest, refugia for disturbance-sensitive species, conditions suitable for cold water fisheries, and support many other important values. Ecological Reserves on State lands also store and sequester significant amounts of carbon, storing 30% more above ground carbon than Maine's managed forests on a per-acre basis (Puhlick and Weiskittel 2021). These functions are crucial to enhance climate resiliency for species and habitats.
- Protecting examples of every natural community type across Maine will help protect the full suite of Maine's biodiversity. Focusing on protection of large blocks of land will support those natural communities "at scale", and connecting those lands and waters across natural land cover will give species better opportunity for movement as climate changes and habitats shift.

AT A GLANCE

Conservation Status
Maine's Climate Action Plan set a goal to protect 30% of natural and working lands by 2030. Four million acres are protected, 22.5% of Maine's land area.

Conservation Targets
Conservation goals include lands and waters that are biodiverse, well connected, and support carbon storage.

Details Matter
Less than 5% of land in Maine is in full reserve-type status, and many common habitat types that support biodiversity are not well represented on conservation lands.

WHAT DO THE DATA TELL US?

- Maine and the rest of northern New England are uniquely positioned to play a significant role in climate resilience due to a legacy of land conservation and lack of extensive development, particularly across the northern and western regions of the state.
- The amount of land area managed as an ecological reserve in Maine doubled in 25 years, to approximately 4.9% of the state (LAPAC 2021). Although no statewide targets for reserve lands have been set, other initiatives have targeted 10%-17% (e.g. Wildlands and Woodlands, Convention on Biological Diversity).
- Conservation in Maine is highly variable across geography and habitats. For example high elevation summits are generally well protected but large examples of lower elevation forest (e.g. cedar swamps, hardwood forest) are under-represented on reserve type lands.

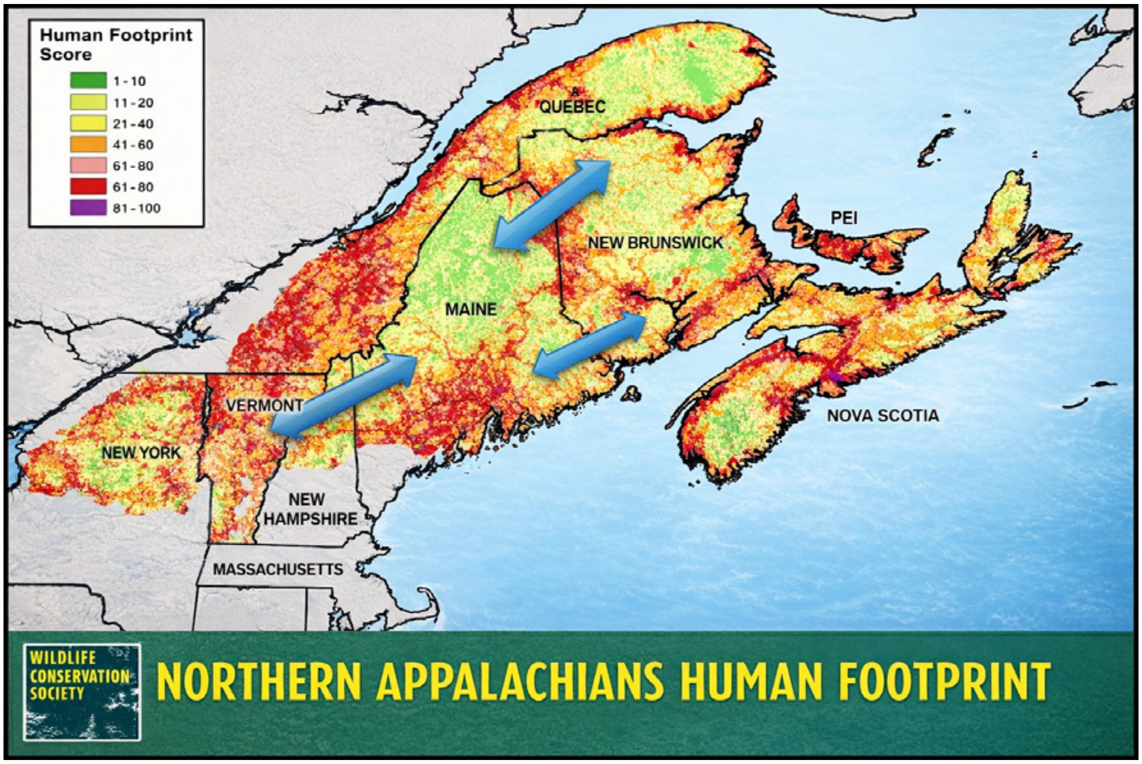


Figure 1. Maine plays a pivotal role at a landscape scale within the larger northern New England and Canadian Maritimes region. This map of human footprint demonstrates how western, northern, and eastern regions of Maine have the lowest permanent development and infrastructure and remain a stronghold for species and habitats to move and adapt to climate change (as indicated by arrows). Source: Wildlife Conservation Society

WHAT ARE WE DOING ABOUT IT?

- Biodiversity conservation in Maine has been bolstered by voluntary protection within Beginning with Habitat Focus Areas. Focus Areas are natural areas of statewide ecological significance that contain rich concentrations of at-risk species and large unfragmented habitat. They include only 11% of Maine's land area, yet contain populations of 85% of rare plant and animal species plus high quality aquatic habitats and rare natural communities. Since 2020 approximately 26,000 acres have been conserved within Focus Areas.
- The 2025 State Wildlife Action Plan identified over 1,300 conservation actions for Species of Greatest Conservation Need and their habitats, including 23 landscape scale conservation actions.

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, ASSETS NEEDED

- To reach established targets for the type and amount of conserved land in Maine, the pace of conservation transactions will need to increase significantly. This will also require an increase in skilled professionals for appraisals, transactions, stewardship, and management.
- Significant funding, with estimates as high as $1.5 billion, is needed to achieve the 30% conservation goal. Funding will need to come from federal, state, and private sources.
- Recent changes in federal funding processes and availability for land conservation are delaying existing conservation projects and jeopardizing future ones.

WHAT TO WATCH

- A collaborative vision for maintaining and restoring a resilient and connected landscape for people and wildlife has been articulated in multiple state plans, and implementation efforts are underway.
- The Maine Forest Service is studying options for the conservation of older forests.

14

Wasted Food in Maine

WHY IT MATTERS

Landfilling food that is produced but not used ("wasted food") wastes all the energy and costs that go into producing it, including land, water, fuel, fertilizer and labor. Beyond the impact on agricultural efficiency and food prices, food waste is responsible for approximately 58% of methane emissions from U.S. municipal solid waste landfills (U.S. EPA, n.d.). Methane is a greenhouse gas with 27 times the warming power of carbon dioxide (GHG Protocol, 2024).

WHAT DO THE DATA TELL US?

In 2023, the Maine Department of Environmental Protection commissioned the first comprehensive inventory and characterization of food loss and waste in Maine. The final report, entitled, "Food Loss and Waste Generation Study" (FLWGS), was published in 2024 and shows, in part, that there is a significant amount of surplus food generated annually in Maine. ReFED defines surplus food as edible food that is produced, but not consumed or sold, and is in danger of being wasted.

Key findings from the Food Loss and Waste Generation Study include:

- Approximately 361,000 tons of surplus food is generated annually in Maine. According to the University of Maine Center for Sustainability Solutions (Food Rescue Maine), this figure equates to approximately 35% of total food produced annually.
- The residential and agricultural sectors (combined) account for approximately 61% of the total surplus food generated.

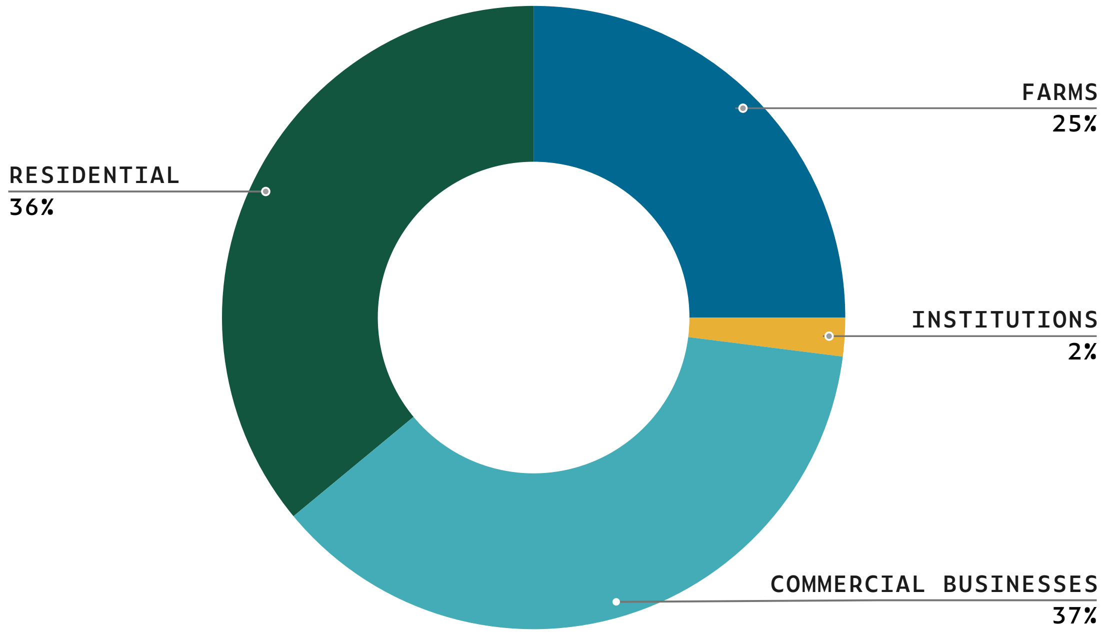


Figure 1. Food losses attributed to agriculture do not reflect the reuse of crop spoils as "green" fertilizer to grow new crops.

WHAT ARE WE DOING ABOUT IT?

In 2025, the Maine Legislature (2025) passed LD 1065, "An Act Regarding The Reduction and Recycling of Food Waste". This law, which goes into effect on July 1, 2030, requires the Department of Agriculture, Conservation and Forestry (DACF) to:

- Develop a methodology to determine designated surplus food generators
- Create a framework supporting waste reduction and management
- Develop a process that provides temporary hardship waivers to entities unable to comply or need more time to meet the intent of the law

DACF is currently focusing on the following initiatives to reduce wasted food in Maine:

- Define infrastructure gaps and identify ways to address them
- Holding community workshops and promoting Pilot Projects
- Continued promotion of the DACF Waste Diversion Grants Program
- Expanded DACF efforts and partnership with the UMaine Mitchell Center for Sustainability to amplify educational efforts statewide

Initiatives by the UMaine Mitchell Center included:

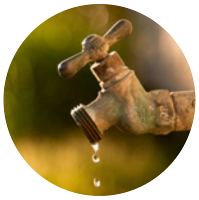
- The Maine Food Recovery Hierarchy website (Food Rescue Maine, n.d.) provides resources and contacts to address gaps identified by the Food Loss and Waste Generation Study.
- The 17-page "No More Wasted Food DIY Toolkit" (Brenneman, n.d.) and a short video entitled, "How YOU can Stop Wasted Food" were developed for use in school curricula.
- The Maine School Cafeteria Study (Food Rescue Maine, 2023) implemented a "No More Wasted Food" program in pilot schools and achieved up to a 25% reduction of wasted food.
- Social Media promotion through posts on Facebook, Instagram, TikTok to deliver food waste educational messages.

Figure 2. A key element of the Maine elementary school wasted food study is the use of student leaders, "Food Rescue Heroes," to assist students in adoption of positive wasted food reduction behaviors.

Figure 3. Susanne Lee, Faculty Fellow at UMaine's Center for Sustainability Solutions, is shown training elementary school leaders at the Frank I. Brown Elementary School in South Portland, Maine. These "Food Rescue Heroes" are part of the Maine Cafeteria Wasted Food Reduction Study.

15

Groundwater Drought


WHY IT MATTERS

Dry conditions in 2025 drove groundwater in parts of Maine to record lows. With more than half the state relying on private wells in 2023, falling water tables forced some residents to deepen wells or seek emergency supplies. Low groundwater worsened low streamflows, harming aquatic habitats.

WHAT DO THE DATA TELL US?

Many USGS monitoring wells in Maine reached record monthly lows in the fall of 2025. 3 out of 18 USGS wells fell below the 5th percentile for the month and have not recovered; 9 fell below the 25th percentile (USGS, 2025).

Groundwater is one of the slowest indicators to respond to and recover from drought. It integrates long-term conditions and types of drought. Continued low groundwater levels throughout the winter months of 2025-26 indicate Maine is still in a hydrologic drought despite recent precipitation.

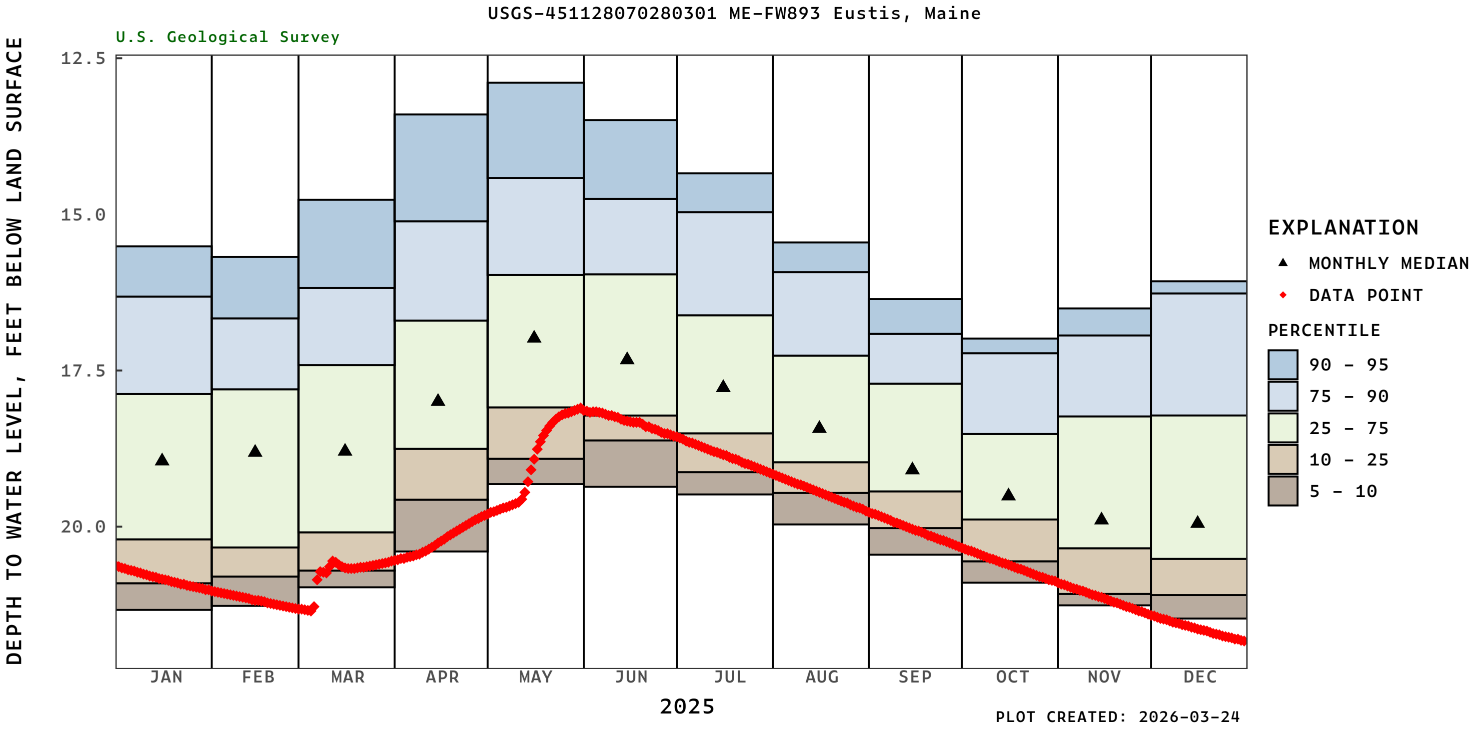


Figure 1. Groundwater levels were below long-term averages throughout 2025 at this USGS monitoring well at Sanford, ME (USGS, 2025)

Figure 2. USGS Groundwater levels stayed below long-term averages at locations such as this one at Middle Dam, ME in winter 2025-26

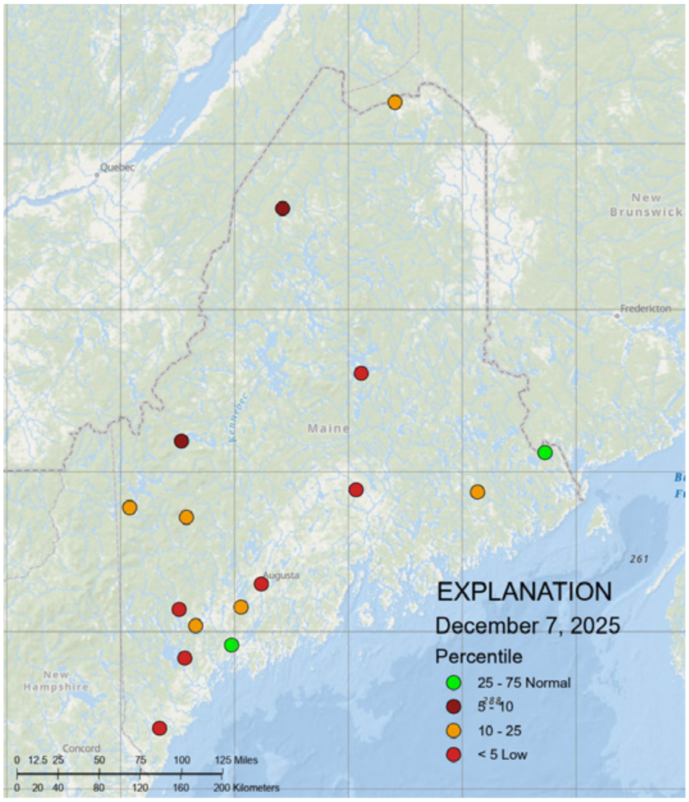


Figure 3. Groundwater well levels in Maine relative to historical monthly statistics (USGS, 2025)

SCIENCE ASSETS

Below normal groundwater levels were documented during the 2020, 2022 and 2025 droughts (Lombard et al., 2020;McCarthy et al., 2023). More long-term monitoring wells throughout Maine would help the state establish a climate response groundwater network that could help shed light on drought relative to climate change (Hodgkins et al., 2009).

WHAT TO WATCH

Extended or multi-season groundwater drought results in stress on residential and public water supply wells, less reliable irrigation, low streamflows, and degraded aquatic habitat.

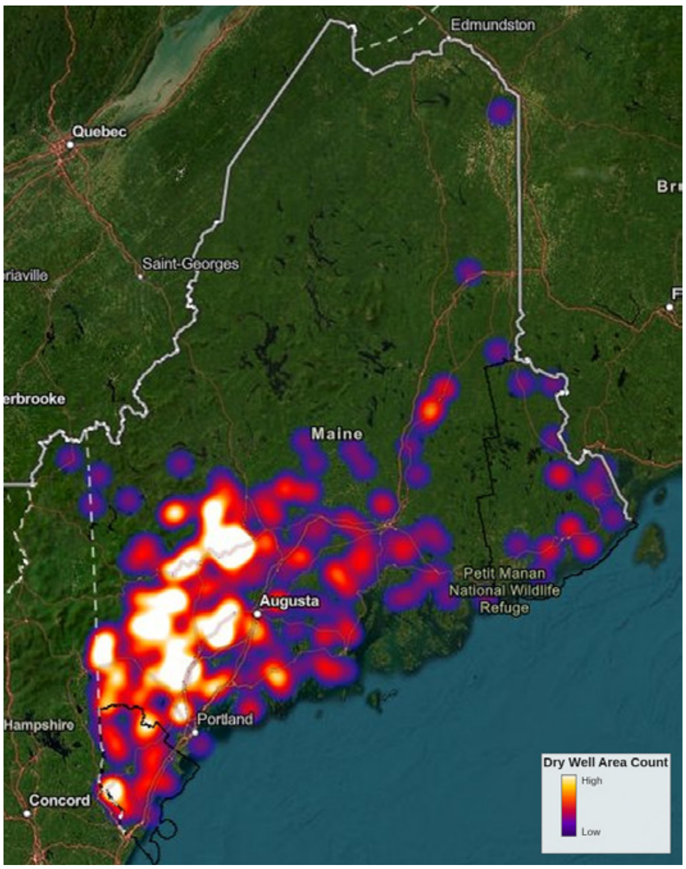


Figure 4. MEMA's voluntary Dry Well Survey recorded 550 dry wells in 2025 , (MEMA, 2025)

16

Streamwater Temperature



WHY IT MATTERS

Streamwater temperatures in Maine have been increasing since the 1980s, and this puts pressure on organisms that require cold, clean water to survive. This includes stoneflies (Order Plecoptera), which are one of the most pollution-sensitive groups of freshwater insects, and are used by Maine DEP as indicators of high water quality. Stoneflies are also a key link in aquatic food chains, providing large prey for many fish species.

WHAT DO THE DATA TELL US?

The most important action to protect sensitive aquatic life is to limit climate warming. However, we can prioritize conservation of watersheds and waterbodies that we expect to be most resilient to warming: some streams have higher 'baseflow', water that comes from deep, cold groundwater and keeps streams colder even in warm summer weather. In addition, protecting riparian tree cover helps keep stream water cool.

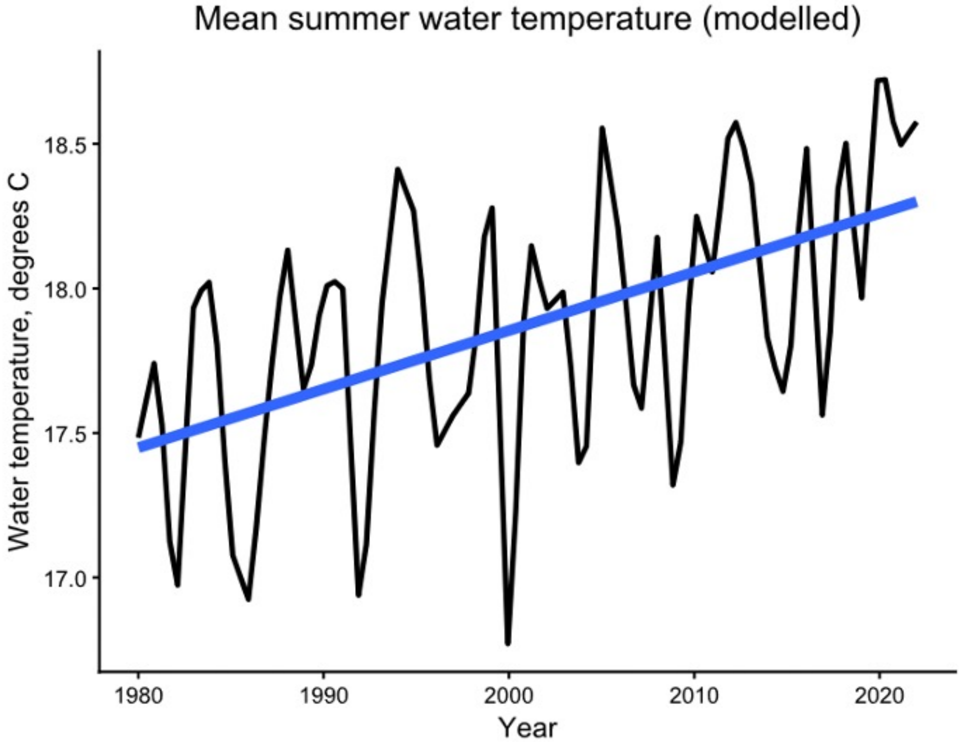


Figure 1. This graph shows modelled water temperature at biological monitoring sample stations in Maine from 1980-2022

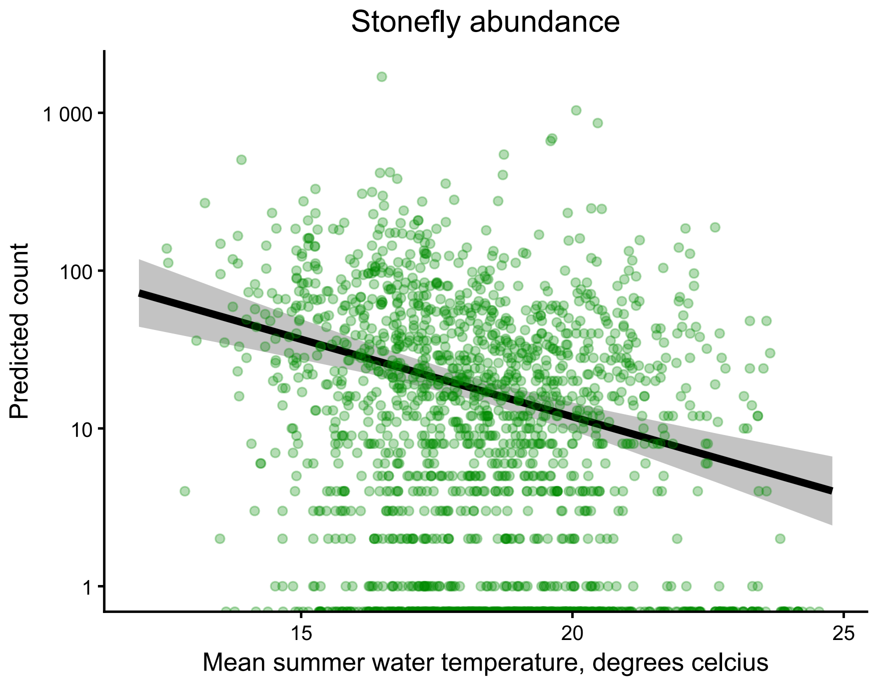


Figure 2. This graph shows predicted stonefly abundance and modelled summer water temperature in Maine

Figure 3. West Branch Ellis River in Andover. Rivers like this one in watersheds with high precipitation and sand/gravel aquifers are likely to have cooler water which is more resilient to warming climate

Figure 4. Wild River in Gilead. This river has long-term monitoring data which is essential for assessing climate impacts on aquatic macroinvertebrates like stoneflies.

CITATIONS

[Davies et al. 2016; Letcher et al., 2024; Lombard et al 2021; Macroinvertebrates.org]

17

Freshwater HABs and Aquatic Invasive Plants

Maine's freshwater ecosystems are warming, seeing longer growing seasons, and receiving heavier nutrient runoff. Those changes favor harmful algal blooms (HABs) and help aquatic invasive plants spread, affecting water quality, habitat, recreation, and drinking water supplies.

Key findings: Average annual maximum August lake temperatures have risen 2.3 °C (4.14 °F) since 1977; 41 lakes have exceeded EPA microcystin guidance for infants and small children; and eight invasive aquatic plant species account for 76 known infestations in Maine fresh waters.

WHY IT MATTERS

- Clean lakes are central to Maine's identity, recreation economy, and shorefront property values. Algal blooms can turn water pea-soup green, while invasive plants reduce access and degrade the lake experience.
- About half of Maine residents receive drinking water from lakes. Cyanotoxins (toxins produced by blue-green algae like microcystin) can require added filtration or source-water treatment, and shoreline residents using untreated lake water may face additional health risks.
- Aquatic invasive plants and HABs are expensive to monitor, prevent, and control, making early detection and watershed protection especially important.

WHAT DO THE DATA TELL US?

- Monitoring by DEP and partners shows a significant warming trend in Maine lakes, about 0.05°C (0.09 °F) per year since 1977, even though year-to-year variability remains high.
- Microcystin exceedances and invasive plant detections have both increased over time. More monitoring and better survey capacity explain part of the rise, but warmer conditions and longer growing seasons also increase risk.

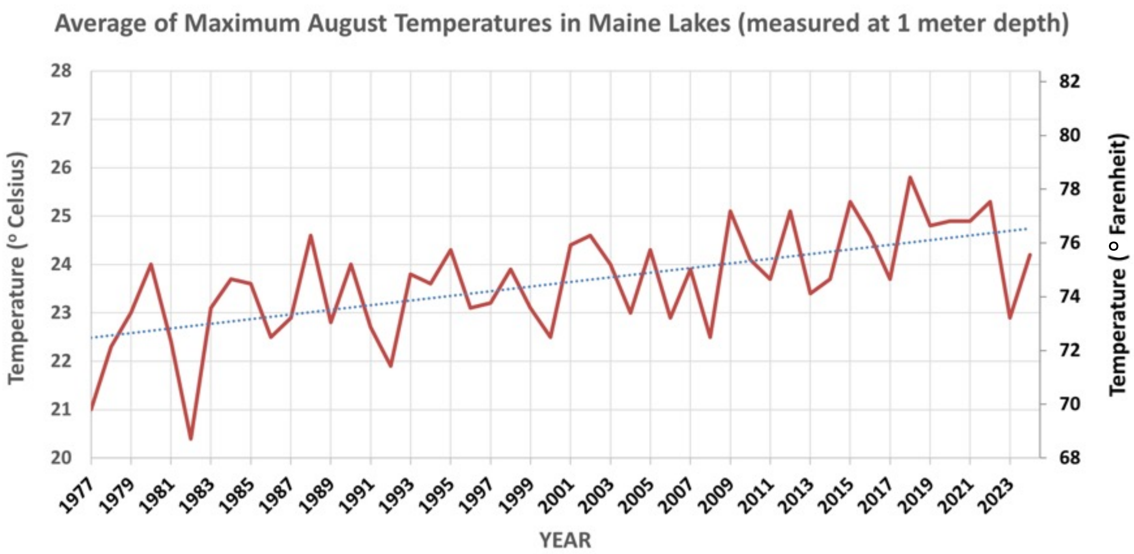


Figure 1. Maine lake temperatures show a long-term warming trend.

Figure 2. Harmful Algal Bloom on Sabattus Pond in 2016 showing scum accumulations near the boat launch. Photo taken by DEP Staff.

- DEP has identified 41 lakes that have exceeded the EPA 10-day microcystin drinking-water advisory for infants and small children; eight invasive aquatic plant species account for 76 documented infestations.

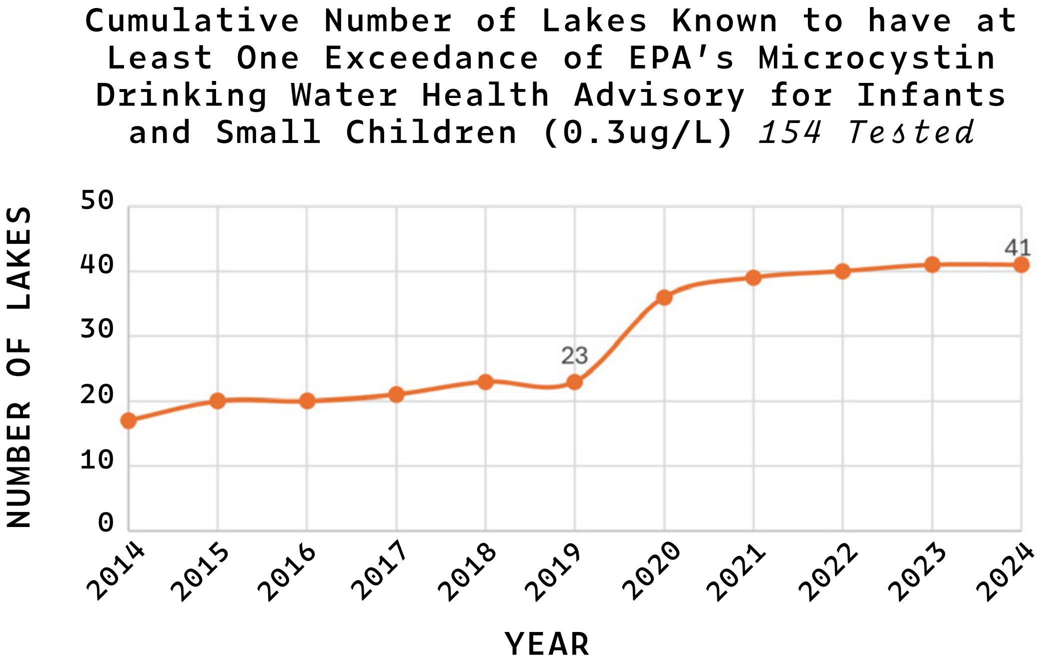


Figure 3. Microcystin exceedances reached 41 lakes by 2024.

Figure 4. Diver assisted removal of aquatic invasive plant, Variable-leaf Milfoil from Great Pond. Photo taken by DEP Staff.

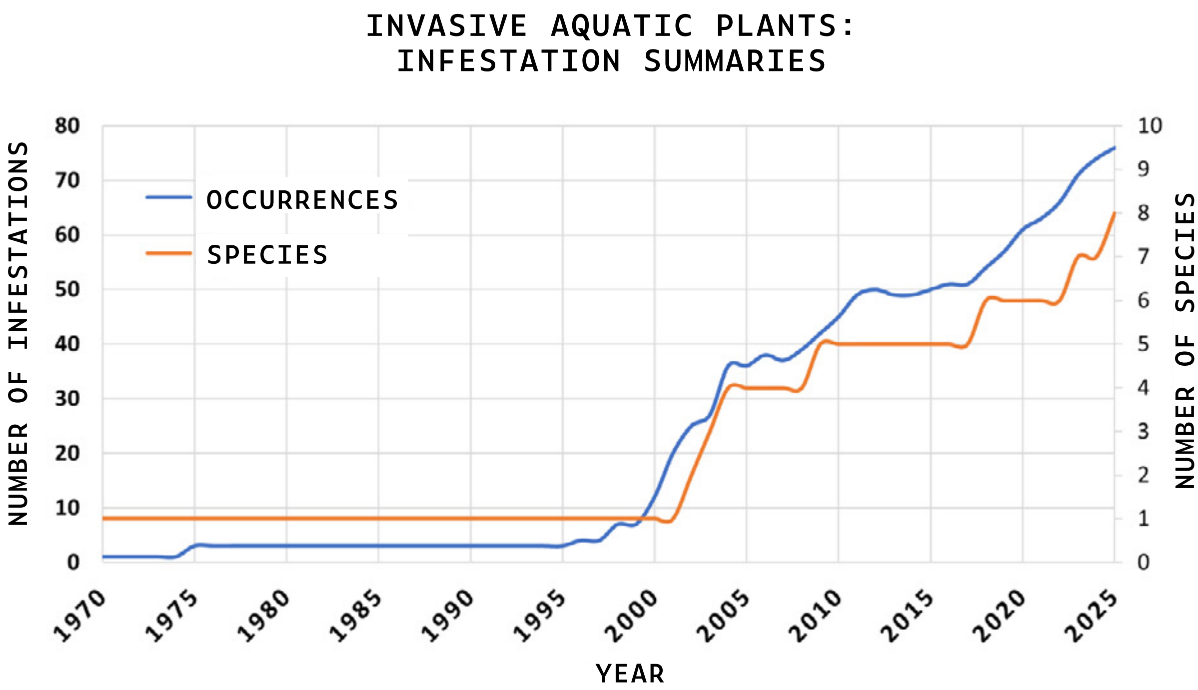


Figure 5. Infestations and species detections have increased over time.

WHAT ARE WE DOING ABOUT IT?

Reducing HAB risk requires phosphorus control and runoff reduction, while invasive plant management depends on prevention, shoreline surveys, rapid response, and volunteer monitoring because prevention is far less costly than long-term control.

CITATIONS

Data Source: Maine Department of Environmental Protection.

18

Human Health Impacts



WHY IT MATTERS

Climate change has profound impacts on human health and well-being across the globe, including in Maine, and these impacts are likely to increase in the future. Efforts to improve public health monitoring, build resilience in community and health care settings, and expand education and outreach efforts to vulnerable groups will help to limit future impacts.

WHAT DO THE DATA TELL US?

Heat-Related Illnesses and Air Conditioning Access As temperatures rise, and as the annual number of extremely hot days increases, cases of heat-related illness (HRIs) increase as well. Across the U.S., the age-adjusted heat-related mortality rate nearly tripled between 2016 and 2023[1]. In summer 2025 in Maine, emergency department (ED) visits due to HRIs spiked along with maximum daily temperatures (Figure 1).[2,3]

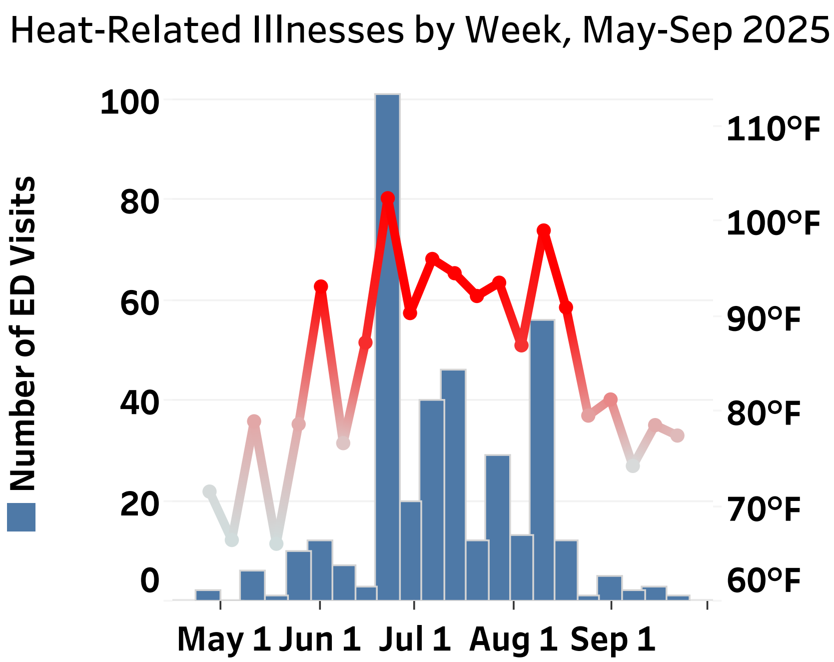


Figure 1. Weekly HRI ED visits and weekly maximum apparent temperature (F), Summer 2025. Data source: MaineTracking Network, Maine Center for Disease Control and Prevention.

Access to cooling strategies is essential for protecting against heat-related illnesses, and this access is increasing in Maine. From 2011 to 2023, the percent of Mainers with air conditioning (A/C) in their homes increased from 53.0% to 78.0% (**Figure 2**)[2], bringing Maine much closer to the national average: in 2020, 88% of Americans used any A/C equipment in their homes.[4] This increase in A/C access improves what had been a significant area of vulnerability for Mainers, but the level of protection varies by county; for example, 85.4% of Kennebec County residents have A/C at home, compared to only 58.5% of Piscataquis County residents.[2]

Blacklegged Ticks and Tick-borne diseases Blacklegged (deer) ticks carry pathogens that can cause serious human illness. Recent work with long-term tick data has shown that earlier tick activity and longer tick seasons are associated with warmer winters and springs.[5] Rates of tick-borne diseases (Lyme disease, anaplasmosis, and babesiosis) have increased in Maine over the past two decades (**Figure 3**)[6] and have risen exponentially in recent years. According to the U.S. CDC, in 2023, Maine had the third-highest rate of Lyme disease among all states.

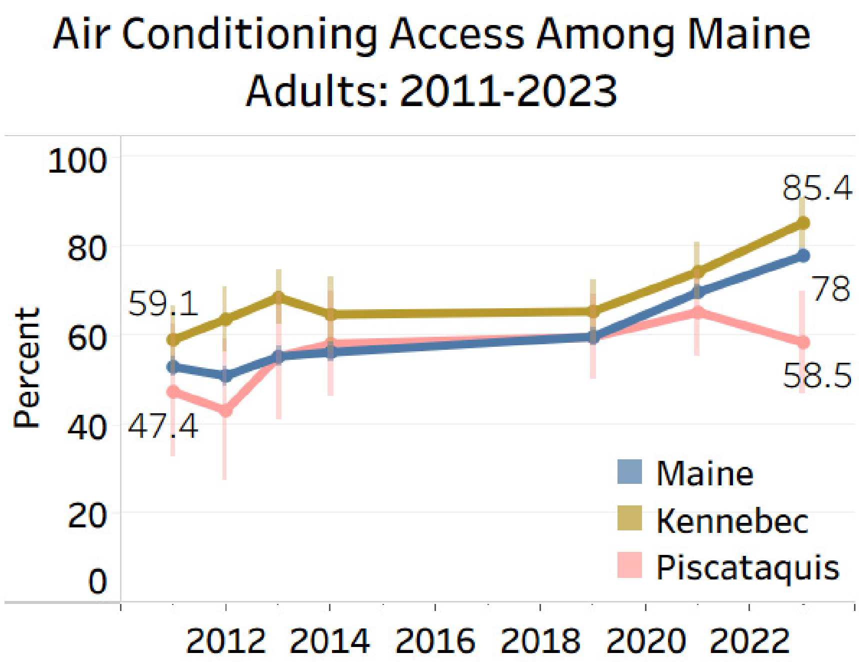


Figure 2. Percentage of adults with access to any type of air conditioning at home, Maine, Kennebec County, and Piscataquis County, 2011–2023. Data source: Maine-Tracking Network, Maine Center for Disease Control and Prevention.

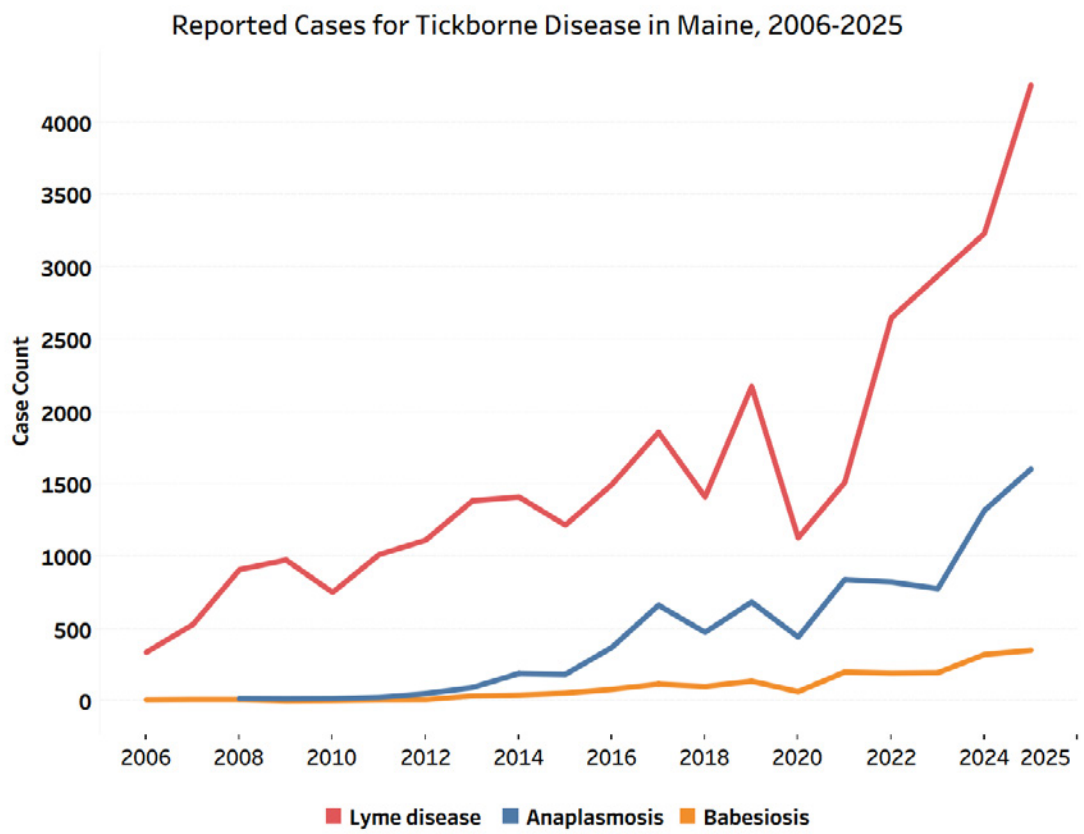


Figure 3. Annual cases of Lyme disease, anaplasmosis, and babesiosis reported in Maine, 2006–2025. Data source: MaineTracking Network, Maine Center for Disease Control and Prevention.

Wildfire Smoke and Aeroallergens Climate extremes can impact air quality, which in turn impacts health. In North America, more frequent wildfires are being driven by hotter, drier climatic conditions. Wildfire smoke is a complex mixture of harmful substances, and wildfire smoke exposure has been associated with adverse respiratory, cardiovascular, mental health, and pregnancy and birth outcomes, as well as premature death.[8] In 2025, severe western Canadian wildfires created smoke plumes that moved eastward and caused high air pollutant levels and air quality alerts (**Figure 4**).[9] Levels of airborne allergens, particularly plant pollen, are also increasing as summers grow longer, warmer, and wetter, and exposure to these aeroallergens can lead to higher rates of allergic and respiratory conditions.

Mental Health Climate change affects mental health in a number of ways, particularly among youth, and adds to the already significant need for mental health services. In a recent survey of over 600 college students in Maine, 46% reported experiencing climate anxiety.[10] Mental health is also negatively impacted when people experience extreme weather events.[11]

WHAT ARE WE DOING ABOUT IT?

- Maine CDC is partnering with County Emergency Management Agencies and other stakeholders to develop extreme temperature response plans, created a community guidebook for extreme heat and cold resilience, and launched a communications campaign to prevent heat-related illnesses in workplaces.
- The Efficiency Maine Trust offers rebates for installation of heat pumps, which provide energy-efficient cooling as well as heating. Adoption of heat pumps is likely the primary reason for the significant increase in home A/C access in recent years.
- Research and tick surveillance efforts are ongoing at the University of Maine Tick Lab, the University of Maine Gardiner Lab, and MaineHealth to better understand drivers of tick abundance and survival. Maine CDC provides educational materials on tickborne disease prevention.
- Research efforts to better identify and communicate climate-related mental health impacts are underway at Colby College, University of Maine, and Bowdoin College.

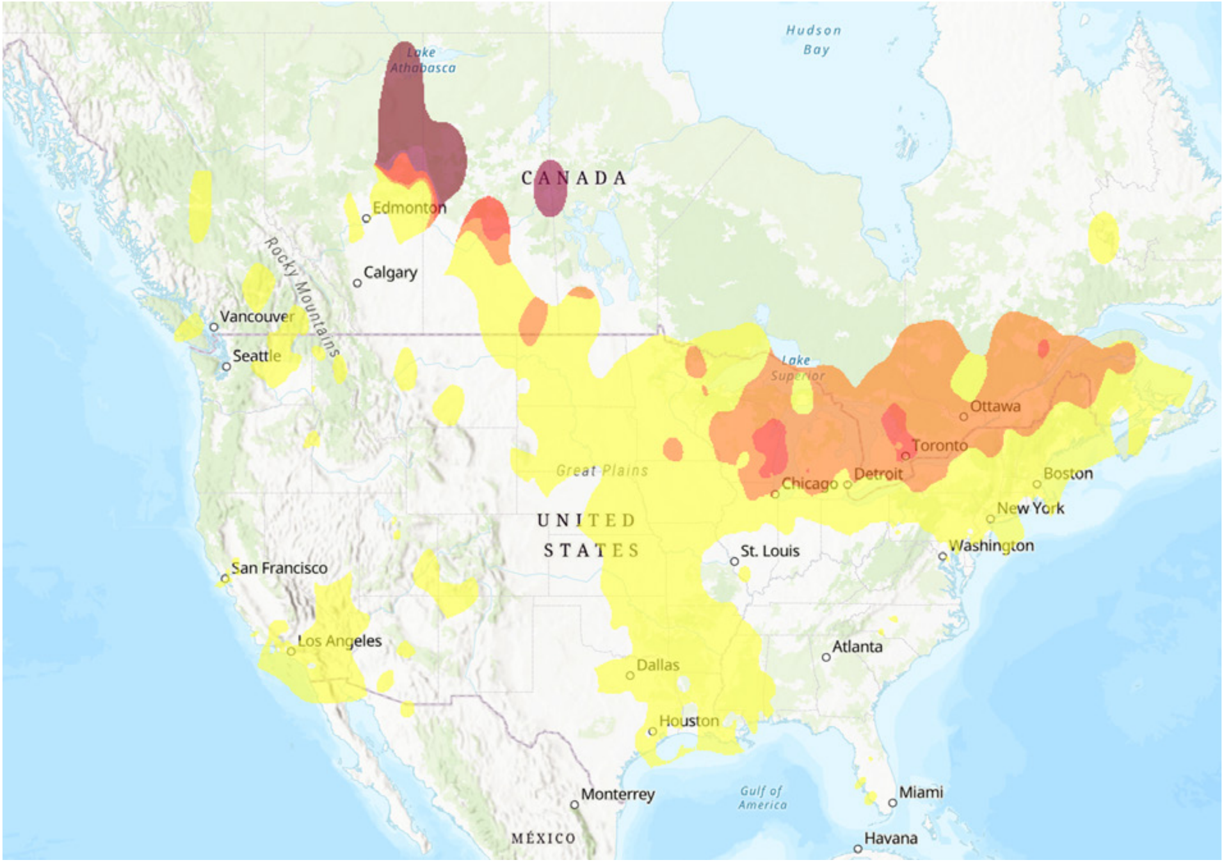


Figure 4. Smoke plume from western Canadian wildfires, August 3, 2025. Air quality in northern and western Maine was categorized as "unhealthy" or "unhealthy for sensitive groups," triggering air quality advisories. Data source: U.S. EPA AirNow (https://gispub.epa.gov/airnow/index.html?tab=3).

CRITICAL SCIENCE ASSETS

- Supporting: Maine Health Data Organization (MHDO) hospital discharge datasets; Maine CDC ESSENCE syndromic surveillance datasets; Maine CDC Behavioral Risk Factor Surveillance System Survey (BRFSS) datasets; UMaine tick surveillance and Maine CDC tick-borne disease surveillance datasets; U.S. EPA AirNow air quality monitoring datasets; Maine DEP/CDC pollen monitoring datasets.
- At risk: Capacity to compile and analyze climate and health data at Maine CDC is dependent on federal environmental health grants, without which data may lag or become unavailable.

WHAT TO WATCH

- Tick data being collected through 2030 may provide more information on the impacts of temperature and precipitation changes on tick phenology, with publication anticipated in late 2026 or early 2027.
- The Department of Environmental Protection, the Mi'kmaq Tribe, and Maine CDC have partnered to establish five pollen monitoring sites across the state, with data expected to be made publicly available in spring 2026.

CITATIONS

5 Fyie et al. 2025, 2026. University of Maine Gardiner Lab. Oral presentations, Entomological Society of America Meetings.

10 Carlson, 2024. Unpublished data.

19

Community & Economic Resilience

WHY IT MATTERS

The social and economic costs of a changing climate are projected to increase over time. Planning and capacity building are critical to reduce costs and ensure effective and equitable mitigation and adaptation.

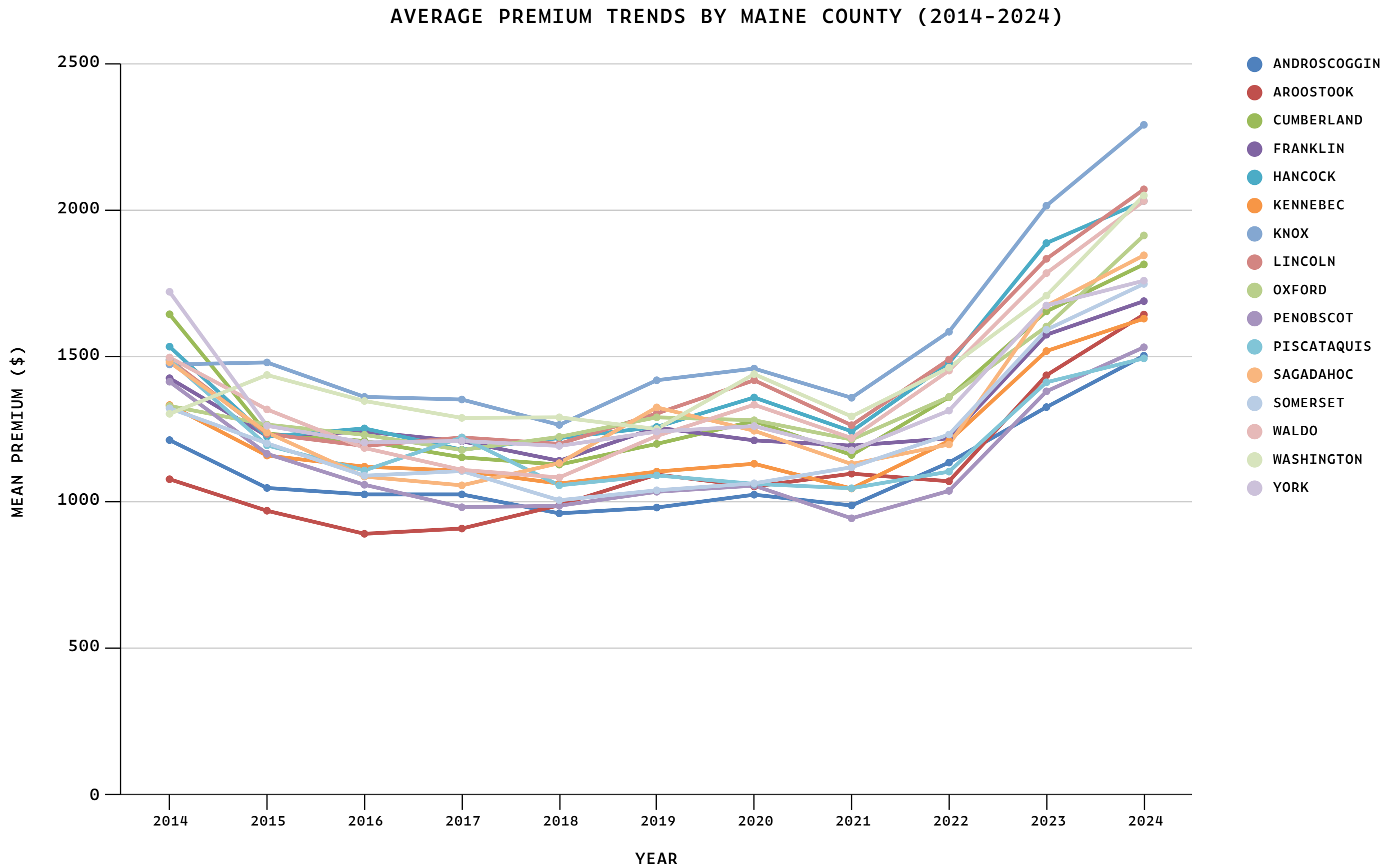


Figure 1. Maine home insurance premiums increased up to 2024 reflecting, in part, increased climate risk and associated costs (1)

WHAT DO THE DATA TELL US?

- Recent climate impacts demonstrate the urgent need for disaster management, increased response capacity, and regional coordination to prevent worse impacts and reduce the cost of response (4,5,6,7).
- Recent research on mortgage payments documents a significant increase in cost pass-through from disaster risk. The authors find clear correlations between climatic events and increased insurance premiums (1).
- Some residents are more vulnerable to climate change. Mainers whose livelihoods are linked to natural resources through farming, fishing or hunting are sensitive to climate stress (8,9) . Rural residents, older adults, and families on fixed incomes face challenges associated with affordability and access to essential resources and services (3, 5, 9, 11,12).

- Inclusive and equitable planning is critical (13). Engagement efforts throughout the state highlight the importance of aligning state policies with municipal and tribal priorities and developing programs that better meet the needs of our most vulnerable residents (3, 5,12)

PROGRESS TO DATE

- More than 263 Maine communities (14) and all five Tribal Governments (Mi'kmaq Nation, Houlton Band of Maliseets, Passamaquoddy Tribe-Indian Township Motahkomikuk, Passamaquoddy Tribe-Pleasant Point Sipayik, Penobscot Nation) have engaged in climate vulnerability assessments and/or climate action planning.
- Service providers and state funding have helped to improve adaptation capacity (7,14)
- Volunteer networks have materially expanded local capacity for mitigation/adaptation, by helping to secure grant funding for project delivery, especially in small communities (2, 4,10)

Figure 2. Community capacity building and planning can help to prevent or mitigate climate risks and associated costs (2,3)

CRITICAL SCIENCE ASSETS, ASSETS AT RISK, AND ASSETS NEEDED

- Measurements critical for improving community and economic resilience: Standardized tracking of municipal requests for/receipt of technical assistance and outcomes (success rates, dollars awarded, admin performance); Implementation progress: share of planned actions funded/constructed; time from plan to shovel-ready and from award to completion; Equity and access: distribution of weatherization/energy assistance by income, geography, and demographic groups; eligibility gaps for those above thresholds but still burdened; Volunteer capacity: recruitment, training, retention, and impact metrics; Outage resilience: frequency/duration of outages by region; access to shelters and backup power; heat pump performance and backup heating use during outages; Transportation access.
- In addition to quantitative and standardized metrics, it is important to assess quality of life issues and community level priorities that aren't easily captured by quantitative measurements (15,16).

WHAT TO WATCH FOR

- A wide range of potential approaches. Solutions to rising insurance premiums, for example, can be approached through zoning, building codes, reduced economic sensitivity, economic development, infrastructure adaptation, and emergency preparedness.
- Movement from planning to financed, regionally coordinated capital projects (including bonding) and uptake of training/tech/data practices (6,7).
- Scale-up of volunteer and tailored technical assistance with documented impacts on funding secured, projects delivered, and residents served (2, 4,10).
- Investments in rural transit and grid/backup options; trends in vehicle miles traveled/emissions, outage duration/frequency, and equitable engagement outcomes (3, 5, 9, 11).

Figure 3. Left: Emily Francis teaching community members about seed collection as a climate adaptation strategy in a changing climate. Center: Maine Window Dressers brings communities together to build window inserts for insulation, helping reduce energy costs for Mainers. Right: Community members are working together in Machias, Saint George Bay, Boothbay Harbor and Portland to assess coastal flood risk.

CLOSING THOUGHTS

As Co-Chairs of the Maine Climate Council's Scientific and Technical Subcommittee, we think often about how science and technology inform decision-making — and how they offer powerful tools to help us address the challenges of a rapidly changing world. In our 2024 full assessment update, we closed the report for the first time with a short chapter on "hope" — not the emotion, but the science of hope, which tells us that hope arises from setting personally meaningful goals, having the agency and determination to pursue solutions, and having a plan to get there. We believed Maine people have that determination, and we believed *Maine Won't Wait* offered meaningful climate goals and cost-effective, science-informed pathways to achieve them. We still believe this is true.

As we release this interim report for Earth Day 2026, our timing coincides with a remarkable human achievement: the NASA Artemis II mission, which launched April 1st and — for the first time since Apollo 17 in 1972 — carried astronauts beyond Earth's orbit to the far side of the Moon. The mission embodied what humanity can accomplish when we bring together the best available science, a diverse crew and ground team, and an international partnership united by a common goal. The images of Earth returned from the Orion spacecraft echo the profound shift in perspective that came from the *Earthrise* photograph taken by Apollo 8 in 1968 and the *Blue Marble* image from Apollo 17 in 1972 — moments that awakened us to the fragility of our planet and our shared responsibility to protect it. This is the only home we have. Science is not the whole answer to climate change, but it is an indispensable part of the toolkit. Every scientific success for the betterment of humans and the planet is an opportunity to show that the future we want is possible.

Dr. Susie Arnold, Island Institute
Dr. Ivan Fernandez, University of Maine
Co-Chairs, Scientific and Technical Subcommittee

PHOTO CREDIT: NASA

GOVERNOR'S OFFICE OF

Policy Innovation
and the Future

maine.gov/future/climate/council/sts