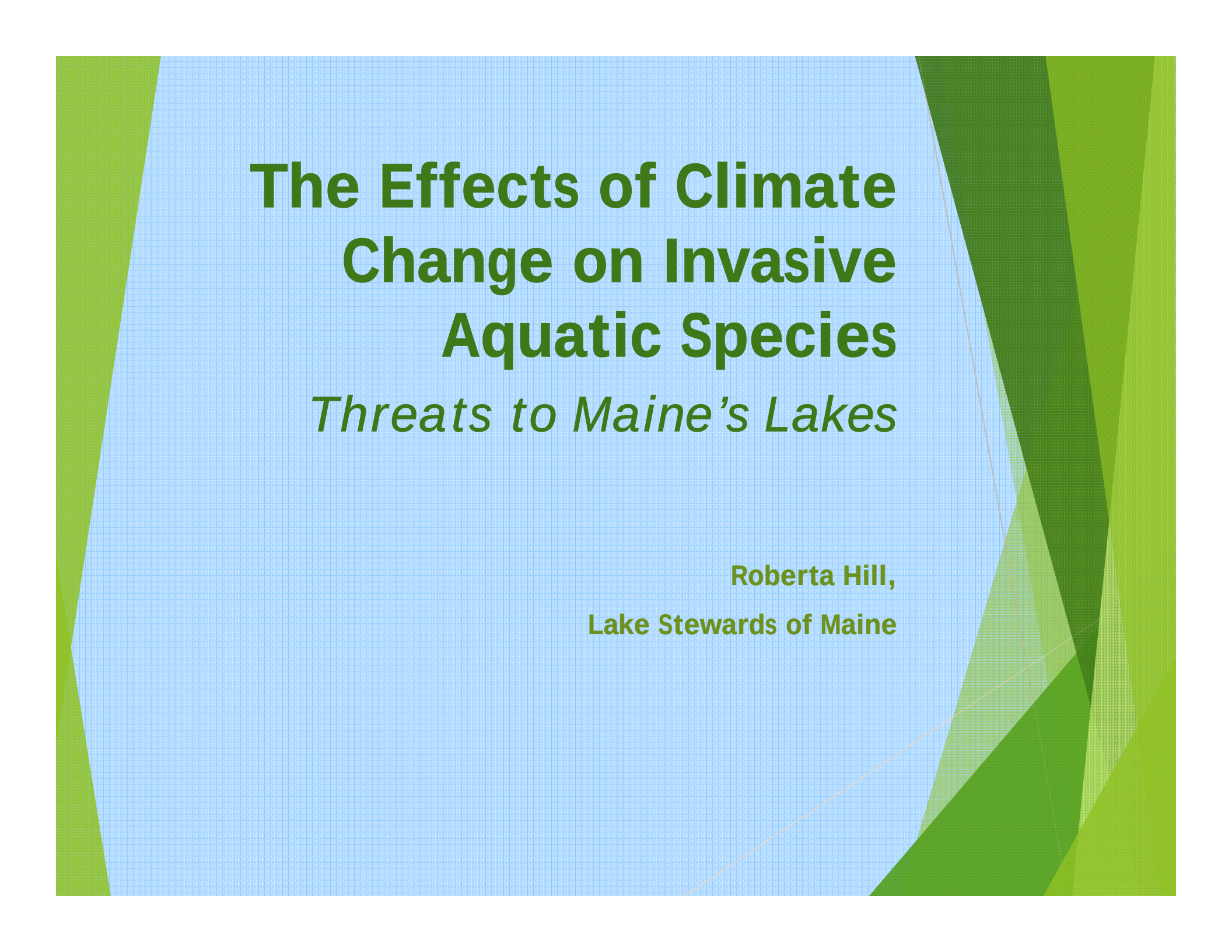




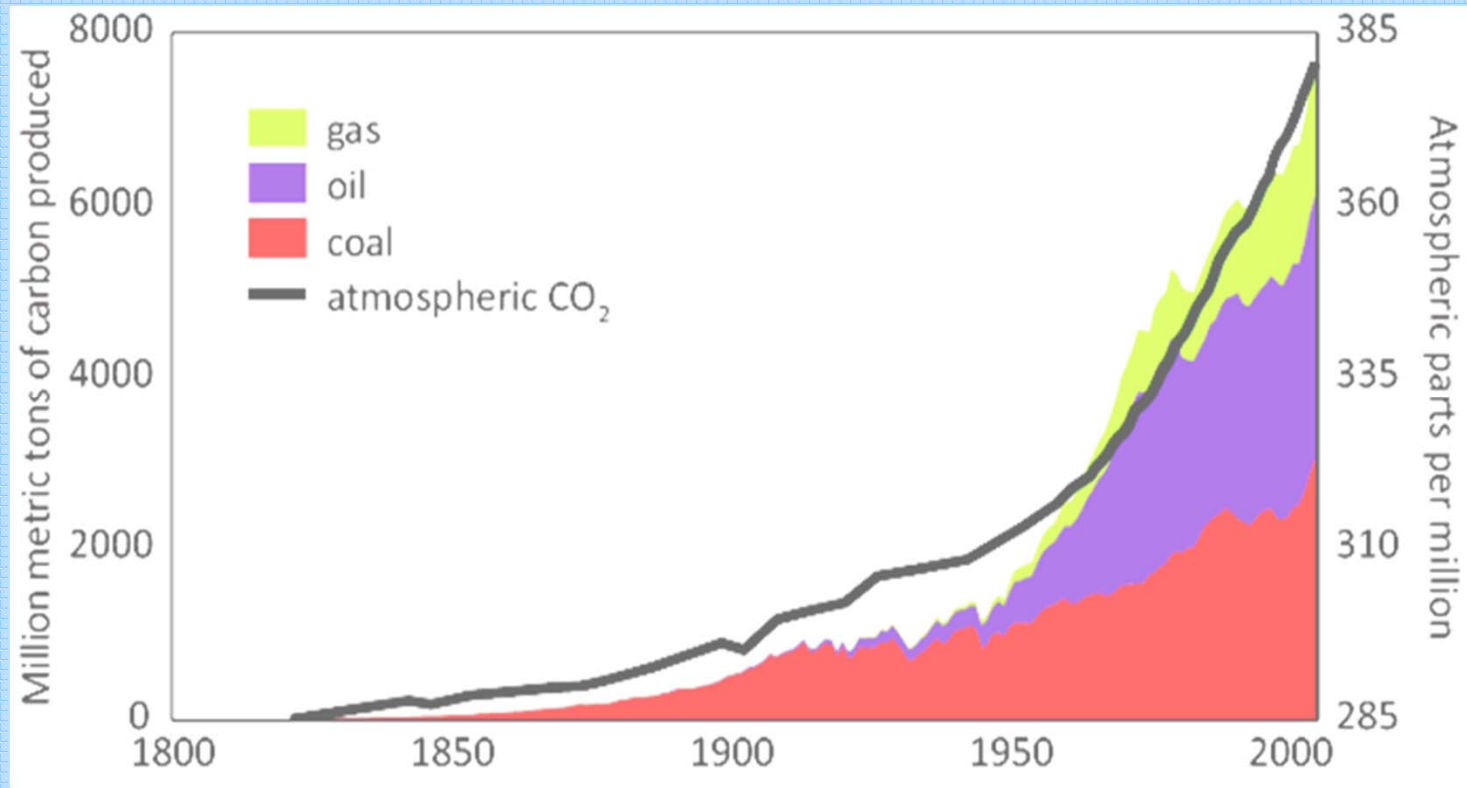
The Effects of Climate Change on Invasive Aquatic Species

Threats to Maine's Lakes

**Roberta Hill,
Lake Stewards of Maine**

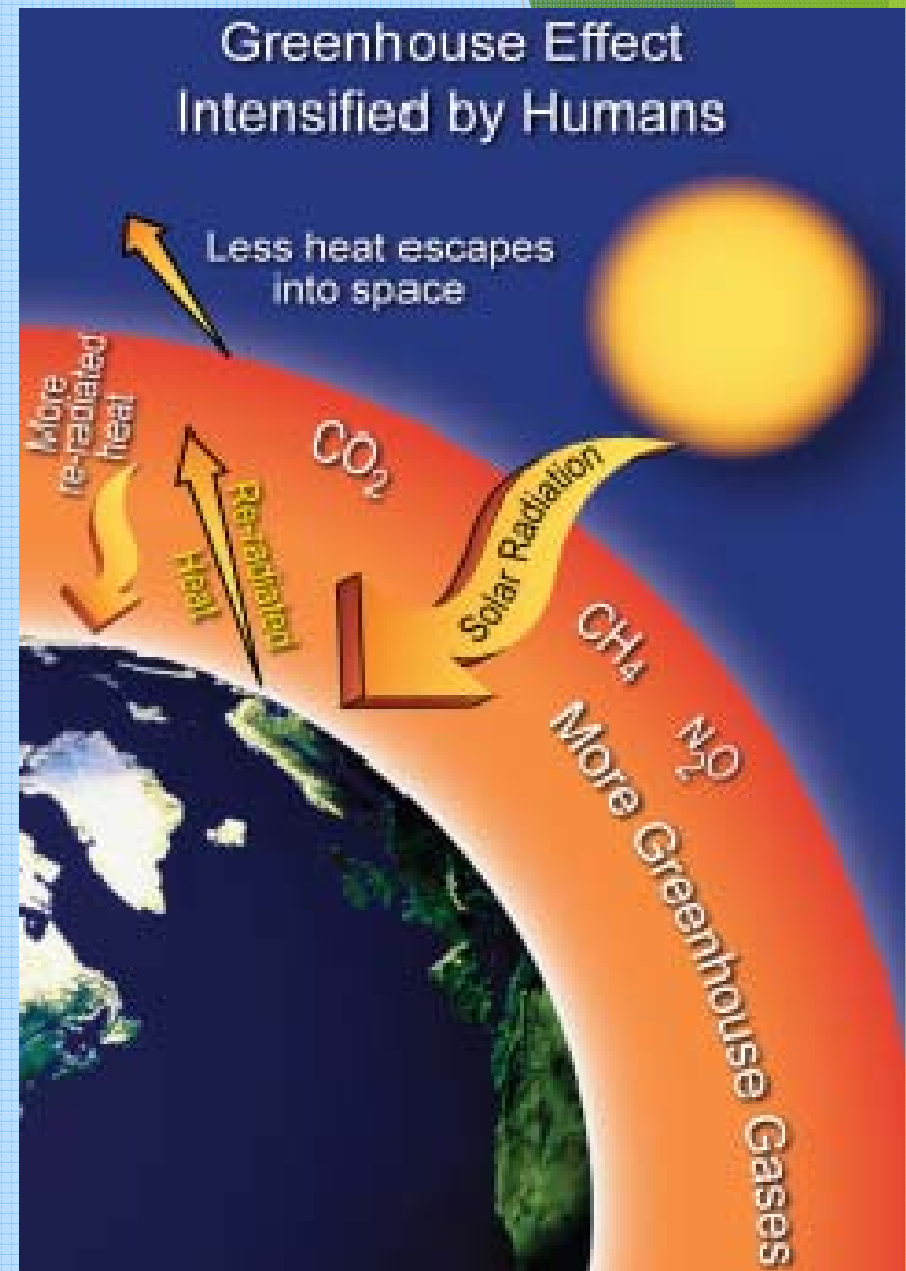
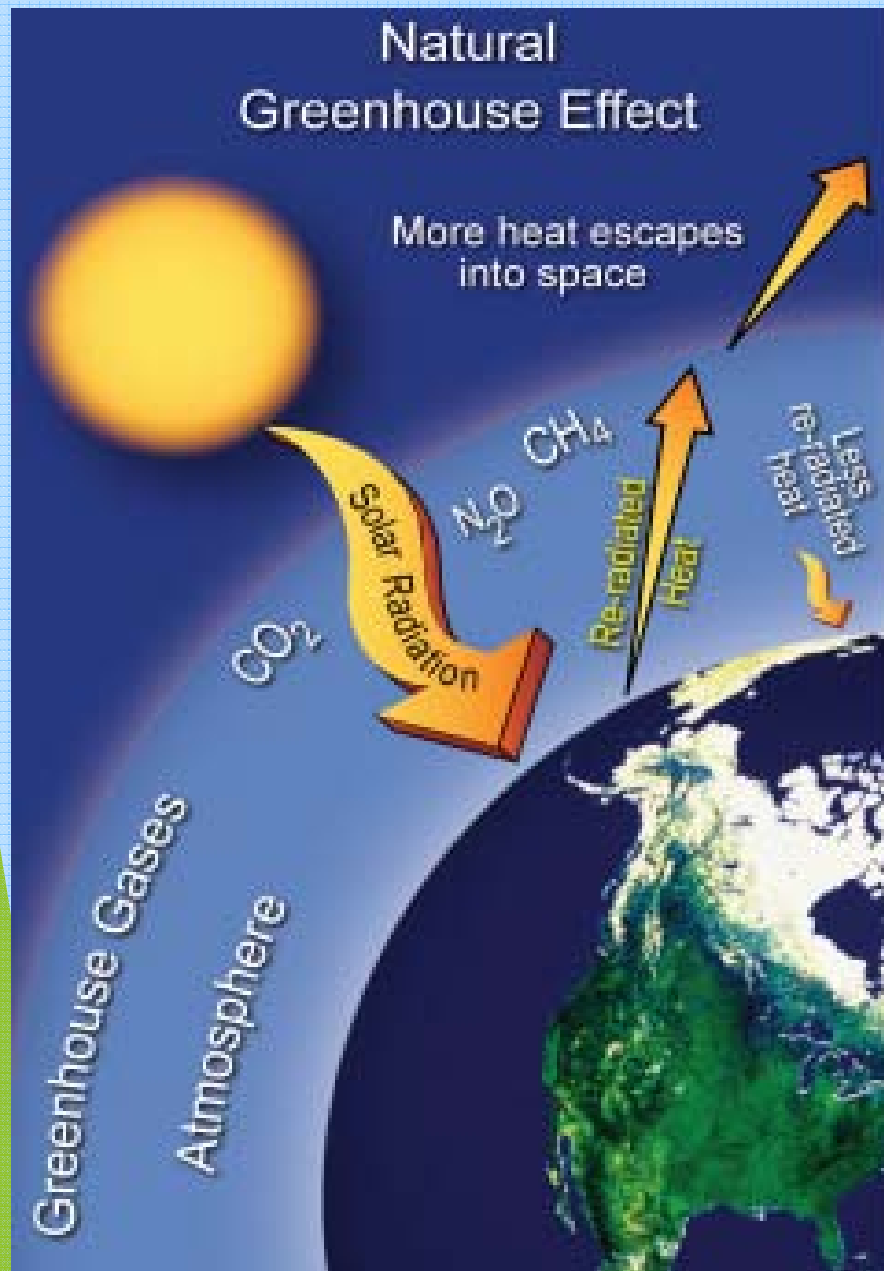
Scientific Consensus

97% - 99.999 %

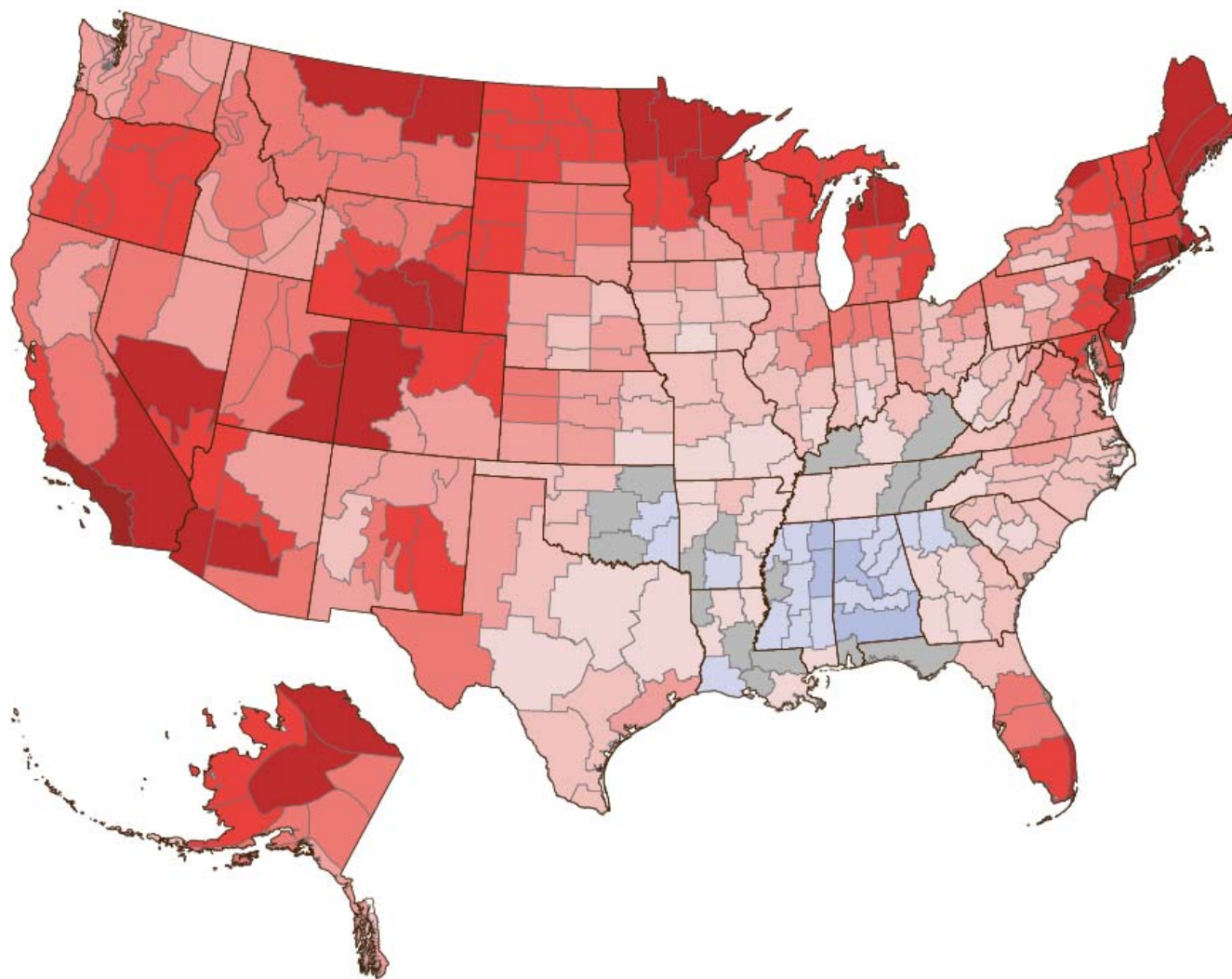


- The climate is warming in ways that are globally disruptive
- Phenomena is caused by humans
- More CO₂ in the atmosphere from burning of fossil fuels

Human Influence



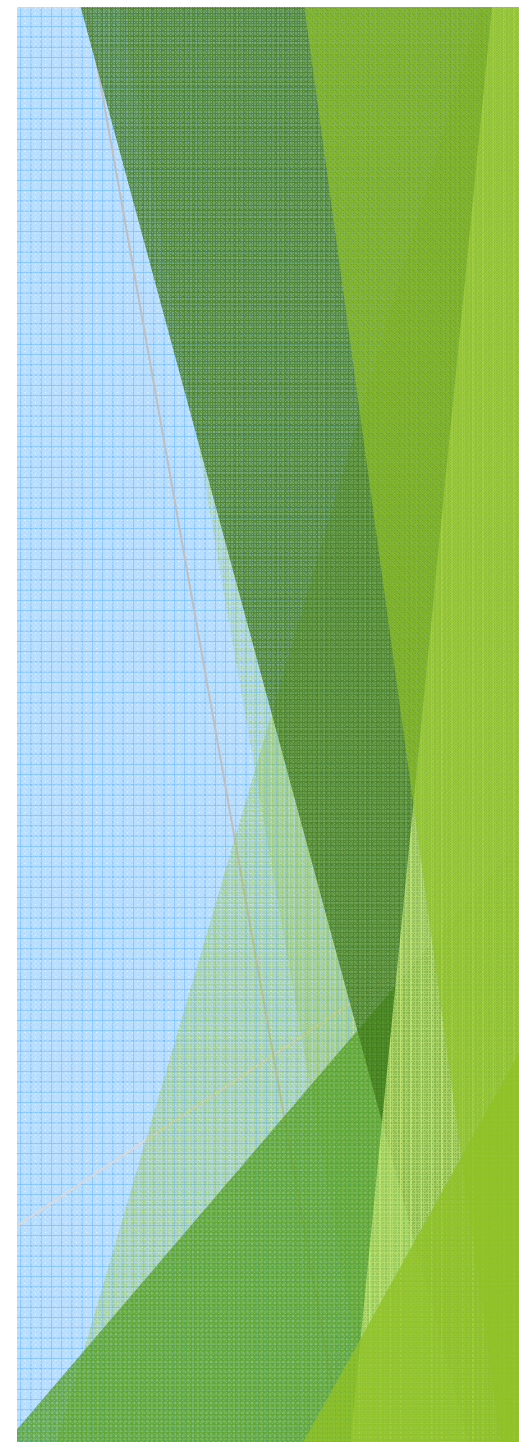
Rate of Temperature Change in the United States, 1901–2015



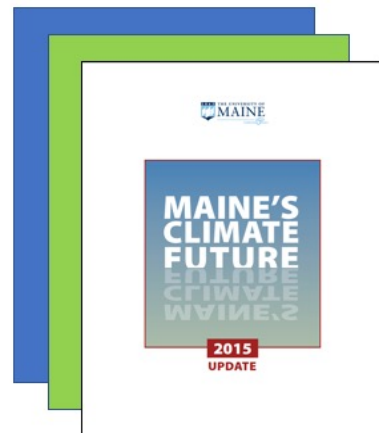
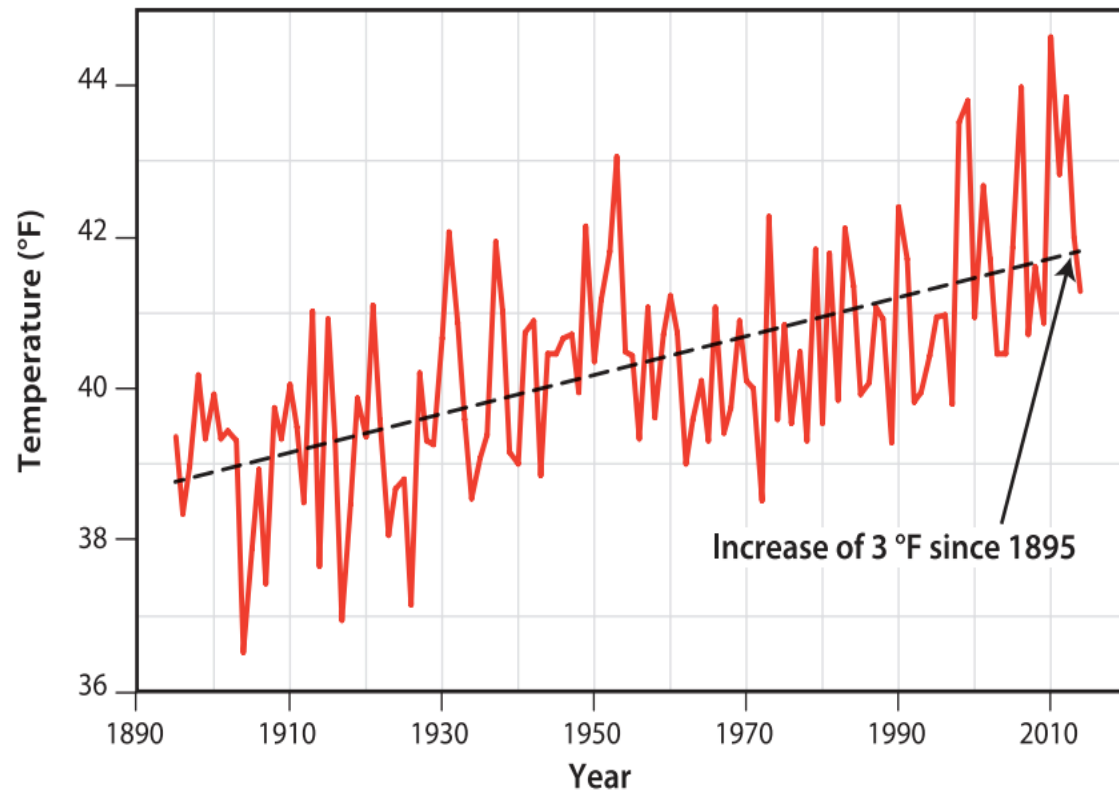
Rate of temperature change (°F per century):



Gray interval: -0.1 to 0.1°F



Maine's Average Annual Temperature



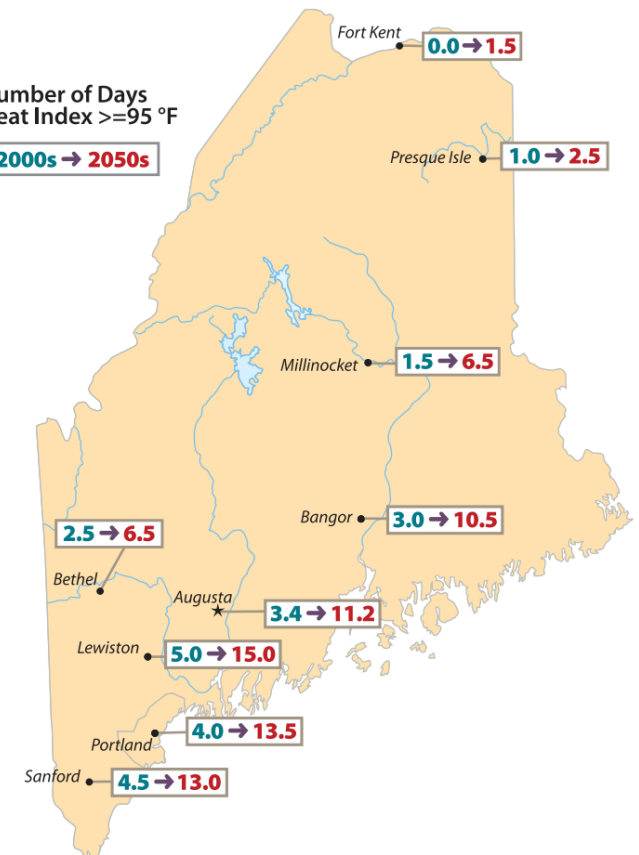
www.climatechange.umaine.edu

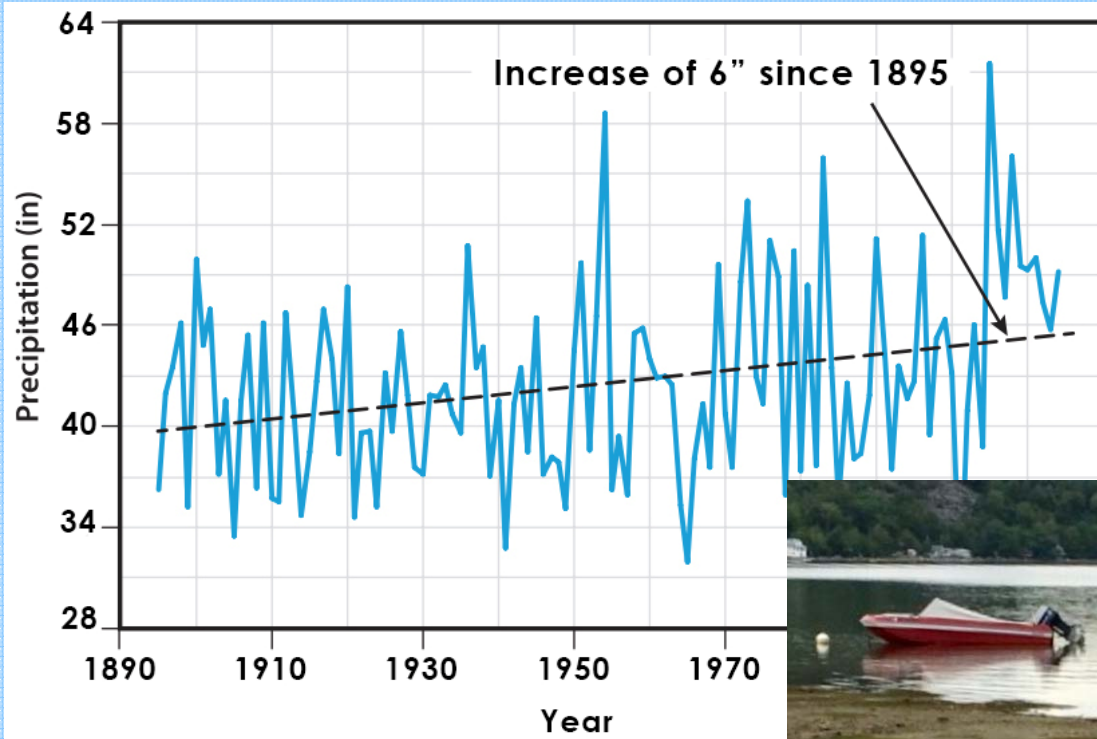
Maine is getting warmer

More Hot Days

Number of Days
Heat Index $\geq 95^{\circ}\text{F}$

2000s → 2050s





- **Wetter winters & springs**
- **Drier summers**



Swan Lake, Swanville, Sept. 2016



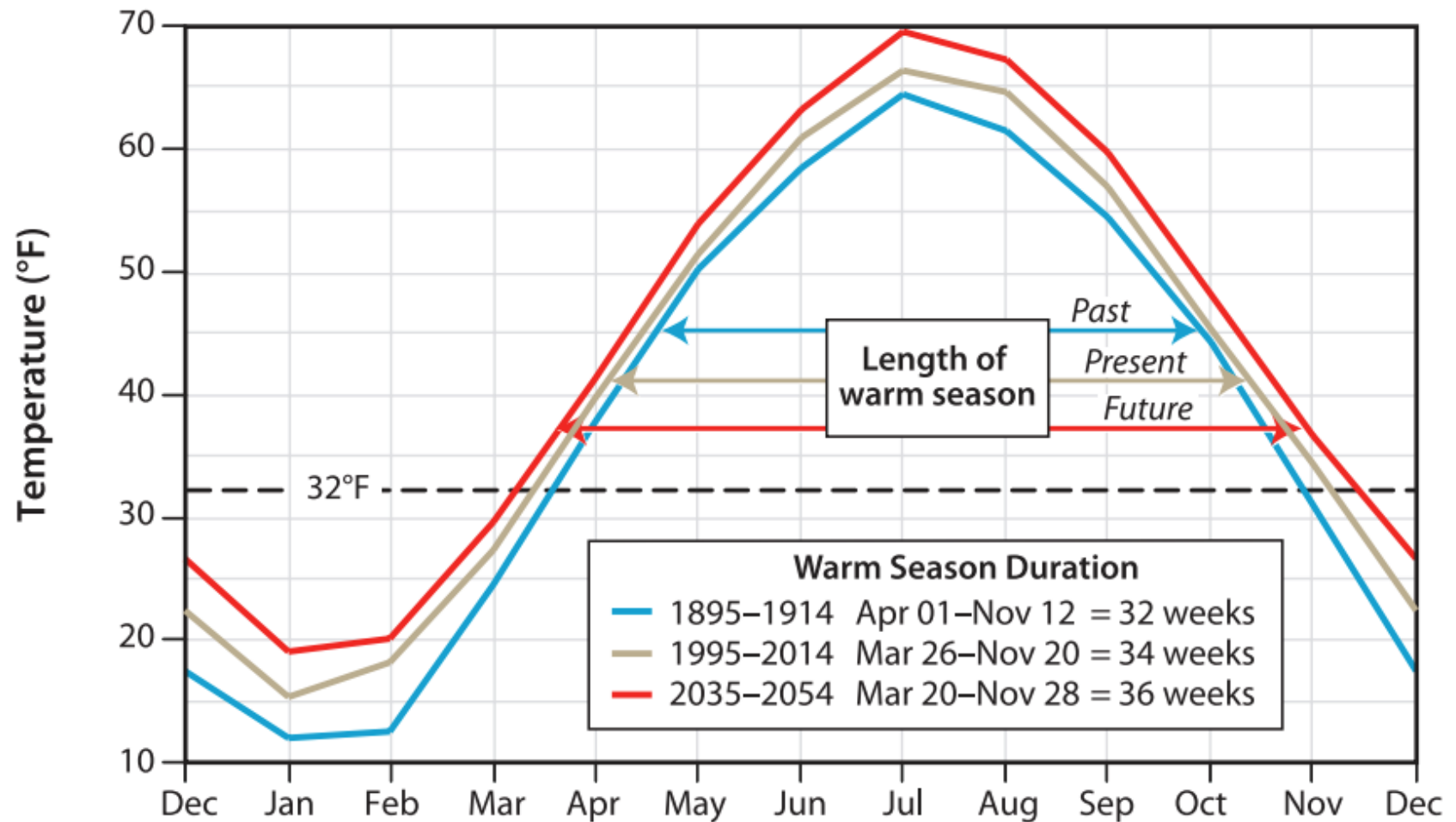
Pittston Maine, April 2016

Lisbon Maine, April 2019

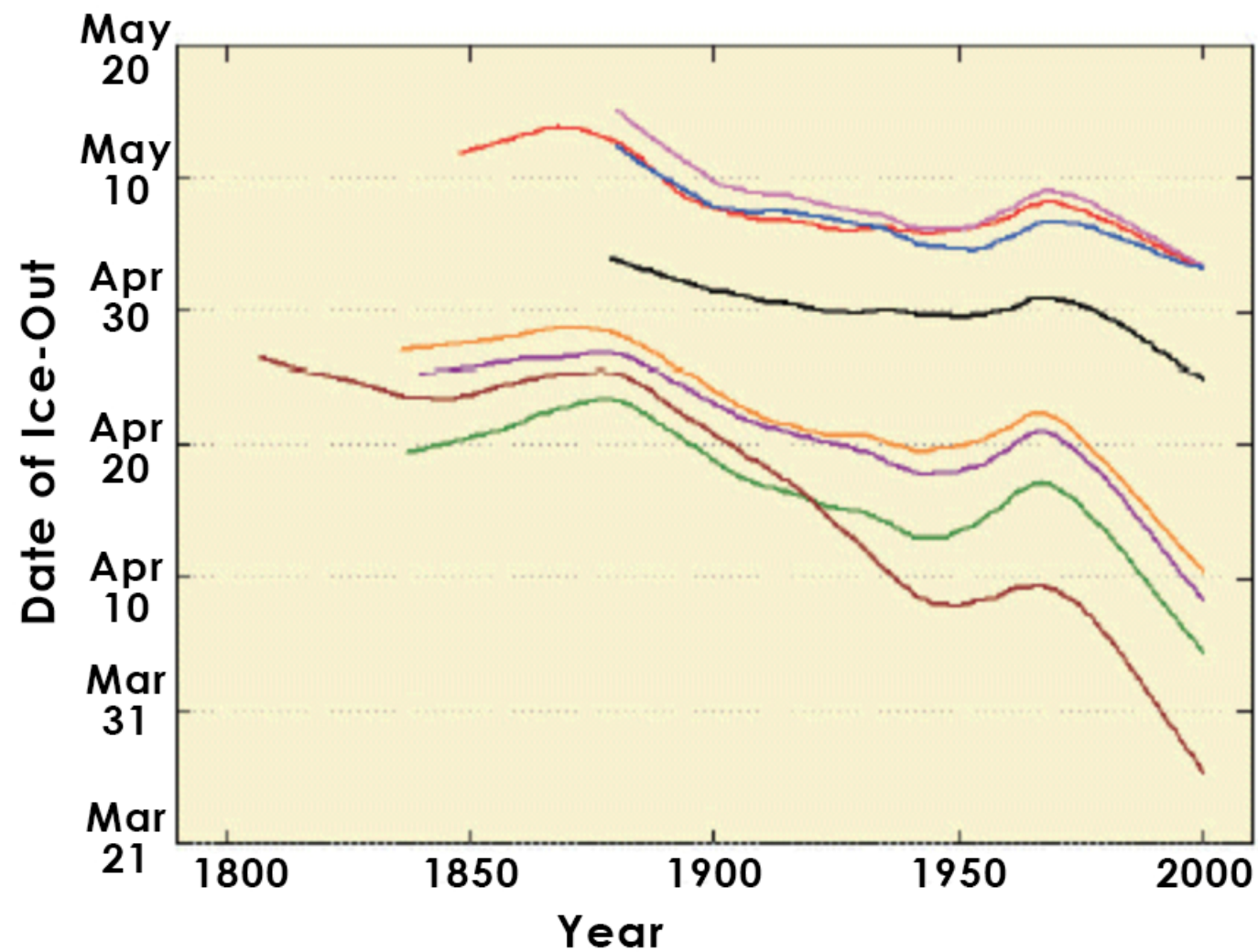


**More frequent extreme weather events
(floods and droughts)**

Maine's Changing Seasons



Growing seasons are getting longer



Shorter periods of ice cover on lakes

All Pose Challenges For Lakes



East Pond alum treatment, Smithfield, 2018

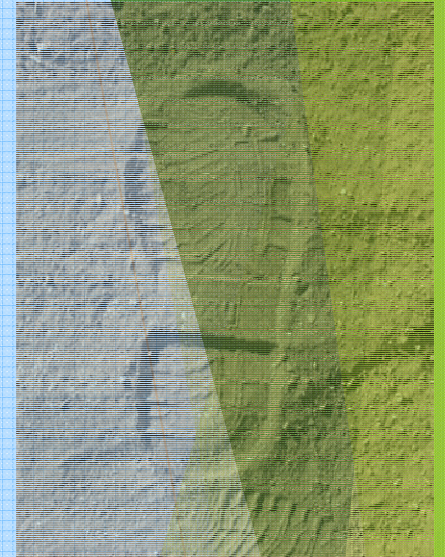
Higher Precipitation

in Winter & Spring



- **Water uptake by the trees & other vegetation in the watershed at minimum**
- **Increased runoff**
- **Higher risk of eroded soils and nutrients being washed into lakes**

Runoff Challenges Exacerbated



- Increased frequency of extreme weather events
- Torrential rains, floods, *and* periods of drought
- Drought makes some soils
 - ✓ more impermeable (and less absorptive),
 - ✓ others less consolidated, setting loose the finer particles



**Fines most likely to
carry phosphorus &
sediment to lakes**

Moosehead – Av 5 PPB

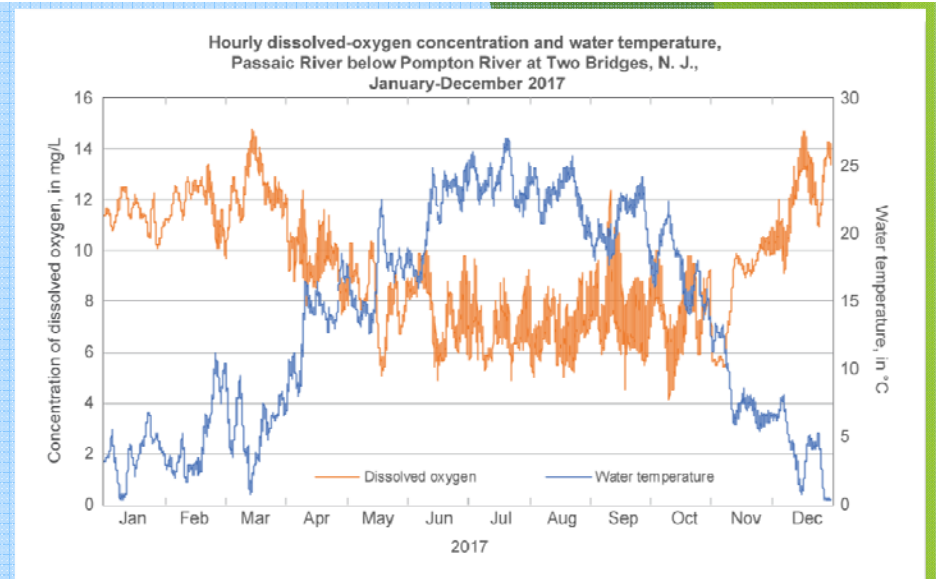


Sabattus– Av 44 PPB



**Phosphorus is the
limiting factor for
planktonic algal growth
in most Maine lakes**

Impacts on Biota & Invasive Species



- Warmer water holds less dissolved oxygen
- Places stress on many native lake inhabitants

FISH CONSUMPTION ADVISORY

Warning About Eating Freshwater Fish

Mercury in Maine freshwater fish may harm the babies of pregnant and nursing mothers, and young children.

- Pregnant and nursing women, women who may get pregnant, and children under age 8 **should not eat any** freshwater fish from Maine's inland waters. Except for brook trout and landlocked salmon, one meal per month is safe.
- All other adults and children older than 8 **can eat** two freshwater fish meals per month. For brook trout and landlocked salmon, the limit is one meal per week.

Warning: Some Maine waters are polluted, requiring additional limits to eating fish.

Fish caught in some Maine waters have high levels of PCBs, Dioxins or DDT in them. These chemicals can cause cancer and other health effects. The Maine CDC recommends additional fish consumption limits on the waters listed below. Remember to check the mercury guidelines. If the water you are fishing is listed below, check the mercury guideline above and follow the most limiting guidelines.



Warmer water:

- Increases bioavailability of toxins such as lead and mercury
- Increases the risk that these toxins will be taken up in even greater quantities by aquatic life





- Organisms naturally adapted to a wide range of conditions (includes most aquatic invaders), will be most resilient
- Invaders will exploit new conditions to their advantage







Climate Change and Biodiversity in Maine: A Summary of Vulnerability of Habitats and Priority Species

Andrew Wilton Maine Center for Conservation Science	Phyllis Gallagher ME Department of Inland Fisheries and Wildlife	Barbara Wilcox The Nature Conservancy
Andrew Goble ME Department of Agriculture, Conservation, and Forestry	Steve Walker Maine Coast Heritage Trust	Gary Erickson Maine Audubon
		Robert Houston U.S. Fish and Wildlife Service



Introduction

As we watch temperatures climb and experience extremes in weather, it is clear that climate change has become a tangible threat to Maine's ecosystems. Long-term research has shown that Maine's wildlife is already responding to climate change. We will likely lose some of Maine's native wildlife and observe permanent changes to their habitats in the coming decades. By 2100, average temperatures may increase 3° to 13°F. In response, the predicted northward shift of species ranges has begun. Rising temperatures will allow pests such as Winter Kill (Chironomus tentans) and Hemlock Woolly Adelgid (Adelges abietis) to become more common, potentially harming native wildlife and their habitats. Drought may occur more frequently and impact all habitats, especially wetlands. Sea level will likely rise three to six feet and will flood coastal marshes and beaches.

Recognizing these challenges, a team of Maine scientists assessed the vulnerability of wildlife and habitats to a changing climate and then identified general strategies to reduce their vulnerability. Other states have taken this first step as they aim to update their state wildlife action plans (SWAPs) to 2015. States originally created SWAPs to set conservation priorities and obtain additional federal funding for wildlife. Maine's plan was prepared by the Maine Department of Inland Fisheries and Wildlife (MDIFW) and is called the Comprehensive Wildlife Conservation Strategy (CWCS). In 2013, the Beginning with Habitat Program, an MDIFW-led partnership of state and federal agencies, and conservation organizations, completed a vulnerability assessment to help update the 2010 CWCS. This summary provides highlights of this assessment, including the vulnerability of Maine's wildlife, plants, and habitats, and a description of a few key adaptation strategies.

Updated in 2014. Maine Department of Inland Fisheries and Wildlife (MDIFW), University of Maine (UM), and the Maine Center for Conservation Science (MCCS). Technical report to the 2014 Maine Coastal Zone, Inc. by the 2014 National Climate Assessment (NCA).

MDIFW, 2014. Maine Comprehensive Wildlife Conservation Strategy (CWCS). Augusta, ME.

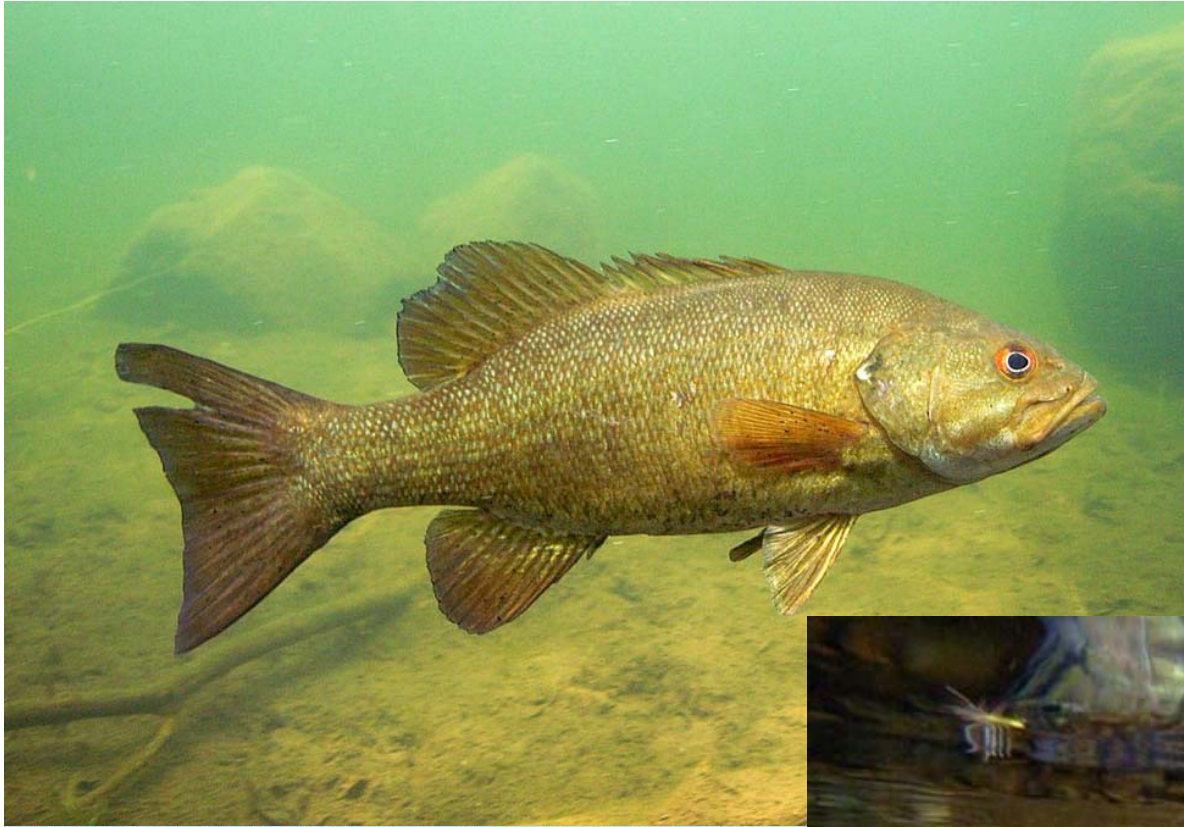
Wilton, A. et al. 2013. Climate Change and Biodiversity in Maine: A Summary of Vulnerability of Habitats and Priority Species. Technical Guide for Conservation Strategies in collaboration with Maine Audubon and Maine Department of Inland Fisheries and Wildlife (MDIFW). Report No. 13-01. 100 pp. Brunswick, ME.

The report was prepared by the Maine Center for Conservation Science, Maine Coast Heritage Trust, and the Maine Department of Inland Fisheries and Wildlife (MDIFW) in collaboration with the Maine Audubon Society and the Maine Department of Inland Fisheries and Wildlife (MDIFW).

2014 - www.manomet.org

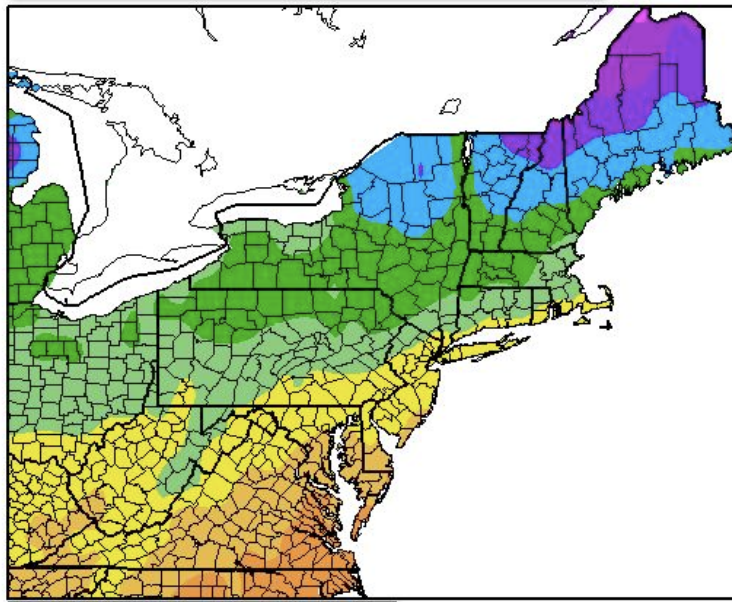


**Cold water species will be
disadvantaged in a warming Maine**



Impacts on Aquatic Plants

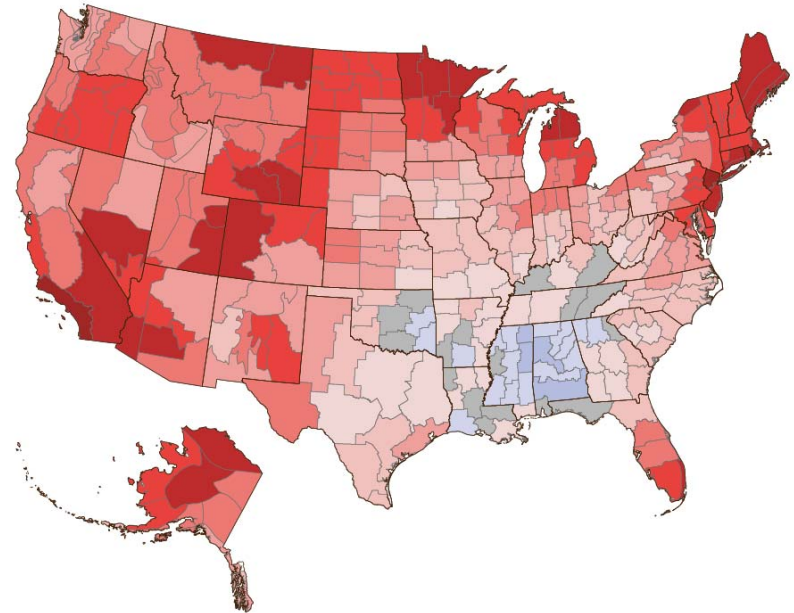
Average Winter Temperatures (°F)
Northeastern United States



Data source: NOAA Northeast Regional Climate Office

Temperature in
degrees F

Rate of Temperature Change in the United States, 1901–2015



Rate of temperature change (°F per century):



Gray interval: -0.1 to 0.1°F

- The further north one is, the faster the annual minimum temperatures will warm
- Maine's winter minimums are provide natural protection for native plants and animals



- **Climate-driven range expansion already happening**
- **Implications for aquatic ecosystems are very serious**





water primrose
Ludwigia peploides

water hyacinth
Eichhornia crassipes





Maine's Invasive Aquatic Plants List

Eurasian watermilfoil

Brazilian elodea

Hydrilla

Fanwort

European naiad

Parrot feather

Curly leaf pondweed

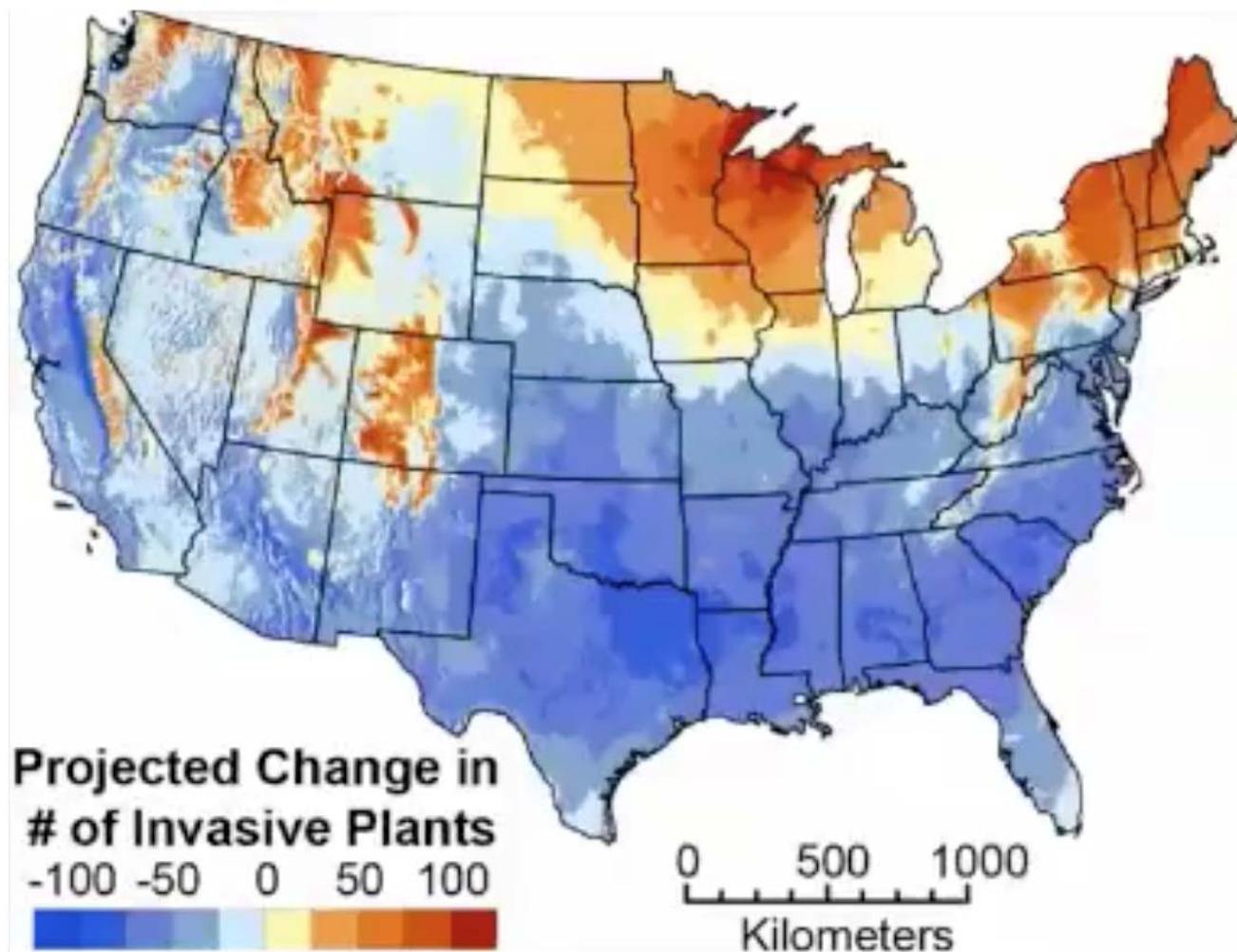
Yellow floating heart

Variable watermilfoil

Water chestnut

European frogbit





Allen & Bradley, 2016

**Hundreds of new plant species (terrestrial
and aquatic) are headed our way**

Forest Pests & Watersheds



Exceptional water quality found in many Maine lakes depends upon the health of heavily-forested lake watersheds





- **Would not have been able to survive here few decades ago, when winters more severe**
- **With Maine's warming climate, cold-intolerant invader poised to decimate our hemlocks**





southern pine beetle



emerald ash borer



In Summary



Climate change is going to exacerbate (amplify, & accelerate) all threats to lakes



In addition to
doing what we are
already doing . . .

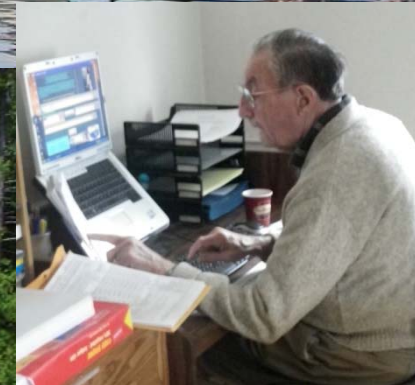






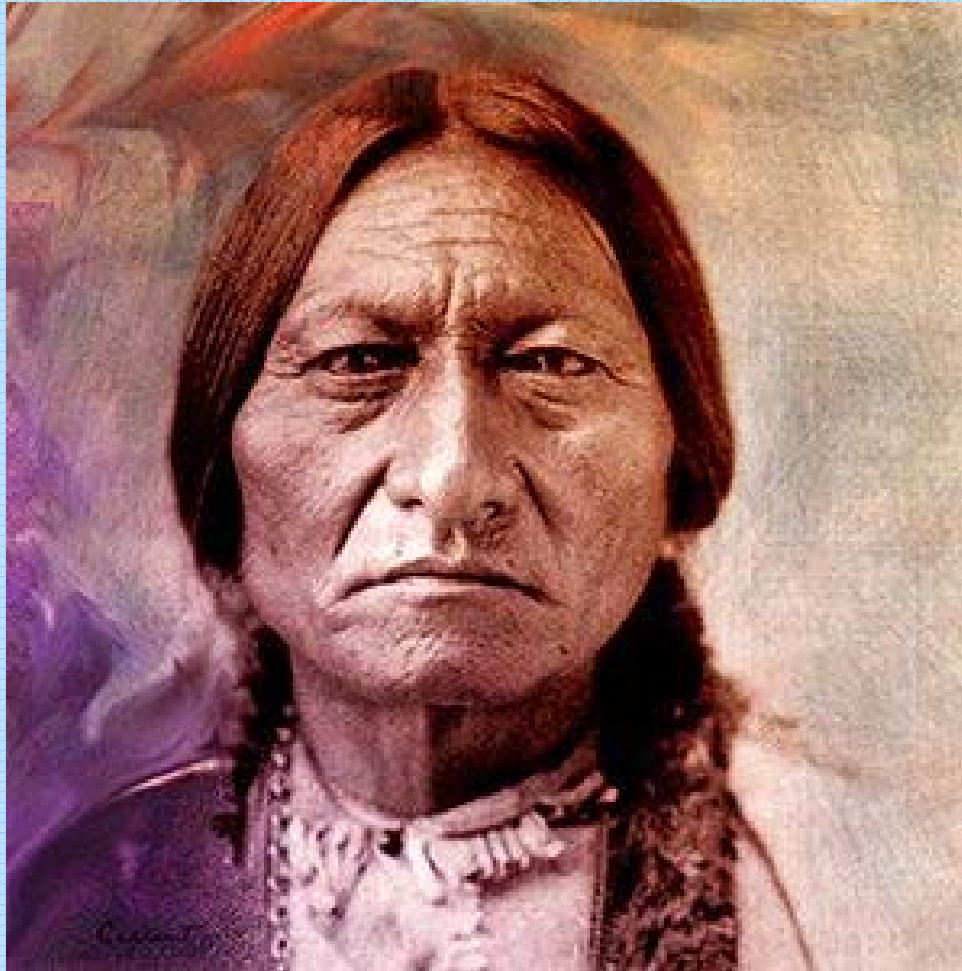












*Let us put our minds together
to see what kind of future we can make for our children . . .*

- Sitting Bull