



Climate Change and New Hampshire Wildlife: A Teaching Resource

Developed by
Judy Tumosa, Watershed Education Specialist
Lindsay Webb, Wildlife Educator

NH Fish and Game Department
June 2020



© Alan Schmierer / Flickr.com

In This Presentation

- ❖ Review of introductory climate change topics and how they impact NH's wildlife.
- ❖ Learn about NH Fish & Game Programs that dovetail with climate change education.
- ❖ Develop ideas on how you can incorporate climate change and wildlife into your own classroom.

Weather versus Climate

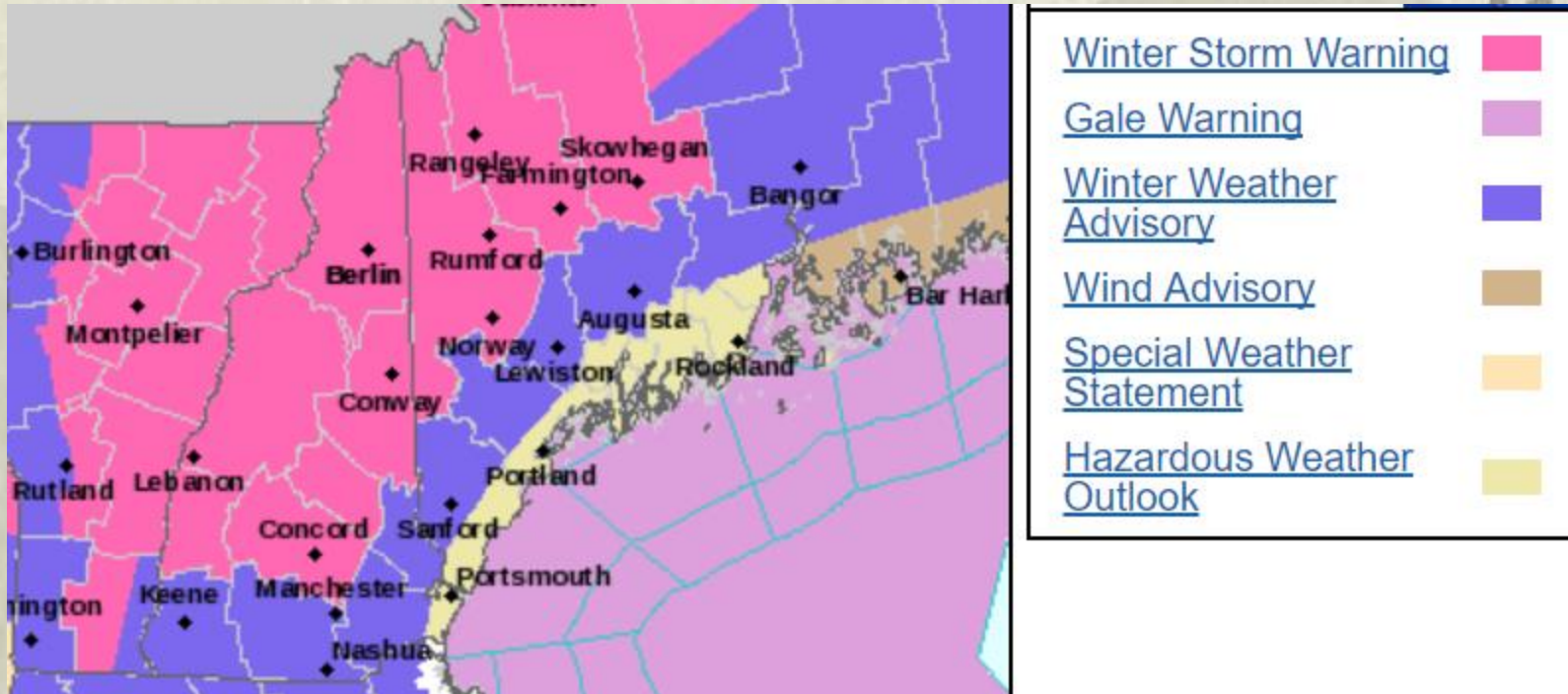
- ❖ Weather: atmospheric conditions (rainfall, wind, temperature, etc.) that occur at any given place and time – what clothes do I wear?
- ❖ Climate: typical weather for an area, averaged over many years – what clothes do I buy?

Weather vs Climate



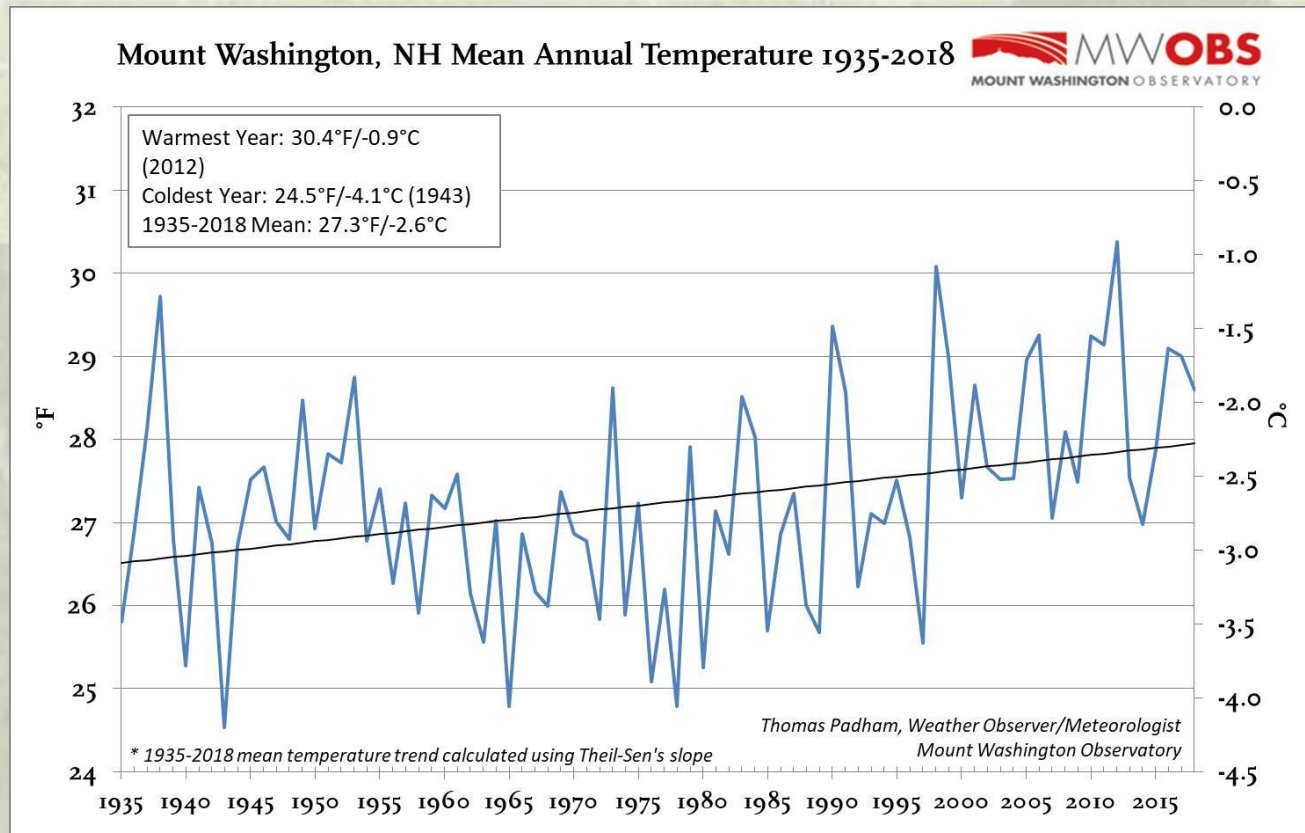
https://youtu.be/cBdxDFpDp_k

Weather versus Climate



This map is displaying weather.

Weather versus Climate

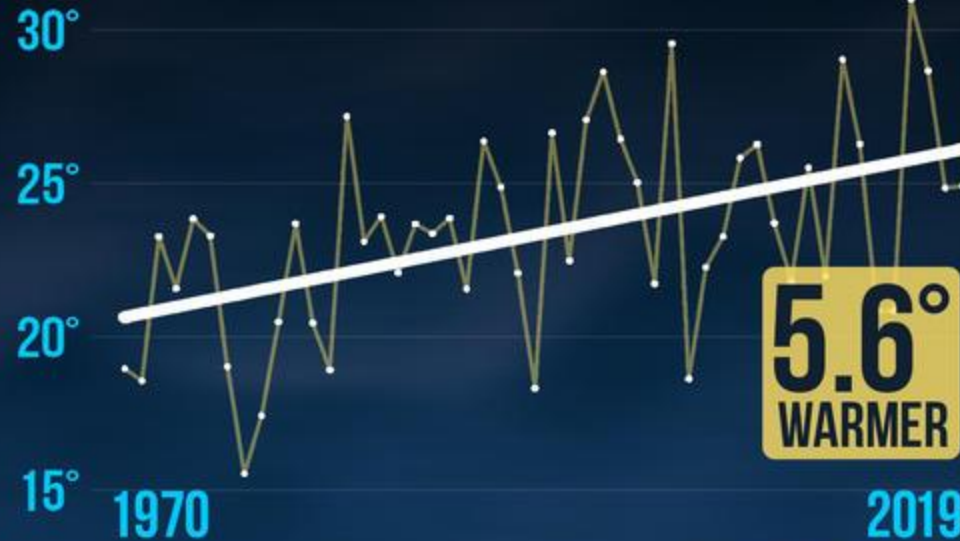


This graph is displaying climate.

Weather versus Climate

WINTER WARMING

Concord, NH

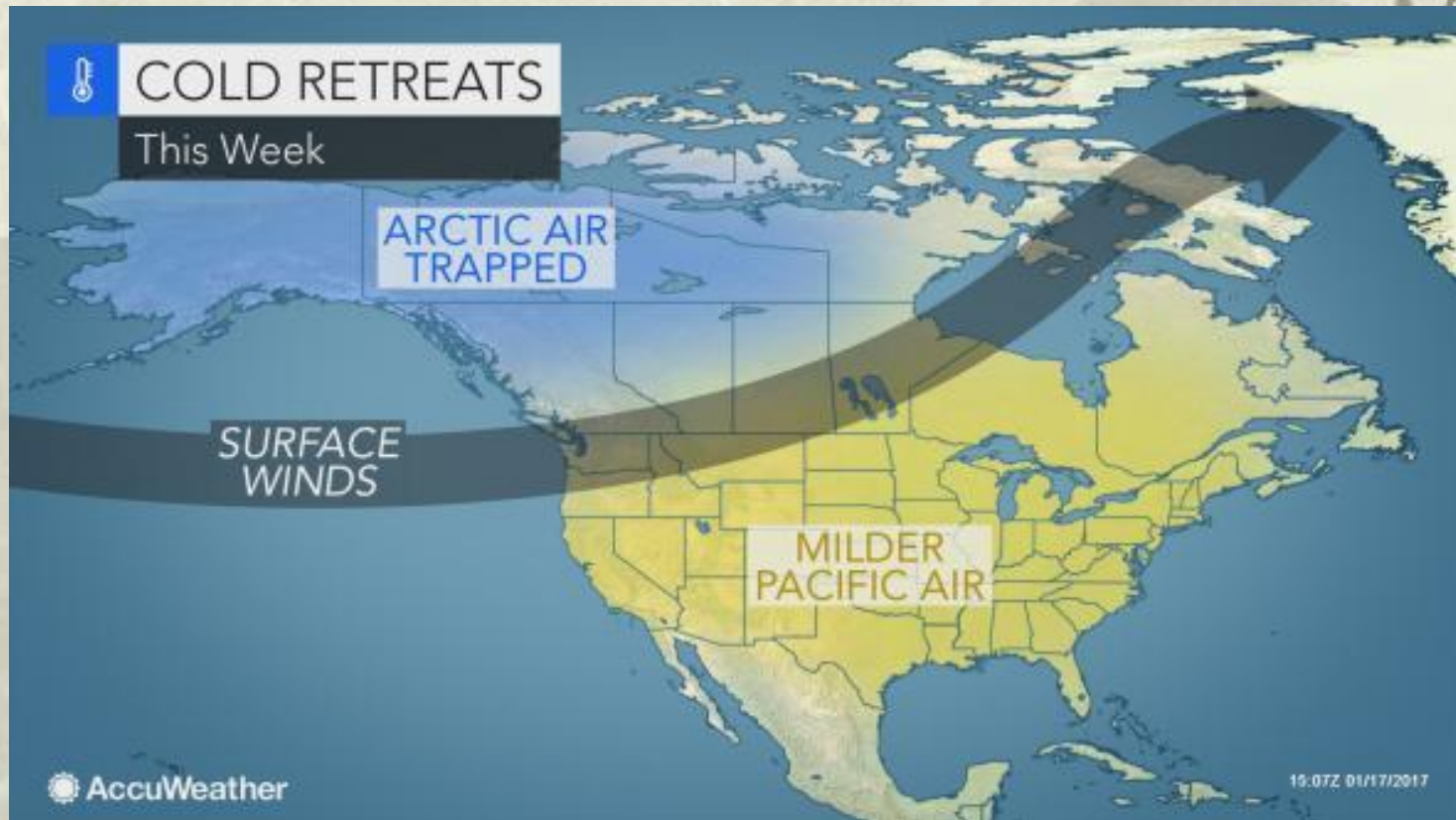


Source: RCC-ACIS.org, Average winter temperature (Dec-Feb). Produced 11/26/2019

CLIMATE  CENTRAL

Is this an example of weather or climate?

Weather versus Climate



Is this an example of weather or climate?

What is Climate Change?

- ❖ Climate changes naturally due to Earth's orbit, solar radiation, and greenhouse gases.
- ❖ Greenhouse gases, such as carbon dioxide, methane and ozone, absorb solar radiation, trapping the sun's heat that would otherwise be released back into space.
- ❖ This greenhouse effect makes the planet warm enough for organisms to survive.

The Greenhouse effect

A T M O S P H E R E



1 Solar radiation passes through the clear atmosphere.
Incoming solar radiation:
343 Watt per m²

3 Some solar radiation is reflected by the atmosphere and earth's surface
Outgoing solar radiation:
103 Watt per m²

6 Some of the infrared radiation passes through the atmosphere and is lost in space
Net outgoing infrared radiation:
240 Watt per m²

G R E E N H O U S E G A S E S

2 Net incoming solar radiation:
240 Watt per m²

5 Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules. The direct effect is the warming of the earth's surface and the troposphere.

Surface gains more heat and infrared radiation is emitted again

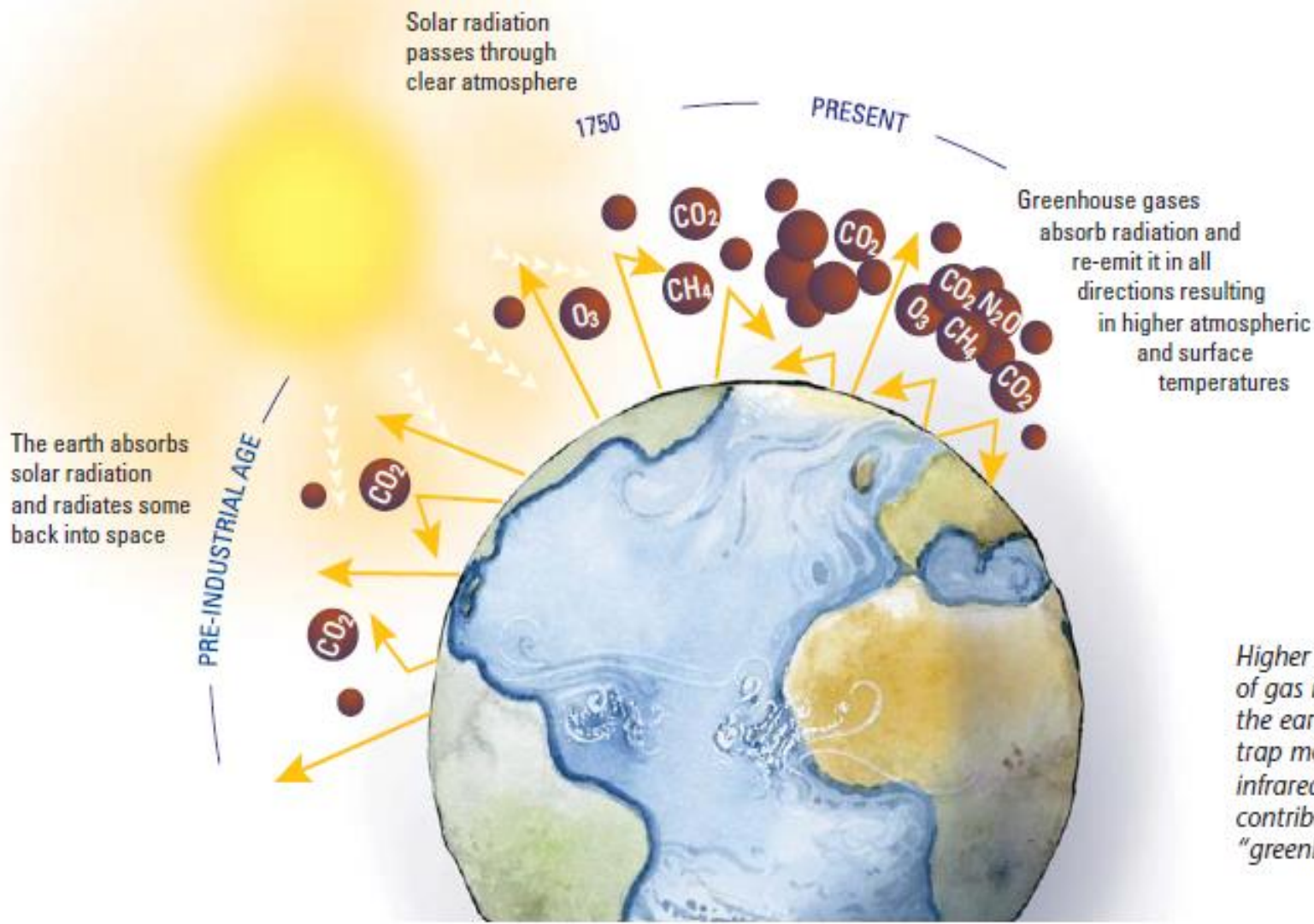
4 Solar energy is absorbed by the earth's surface and warms it...
168 Watt per m²

... and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere

E A R T H



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO. Cambridge university press, 1996.



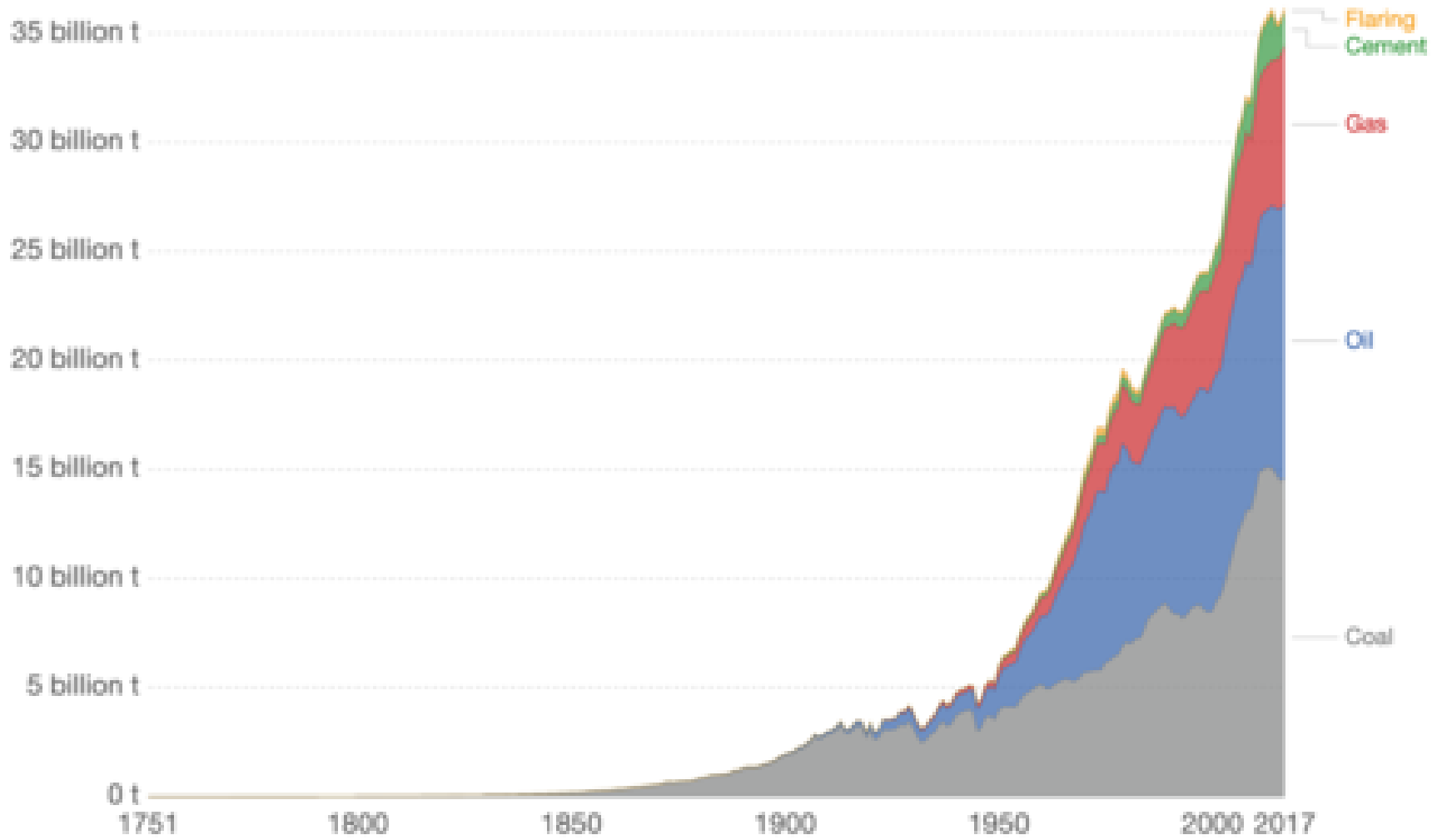
What is the problem?

- ❖ For the past 150 years, humans have greatly increased the amounts of these greenhouse gases especially carbon dioxide, through the burning of fossil fuels and other practices.
- ❖ This has led to negative impacts on the Earth's climate and a general warming of the planet.

CO₂ emissions by fuel type, World

Annual carbon dioxide (CO₂) emissions from different fuel types, measured in tonnes per year.

Our World
in Data



Source: Global Carbon Project (GCP); CDIAC

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

How does climate change impact wildlife in the U.S.?

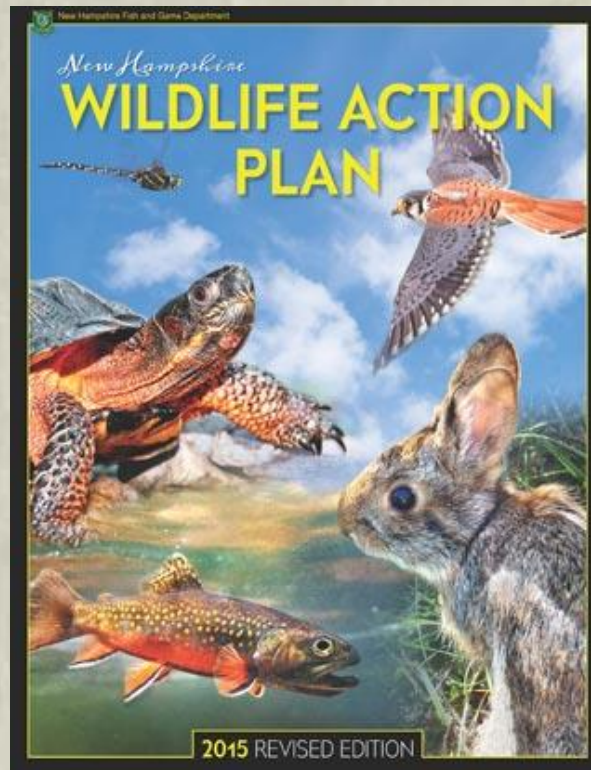


<https://youtu.be/drINEQFXbPY>

How does climate change impact wildlife in N.H?

Guiding Document is the NH Wildlife Action Plan

<https://www.wildlife.state.nh.us/wildlife/wap.html>



NHWAP Wildlife Risk Assessment - Chapter 4: Climate Change

- ❖ **Extreme storms and flooding**
- ❖ **Shifting habitat**
- ❖ **Phenology**
- ❖ **Winter seasonal changes**
- ❖ **Rising temperatures**
- ❖ **Invasive Species**

<https://www.wildlife.state.nh.us/climate/index.html>

Extreme Storms and Flooding

- ❖ Scientists predict annual average precipitation will increase 14-20%
- ❖ Storms will be less frequent, more severe with longer dry periods between storms



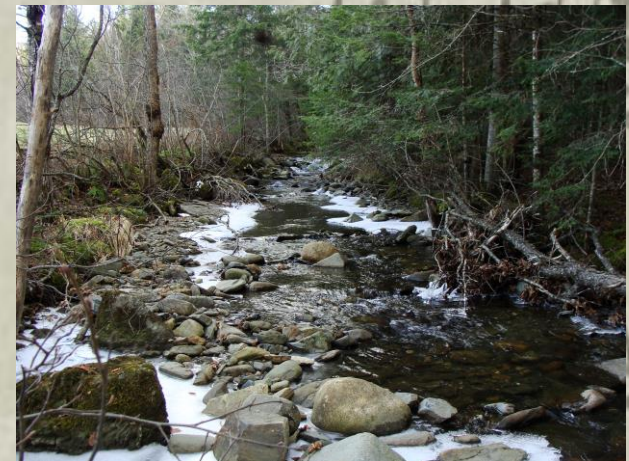
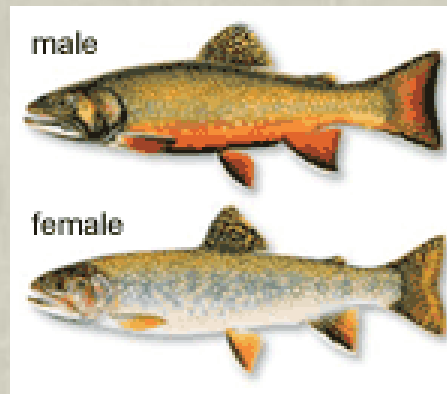
Extreme Storms and Flooding Impacts

- ❖ Extreme storms can cause flooding
- ❖ Flooding can cover loon and turtle nesting sites located on the banks of the water body
- ❖ Flooding increases the amount of pollutants and sediments that wash into streams
 - Sediment can cover spawning areas for fish and smother macroinvertebrate populations, clog feeding mechanisms of mussels



Extreme Storms and Flooding Impacts (con't)

- ❖ Flooding alters stream flows and destroys stream crossings
 - Watershed connectivity is interrupted, making it impossible for aquatic organisms (trout) to reach spawning grounds and cold water refugia



Shifting Habitat

- ❖ As temperatures rise and moisture levels change due to climate change, the plant communities that make up habitat for wildlife will also change. In turn, wildlife may shift their habitat range.



Shifting Habitat

❖ Habitats in New Hampshire most at risk:

- Coastal Islands
- Hemlock Hardwood Pine Forests
- Lowland Spruce Fir Forests
- Marine
- Northern Hardwood-Conifer Forest
- Salt Marsh



Shifting Habitat Impacts

- ❖ Wildlife species in New Hampshire most at risk from a shifting habitat directly rely on these habitats to get their basic needs and can not adapt to changes quickly.
- ❖ Wildlife that are already at the edge of their range.
 - Canada lynx and snowshoe hare
 - Moose
 - Northern bog lemming



Phenology

- ❖ Phenology is the timing of biological events throughout the year, such as leaf out in the spring, emergence from hibernation, the arrival of migrating birds, and the appearance of adult insects.
- ❖ A mismatch can occur: what wildlife species need in their habitat versus what is available at very critical times for their survival.



Phenology Impacts

- ❖ Some birds have evolved to time their migrations to coincide with the emergence of insects.
- ❖ Moose and winter tick: shorter winter (less snow) makes it easier for ticks to survive when they fall off the host. Heavy tick loads on moose calves can kill them and cows respond with lower reproductive rates.



Winter Seasonal Changes

- ❖ Warmer temperatures associated with climate affect winter conditions including less accumulating snows and the earlier arrival of spring-like weather.
- ❖ Winter months now include more precipitation in the form of rain or ice, and less as snow, resulting in reduced snowpack.



Winter Seasonal Changes

- ❖ Ice forms on waterbodies later in the season and melts out earlier.
- ❖ In the short term, as Arctic ice continues to melt, the polar jet stream may shift, creating instead increased extremes of cold and snow in New Hampshire.



Winter Seasonal Changes Impacts

- ❖ Over time, winter's warming transition directly affects a diverse number of species.
 - Hibernation cycles will be affected by the delayed winters and earlier springs.
 - Aquatic species will be affected by reduced seasonal ice duration and the ultimate warming of most waterbodies.
 - Cold-water fish may be displaced by competing warm-water fish.
 - An earlier onset of spring following a winter of diminished snow cover will result in earlier blooms which will be more susceptible to frost, but early-season flowers are critical to pollinating bees whose numbers are already in decline.

Winter Seasonal Changes Impacts

❖ Over time, winter's warming transition directly affects a diverse number of species.

– Physical Adaptations:

- Snowshoe hare and weasels have fur that transitions from brown to white during the winter, enabling them to blend in with their environment. These species will become more vulnerable to predation with reduced winter conditions.



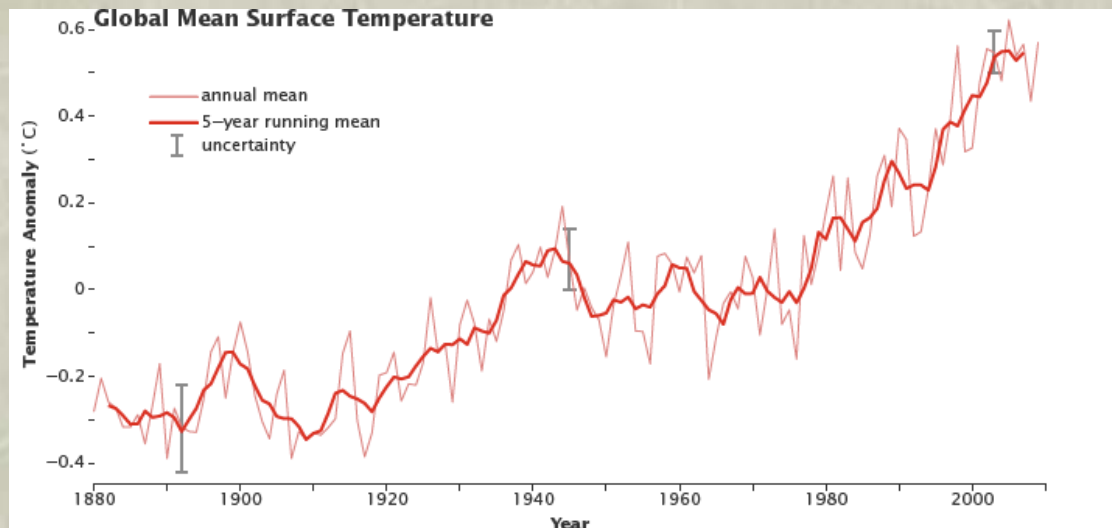
Winter Seasonal Changes Impacts

- ❖ Over time, winter's warming transition directly affects a diverse number of species.
 - Other species that thrive in colder, winter conditions are responding by relocating their ranges further north. Moose are currently at the southernmost boundary of their habitat and will retreat northward as winter conditions continue to diminish.
 - Frequency of snowfall and accumulated depths are critical to the American marten and Canada lynx, and both are adapted to function optimally in deep snow.



Rising Temperatures

- ❖ Scientists predict average annual air temperature in NH will rise, leading to more days > 90 degrees F
- ❖ Warmer summers will increase stream temperatures
- ❖ Warmer winters will mean reduced snowfall, shorten the winter, decrease the snowpack which leads to freezing soils and damaged tree roots



Rising Temperatures Impacts

- ❖ Coldwater fish species (trout) cannot tolerate temperatures below 65 degrees F and water with less oxygen
 - If colder water access is cut off due to inadequate stream crossings, these species will be replaced by warm water fish species
 - Two of NH's endangered mussels use cold water fish as part of their life cycle



Dwarf wedgemussel



Brook floater

Rising Temperatures Impacts (con't)

- ❖ Moose in NH are in the southern limits of their range
- ❖ Warmer weather causes moose to have heat stress
- ❖ Eventually they bed down and cease foraging, increasing their risk of mortality
- ❖ Winter ticks are major moose parasites and shorter winters allow them to thrive



Invasive Species

- ❖ An invasive species is a plant, animal, or any other organism that causes ecological or economic harm in a new environment where it is not native.



Invasive Species Impacts

- ❖ Many invasive species will expand into NH because of warmer temperatures caused by climate change
- ❖ For various reasons, invasives may replace native plant species and therefore impact wildlife habitat

Who Are We?

- ❖ NHFG Education is divided into two program units:
Aquatic Resource Education and Wildlife Education
- ❖ Both provide many opportunities to bring wildlife and habitat learning into the classroom.

Aquatic Resources Education (ARE) Program

- ❖ Funded by federal ARE grant with state match from teachers and volunteers who assist with the programs
- ❖ Components are Watershed Education Program (WEP) and Let's Go Fishing (LGF) programs
- ❖ Teaching teachers, students and communities how to keep their watershed healthy for fish and wildlife.



WEP Climate Change Curriculum Connections

- ❖ Teacher training in watershed assessment protocols and Citizen Science projects
- ❖ Watershed Curriculum resources
- ❖ Water Quality and Macro sampling equipment loan program
- ❖ [NHFG Climate Change](#)

Wildlife Program Curriculum Connection Opportunities

- ❖ Fur Kits and Track Kits and Furbearer Fundamentals – borrow a trunk from the Concord Fish & Game office for hands-on activities with furs, tracks, and skulls
- ❖ Wild Times for Kids – Newsletter for kids all about wildlife and habitats.
- ❖ Schoolyard Action Grants – Small grants for funding for schoolyard wildlife habitat and outdoor classroom projects.
- ❖ Urban Wildlife Program – Currently running in grades 3 and 5 in Manchester, NH.

Wildlife Program Curriculum

Connection Opportunities

- ❖ Project WILD – Teacher Training / Professional Development available throughout the year or by request.
- ❖ Citizen Science Opportunities available during different times of the year – Data is collected for wildlife biologists. Some opportunities include:
 - Turkey Surveys
 - Rabbit Surveys
 - Reptile and Amphibians Sightings

Ideas for Climate Change Integration

- ❖ Participate in a NHFG Education Program
- ❖ Use these slides in your own powerpoint.
- ❖ Participate as a class in a community science project
- ❖ Invite a biologist or scientist to come talk to your students about climate change (Skype a Scientist)
- ❖ Create habitat in your schoolyard - Schoolyard

Action Grants:

<https://www.wildlife.state.nh.us/education/grants.html>

Other Climate Change Curriculum

- ❖ So many free climate change curriculum for teachers to use!
- ❖ Most do not include wildlife, so it is important to use information in this slideshow and from NH Fish and Game's website.
 - Climate Literacy & Energy Awareness Network: <https://cleanet.org/index.html>
 - National Oceanic and Atmospheric Administration: <https://www.noaa.gov/education/resource-collections/climate>
 - National Aeronautics and Space Administration: <https://climate.nasa.gov/>
 - National Geographic: <https://www.nationalgeographic.com/environment/climate-change/>
 - Association of Fish and Wildlife Agencies: <https://www.fishwildlife.org/afwa-inspires/project-wild/wildlife-climate>



Judy Tumosa, Watershed Education Specialist
Lindsay Webb, Wildlife Educator

NH Fish and Game Department
11 Hazen Drive
Concord, NH 03001

Judy.l.tumosa@wildlife.nh.gov
Lindsay.webb@wildlife.nh.gov