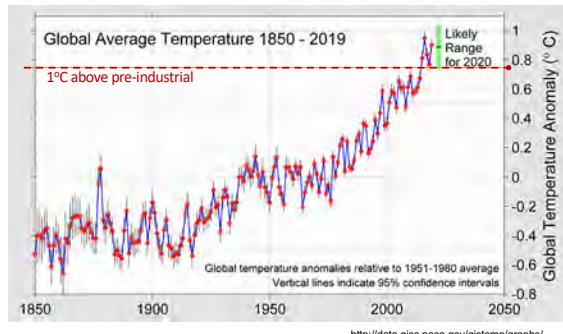


The effects of climate change on native plants



1

Last five years the hottest since 1884



2

Certain gases in atmosphere interfere with heat waves as they move toward space
 * carbon dioxide, methane, nitrous oxide *

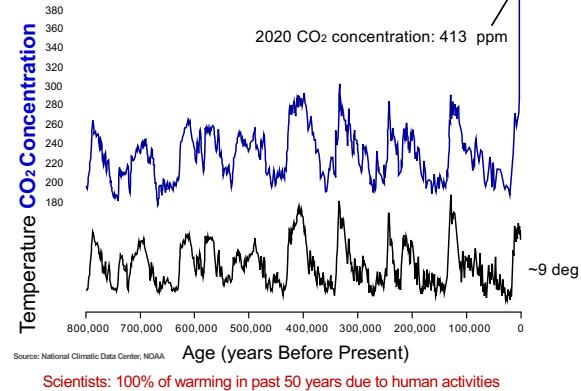
Interference from these gases slows heat loss from Earth, so air warms

*more gas molecules,
 **slower heat loss
 ***more warming

modified from The Climate Reality Project

3

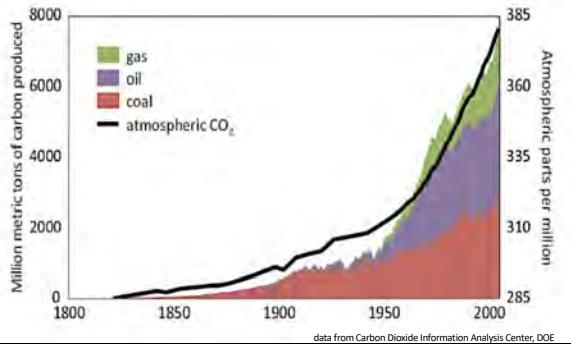
How do we know this isn't just a natural cycle?



4

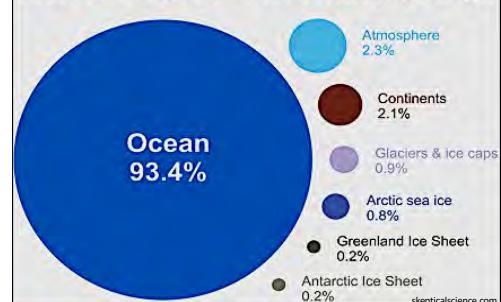
How do we know humans are responsible?

Increasing atmospheric CO2 closely tracks known carbon emissions from fossil fuels.



5

Where is global warming going?



Warmer oceans: more evaporation, more humidity
 With warmer air → changes in winds and currents

6

The “NEW NORMAL”

1. Rising temperatures

- warmer winters, earlier springs
- longer growing season
- more extremely hot days, fewer cool nights

2. Heavier downpours, more flooding

3. More summer drought, wildfires

Impacts of the New Normal on native plants

Heat, flooding, droughts, extreme weather:

- Increase plant stress
- Increase susceptibility to disease, herbivory
- Change species interactions (competition, herbivory, pollination, microbial effects)
- Can change habitat availability & species range
- Change community composition
- Will cause local extinction of some species

7

8

Impacts of Climate Change: Temperature LONGER FROST-FREE SEASON

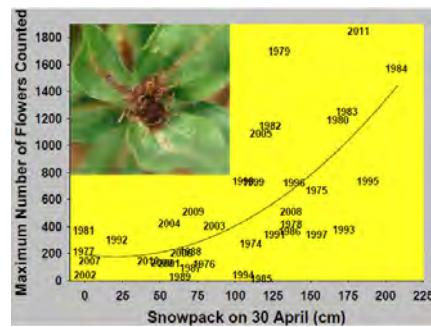
+18
+9
+9
+5
+21
+10

Increase in number of days between last spring freeze and first fall freeze during 1991-2011 relative to 1901-1960.

Source: Kenneth Kunkel, Cooperative Institute for Climate and Satellites, North Carolina State University and NOAA/NCDC

- Fewer cold nights for perennials that need chilling
- Warmer winter can lead to domino effect on interactions

Warmer winters in Rockies → less snow & fewer flowers survive late freeze



so less food for pollinators,
fewer seeds to maintain plant population

9

10

Mismatched timing in species interactions

Plants and pollinators can respond differently to warming

- Asynchrony can cause failure to set seed, lack of food for pollinators
- Bad for plants AND pollinators



Speyeria mormonia and Erigeron speciosus



Source: David Inouye

Warmer winters, earlier flowering

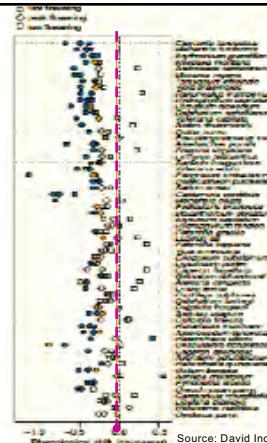
Native Plants:

Shifts in flowering time in just 39 years

- 69 native species
- Rocky Mountains
- most species flower earlier, extent variable
- plants may flower at smaller size

Franks & Weis (2008) J. Evol. Biol.

Long-term studies crucial

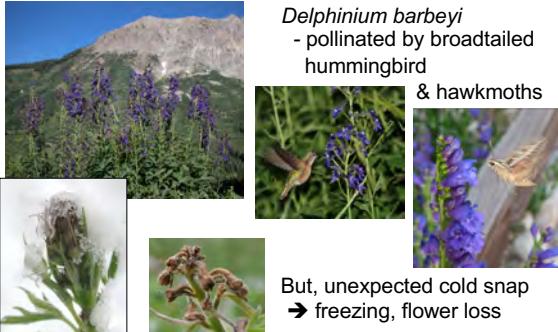


Source: David Inouye

11

12

Warmer winters & earlier flowering

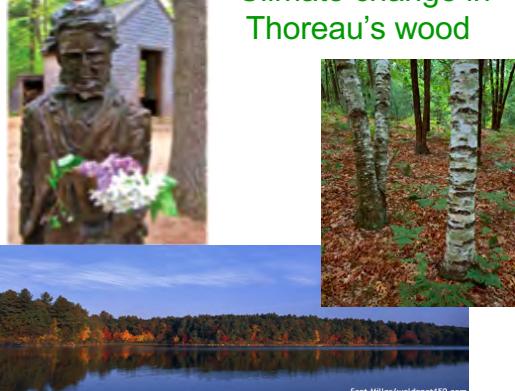


Delphinium barbeyi
- pollinated by broadtailed
hummingbird
& hawkmoths

But, unexpected cold snap
→ freezing, flower loss
- no food for pollinators
- no seeds

Source: David Inouye

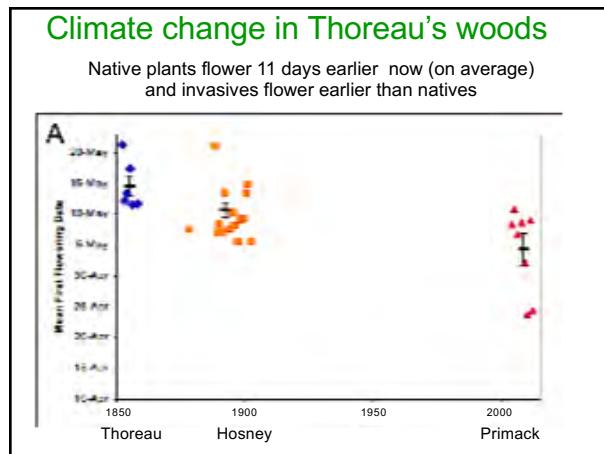
Climate change in Thoreau's wood



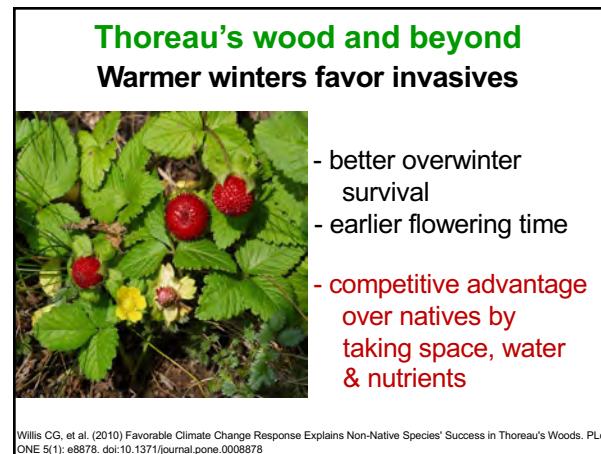
Scot Miller/waldenat150.com

13

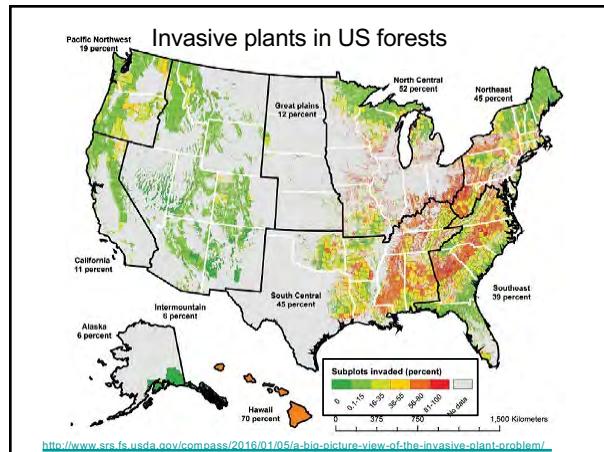
14



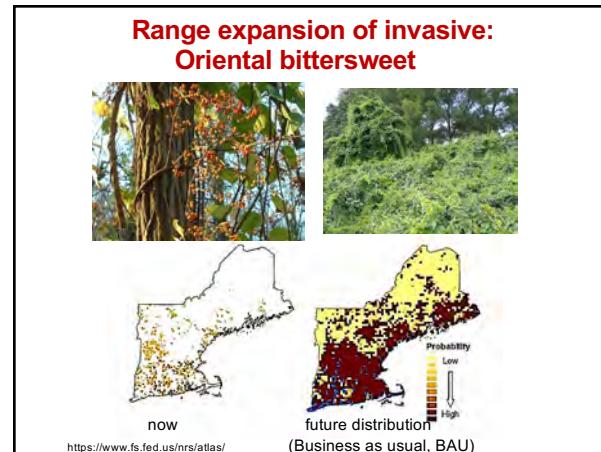
15



16



17



18

Effects of warmer winters: animals

Deer

- more food during winter
- healthier populations
- higher overwinter survival
- increase in # offspring & offspring survival



19

Deer grazing changes plant communities!

-Native plants favored by deer decline, ie *Trillium*



-Plants deer avoid increase:
garlic mustard



multiflora rose

20

Effects of warmer winters on animals

Insects

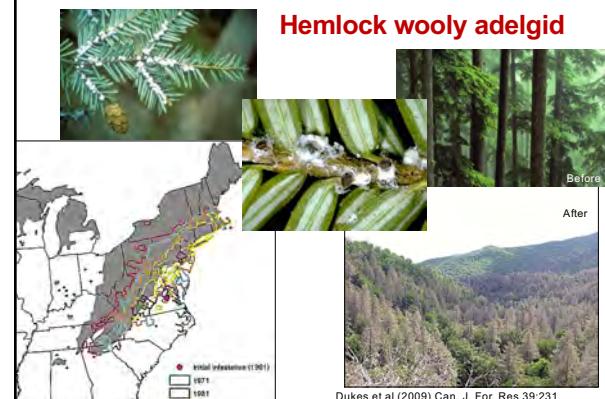
- better overwinter survival
- earlier appearance
- more generations/yr
- range expansion



21

Warmer winters: Insect range expansions

Hemlock wooly adelgid

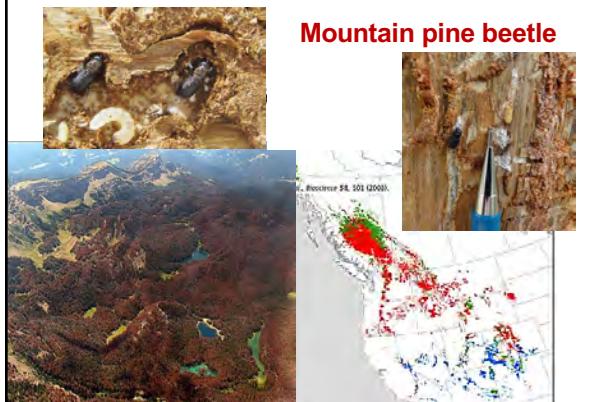


Dukes et al (2009) Can. J. For. Res 39:231

22

Warmer winters: Insect range expansions

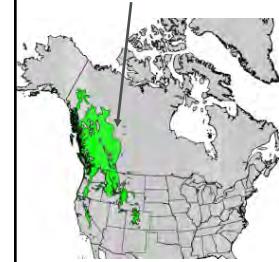
Mountain pine beetle



23

MPB now ready to spread to eastern Canada

-Crossed the Rockies



Lodgepole Pine

- Shifted onto Jack Pine



Jack Pine

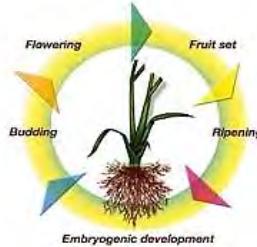
24



25

Heat stress from rising temperatures:

- reduces growth rate (less photosynthesis)
- increases water loss
- can impact every stage



very hard on forest trees

- reduced growth
- stress
- large trees die first

26

Pathogens feast on stressed trees



27

California Wildfires 2020

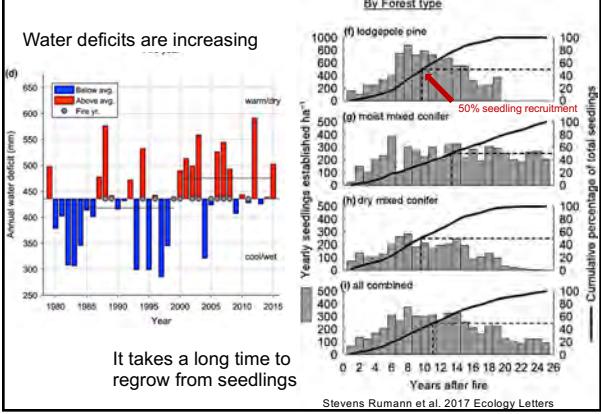
Aggravated by years of drought



4 million acres burned, 31 deaths, \$ billions in damage
What are the impacts on the plants??

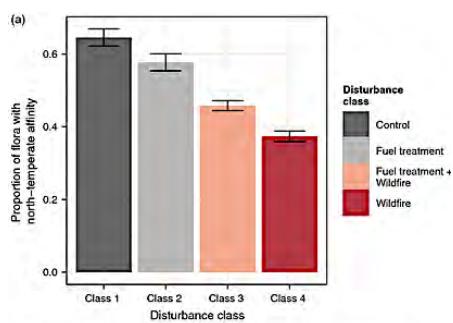
28

Impacts of California wildfires on forests



29

Wildfires can change plant communities



California: Burned plots more likely to change from northern temperate to southern xeric

30



Thank you!



Email me anytime with questions:



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