The effects of climate change on native plants

Dr. Sara Via
Professor &
Climate Extension Specialist
UMD, College Park
svia@umd.edu

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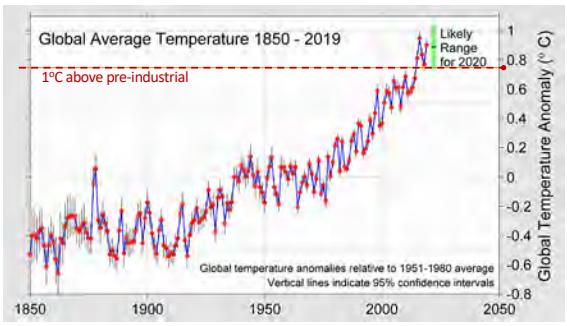
Last five years the hottest since 1884



http://data.giss.nasa.gov/gistemp/graphs/

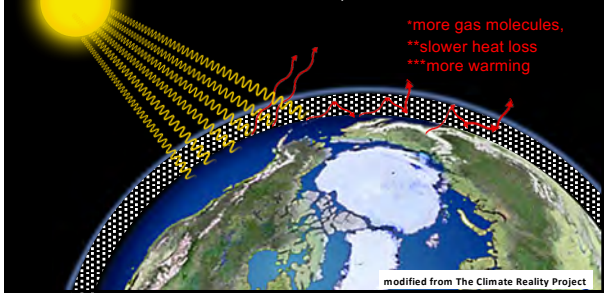
19 of 20 hottest years all since 2000– WHY??

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



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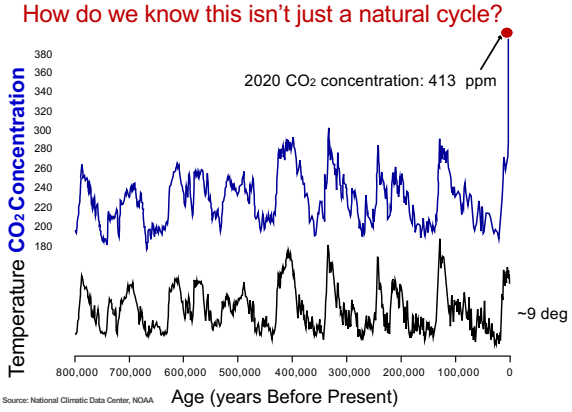
How do we know this isn't just a natural cycle?

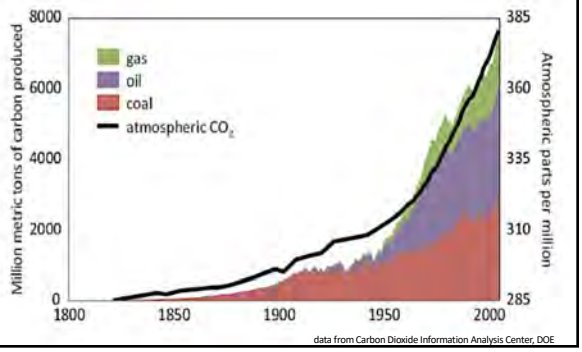


Scientists: 100% of warming in past 50 years due to human activities

4

How do we know humans are responsible?

Increasing atmospheric CO_2 closely tracks known carbon emissions from fossil fuels.



data from Carbon Dioxide Information Analysis Center, DOE

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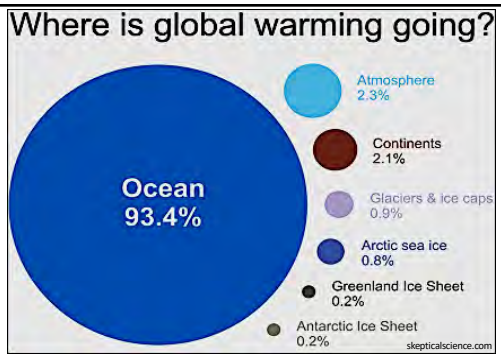
Where is global warming going?



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**

7

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**

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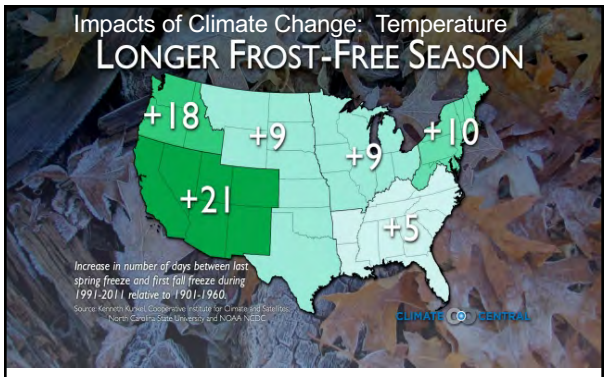
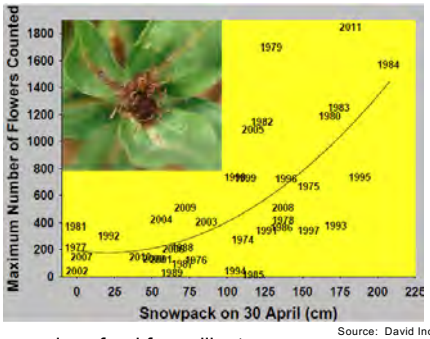


- **Fewer cold nights for perennials that need chilling**
- **Warmer winter can lead to domino effect on interactions**

9

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



Source: David Inouye

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

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

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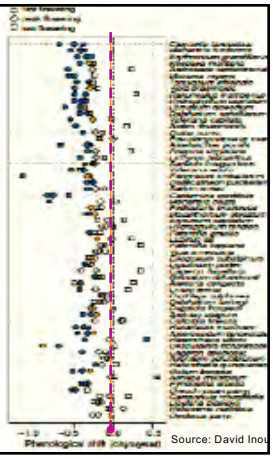
Warmer winters, earlier flowering

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 Inou

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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

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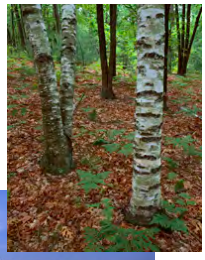
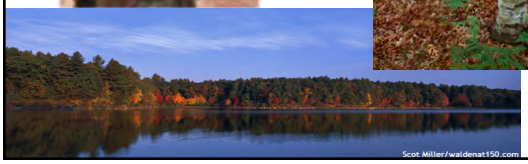
Climate change in Thoreau's wood





Scot Miller/waldenat150.com

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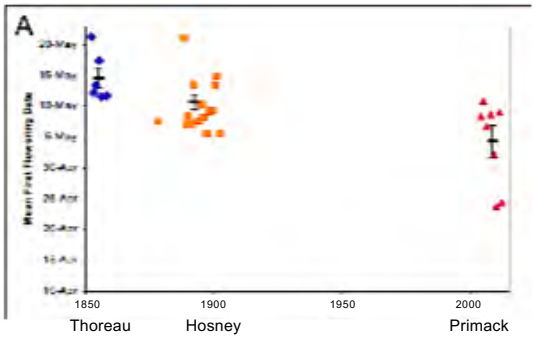
Climate change in Thoreau's woods

Native plants flower 11 days earlier now (on average)
and invasives flower earlier than natives



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Thoreau's wood and beyond

Warmer winters favor invasives

- better overwinter survival
- earlier flowering time

- competitive advantage over natives by taking space, water & nutrients

Willis CG, et al. (2010) Favorable Climate Change Response Explains Non-Native Species' Success in Thoreau's Woods. PLoS ONE 5(1): e8878. doi:10.1371/journal.pone.0008878

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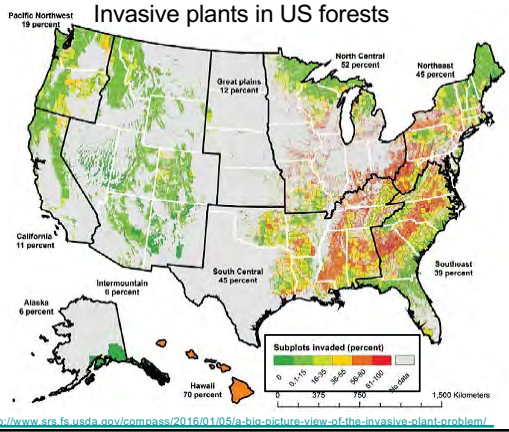
Invasive plants in US forests



http://www.srs.fs.usda.gov/compass/2016/01/05/a-big-picture-view-of-the-invasive-plant-problem/

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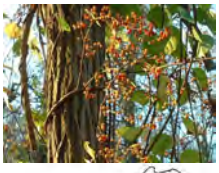
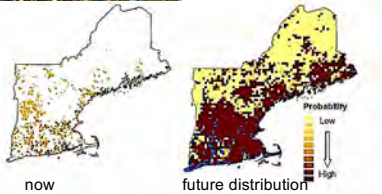
Range expansion of invasive: Oriental bittersweet





now

future distribution
(Business as usual, BAU)

https://www.fs.fed.us/nrs/atlas/

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Effects of warmer winters: animals

Deer

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

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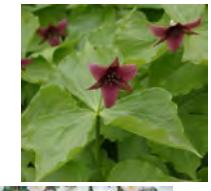
Deer grazing changes plant communities!

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



-Plants deer avoid increase:

garlic mustard

multiflora rose

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Effects of warmer winters on animals

Insects

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

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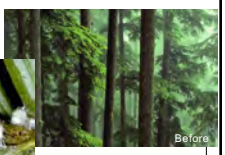
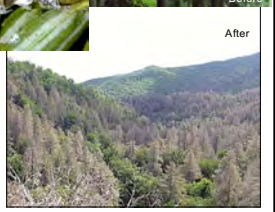
Warmer winters: Insect range expansions

Hemlock wooly adelgid



Before

After



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

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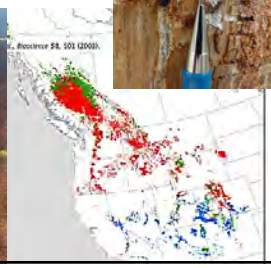
Warmer winters: Insect range expansions

Mountain pine beetle



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MPB now ready to spread to eastern Canada

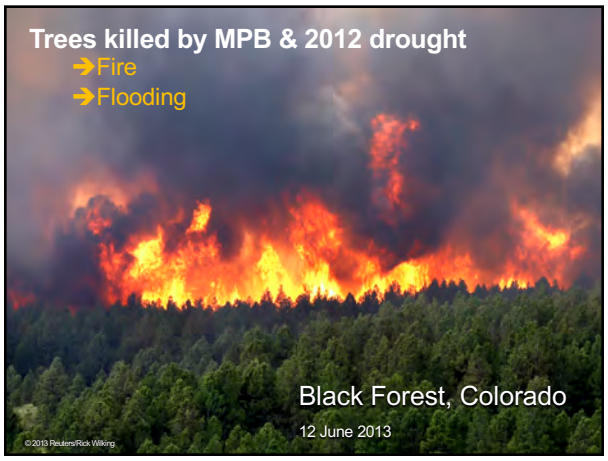
-Crossed the Rockies

- Shifted onto Jack Pine

Lodgepole Pine

Jack Pine

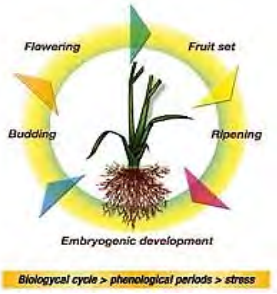
24



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

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Pathogens feast on stressed trees

Armillaria root rot

And heat stressed trees grow more slowly

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

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California Wildfires 2020

Aggravated by years of drought

4 million acres burned, 31 deaths, $ billions in damage

What are the impacts on the plants??

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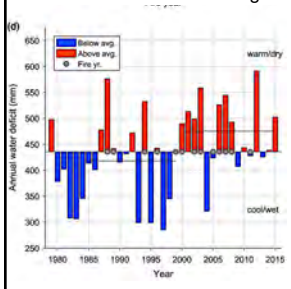
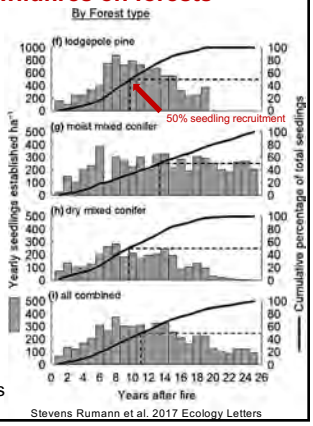
Impacts of California wildfires on forests

Water deficits are increasing





It takes a long time to regrow from seedlings

Stevens Rumann et al. 2017 Ecology Letters

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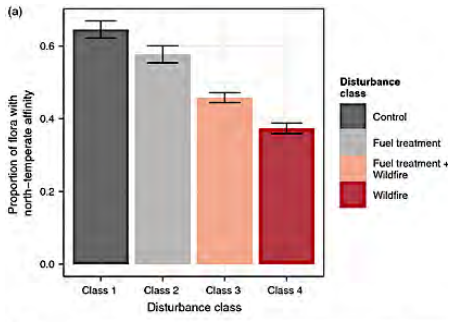
Wildfires can change plant communities



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

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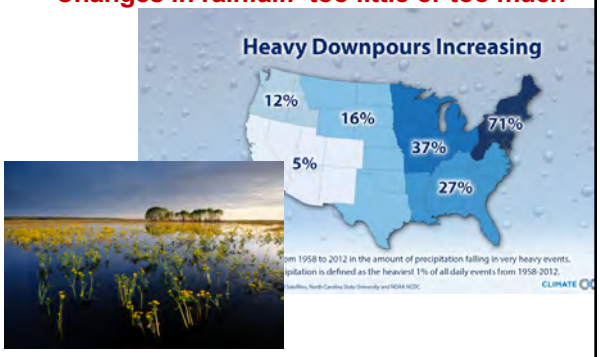
Changes in rainfall: too little or too much



Flooding can stunt or kill plants, increase disease, bring in toxins, change plant community if frequent

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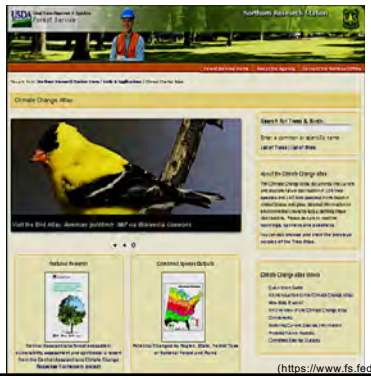
Climate Resilience Toolkit: Climate Change Atlas

How will climate change affect ranges of birds/plants?



(https://www.fs.fed.us/nrs/atlas/)

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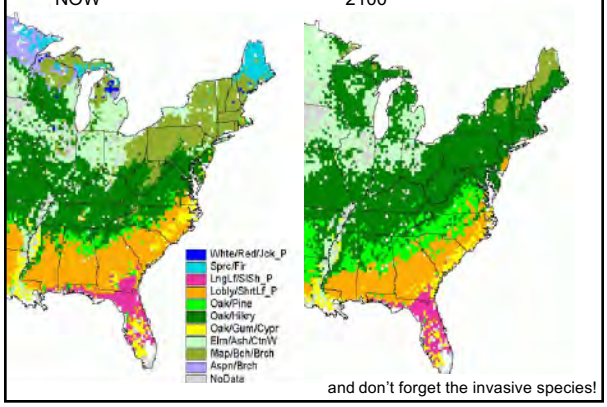
Forest Composition will change under BAU

NOW 2100



and don't forget the invasive species!

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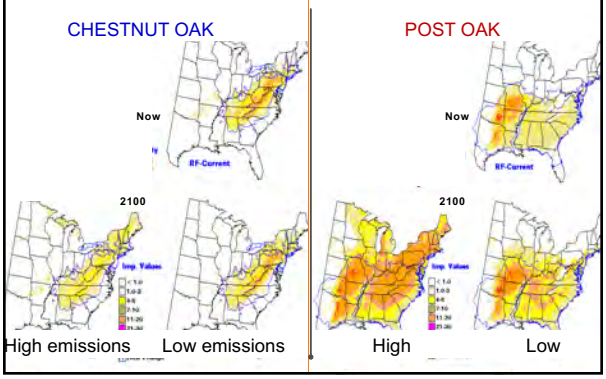
Climate Change Tree Atlas

some species will leave, others will come in



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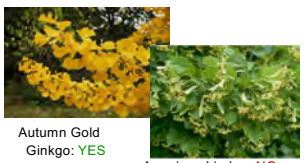
Chicago Botanical Garden

Which tree species will survive in Chicago under climate change?

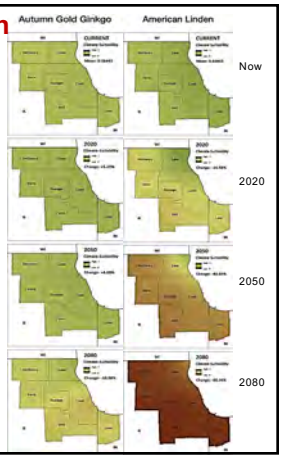
-20% of species in study won't survive expected 2050 conditions

- 80% gone in 2080



Autumn Gold Ginkgo: YES

American Linden: NO



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Climate Action: Carbon sequestration at home

- Plant as many trees as possible
- Emphasize perennial herbaceous plants
- Avoid species already at southern end of range

QUICK TIPS FOR MAXIMIZING CARBON STORAGE IN YOUR PLANTS

The following tips for increasing carbon sequestration in your garden using vegetation are derived from design and management guidelines developed by the U.S. Forest Service's Center for Urban Forest Research, as well as other sources.

- Plant more trees and shrubs where feasible.
- Choose large (at maturity), long-lived species with dense wood.
- Extend the life of your plants (and thus the duration of carbon storage) by growing regionally hardy and site-appropriate species and practicing sustainable plant care.
- Grow tough, adaptable native plants.
- Avoid high-maintenance or disease-susceptible species.
- Plant a diverse mix of trees, shrubs, and perennials (biodiverse gardens are healthier and more resilient).
- Provide your trees and shrubs with enough room (above- and below-ground) to grow to full maturity.
- Grow a mix of species of different ages and sizes to ensure a continuous canopy and understory over time.
- Replace any trees and shrubs removed due to old age, wind damage, or disease.
- Don't forget to mulch!

The Climate-Conscious Gardener, 2010

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Thank you!

Email me anytime with questions:

Dr. Sara Via
Professor &
Climate Extension Specialist
svia@umd.edu

Chat Transcript Climate Change and Native Plants Webinar with Dr. Sara Via

12:06:18 From Jean Margaret Burchfield : Welcome to all those who have just joined in! This webinar will be recorded. Please turn off your videos and mics. The recording and resources will be sent to your email once the recording has processed. You will also find the recording on the HGIC YouTube channel! Thank you for coming and feel free to ask any questions in the chat box as we go.
12:18:12 From Alison Milligan : What species are most vulnerable to extinction, pollination degradation?
12:25:51 From Grace Fisher : That increase in number of frost free days is compared to 1901-1960. How does the mini-ice age of the early 1900's affect that?
12:33:14 From Jeremiah Mowen : I've seen it. "Back in the day" my hydrangea would die back and go dormant in the late fall. Now it usually tries to put out leaves at least twice (sometimes) three times in the winter before it is supposed to. They always freeze and die and I am sure it stresses the plant and makes it more difficult for it when it is actually time for it to grow.
12:39:53 From Fawn Palmer : Are certain native genera better able to adapt to this shift in flowering time?
12:40:47 From aimee freeman : Why don't invasive plants suffer the same decline as early blooming natives (rocky mtn data)
12:43:17 From Fawn Palmer : that mini ice age was in the seventeenth century until mid nineteenth century
12:43:34 From Jean Margaret Burchfield : I found this on Google about the "Little Ice Age": The Little Ice Age is a period between about 1300 and 1870 during which Europe and North America were subjected to much colder winters than during the 20th century.
12:44:06 From Anne Hilliard : as the climate warms can sheltering plants help them survive?
12:44:35 From Fawn Palmer : Oh, good correction, so fourteenth century until 3/4 through nineteenth century.
12:45:24 From Jean Margaret Burchfield : We'll be on break until 12:50pm!
12:47:20 From Grace Fisher : I just remember my geology teacher casually mentioning a mini ice age in the 20's or 30's
12:48:07 From Cristina Niciporciukas : there is a global effort to increase tree planting. has any research done regarding how beneficial this is towards preserving the current ecosystem?
12:48:27 From Anne Hilliard : Should individuals monitor their plant bloom times? Is there a citizen science project for this?
12:48:56 From Sara Via : Anne, Yes, sheltering natives from baking heat can be helpful. One way to do this is to move them away from large rocks that absorb heat. Or you can plant some shrubs that provide a few hours of shade, etc.
12:49:41 From Sally Matts : The Industrial revolution ties in with the increase of human population. How could we possibly go back to lower temperatures with greater number of people on earth?

12:50:07 From Fawn Palmer : Are botanists/horticulturalists looking at native species south of the state border that will become naturalized soon? For instance, Red Buckeye, Aesculus pavia, is native to VA, but not Md. Red Buckeye is a hummingbird pollinated understory, spring bloomer. And recommended for rain gardens. Could it be considered for a Md. rain garden that must be planted with natives?
12:50:39 From Stephanie Ann Pully : Anne, here is the information for Project Budburst to monitor plant phenology: https://budburst.org
12:50:55 From Sara Via : Anne, There is a citizen science project from the National Phenology Network where you can buy cloned lilacs or dogwoods (i.e., same genotype), and follow their flowering.
12:50:59 From Barbara Hopkins : Will the chat q&a be part of the handout we get later?
12:53:10 From Jean Margaret Burchfield : Deer resistant native plants HGIC: https://extension.umd.edu/hgic/topics/deer-resistant-native-plants-list
12:54:53 From Jean Margaret Burchfield : Invasive Insects HGIC: https://extension.umd.edu/hgic/topics/invasive-insects
12:59:08 From Barbara Hopkins : Bad problem for grizzly bears in Yellowstone NP.
13:01:44 From aimee freeman : I've been seeing monarch cats late in the season (late oct/early nov)which cannot survive the fall cold temps. Assuming these are the migration generation (or are they producing an extra generation?), can anything be done to help increase monarch population?
13:06:14 From Christina Myles-Tochko : do the fires kill the invasive animals?
13:12:26 From Barbara Hopkins : To clarify, it's the Mountain Pine Beetle that is a problem for grizzly bears in Yellowstone.
13:16:05 From Barbara Hopkins : Looks like we will also lose a lot of autumn color.
13:20:12 From Alison Milligan : Don't interpolate from this that you should be planting Ginkgo (a non-native plant).
13:20:37 From Alison Milligan : No significant beneficial value to native fauna/insects
13:21:42 From Alison Milligan : :)
13:22:23 From Barbara Hopkins : But it does seem like we shouldn't plant maple if we want the tree to last 50-100 years.
13:23:11 From Alison Milligan : The WSA has a program they just announced for AA County
13:23:14 From Alison Milligan : http://aawsa.org/groves-of-gratitude Native maples can still be planted.
13:24:10 From Jean Margaret Burchfield : HGIC Climate Change Gardening https://extension.umd.edu/hgic/topics/adapting-your-garden-impacts-climate-change
13:26:19 From Fawn Palmer : how far south should a southern ecotype be chosen?
13:27:11 From Alison Milligan : Use the US Fish and Wildlife Service 'Conservation Landscaping Guide' and avoid plants that grow in the Mountain physiographic region if you don't live in that region
13:28:20 From Alison Milligan : Plant Asclepias tuberosa - a more drought-tolerant host plant
13:28:32 From Alison Milligan : Butterflyweed!

13:29:25 From Fawn Palmer : I using USDA PlantsDatabase which show which states a certain species is native to. I was thinking about adding in Virginia native species that may not be in Md yet.
13:29:35 From Barbara Hopkins : If their migration clue is day length, it seems like when the days grow shorter they would leave, even if they left another generation behind. Just a guess.
13:30:09 From Patricia Kenny : Contact Monarch Watch! - some people bring monarchs in to porch or a enclosure to progress.
13:30:27 From Wendy Hall : I worry that Temps are getting warmer but also more variable. Planting more southern trees may expose them to cold snaps. thoughts?
13:30:30 From Alison Milligan : Birds flying out of the fires are falling out of the sky in NM because their lungs are full of smoke. Horribly sad.
13:30:38 From Fawn Palmer : the last generation of Monarchs here does not mature sexually. So they do not lay eggs.
13:32:03 From Jean Margaret Burchfield : Did we respond to this one?: there is a global effort to increase tree planting. has any research done regarding how beneficial this is towards preserving the current ecosystem?
13:32:26 From Alison Milligan : Totally agree with Sarah - don't bring southern species into Maryland. Watch the hardiness zone maps.
13:32:47 From Patricia Kenny : They release themselves...
13:33:00 From Fawn Palmer : from the range shifts, it looks like the coastal plain area native species are the ones that move north more.
13:33:40 From Alison Milligan : Change energy policy to really impact climate change
13:34:32 From Jean Margaret Burchfield : En- Roads
https://www.climateinteractive.org/tools/en-roads/
13:34:39 From Alison Milligan : Thank You!
13:34:50 From Grace Fisher : thanks Jean!
13:35:04 From Jean Margaret Burchfield : :)
13:35:12 From Fawn Palmer : The native plants that shift range do it. We are not going to be able put up a state border crossing and prevent them.
13:35:27 From Dolores Ciufo : Great presentation!
13:35:36 From aimee freeman : Thank you Sara!
13:35:38 From Barbara Hopkins : Very informative, thanks
13:35:43 From Janet McGrane : thank you
13:35:44 From Fawn Palmer : Thank yoy Dr. Sara Via and Jean and Sarah.
13:35:46 From Virginia Klocko : Thank you so much for such a great presentation!!!!
13:35:47 From Jean Margaret Burchfield : Yes, email to come with links and resources!
13:36:06 From Alison Milligan : US Fish and Wildlife Guide All MG's get one
13:36:10 From Fawn Palmer : Excellent presentation.
13:36:12 From Christina Pensinger : Thanks everyone!!!

Resources

Native plants in a changing climate—how to conserve them. See a large array of excellent resources at the Native Plant Trust: https://www.nativeplanttrust.org/conservation/adapting-to-climate-change/

California wildfires linked to climate change:
https://www.nytimes.com/article/why-does-california-have-wildfires.html

Climate change and Northeast forests: Interesting article in the Oct. 7 New York Times:
https://www.nytimes.com/2020/10/07/climate/new-england-trees-forests.html