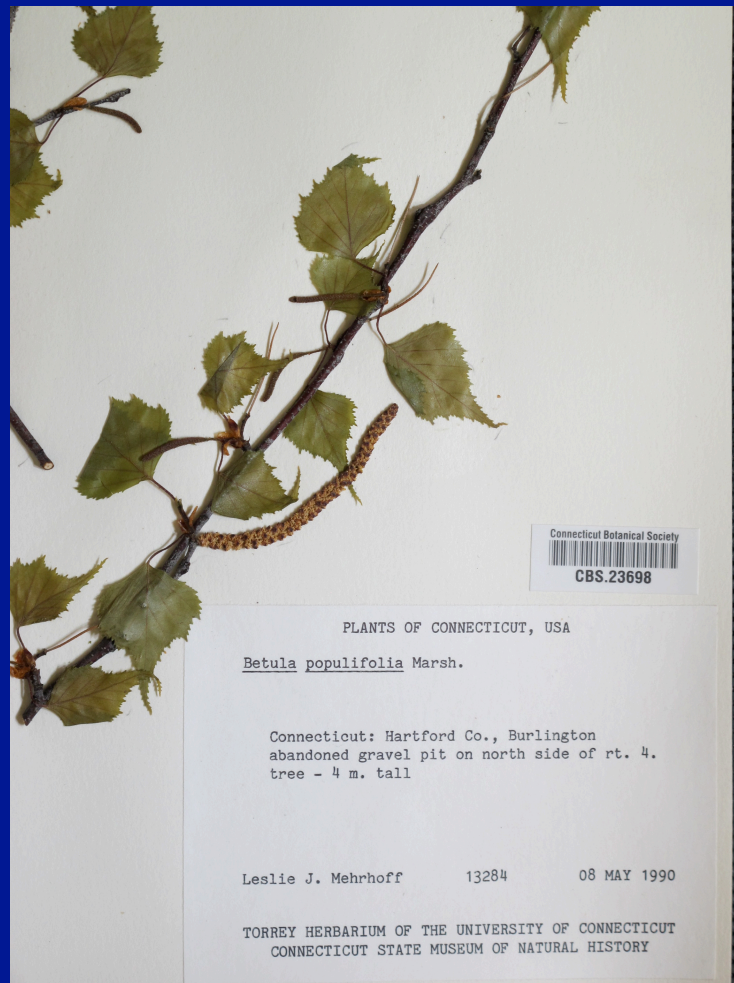


Using natural history collections for climate change research



Richard B. Primack and
many others

White birch

Are there historical records that can be used in climate change research?

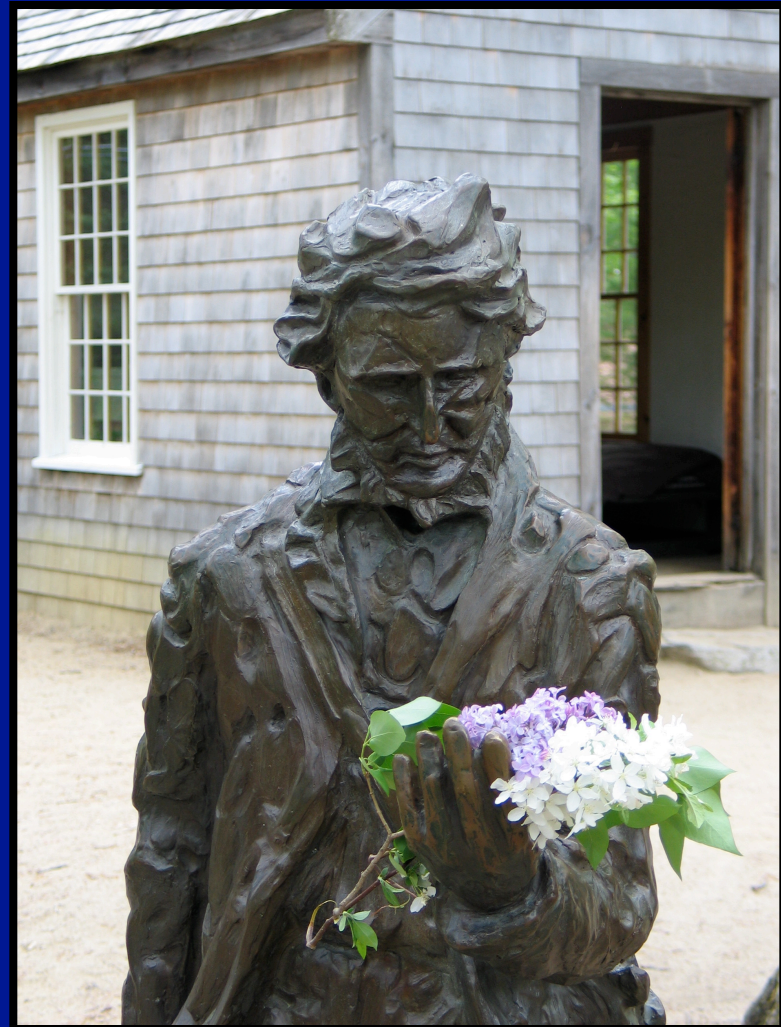
The challenge is to:

Find them,

Digitize them

Make them available

One obvious source:
Journals of naturalists

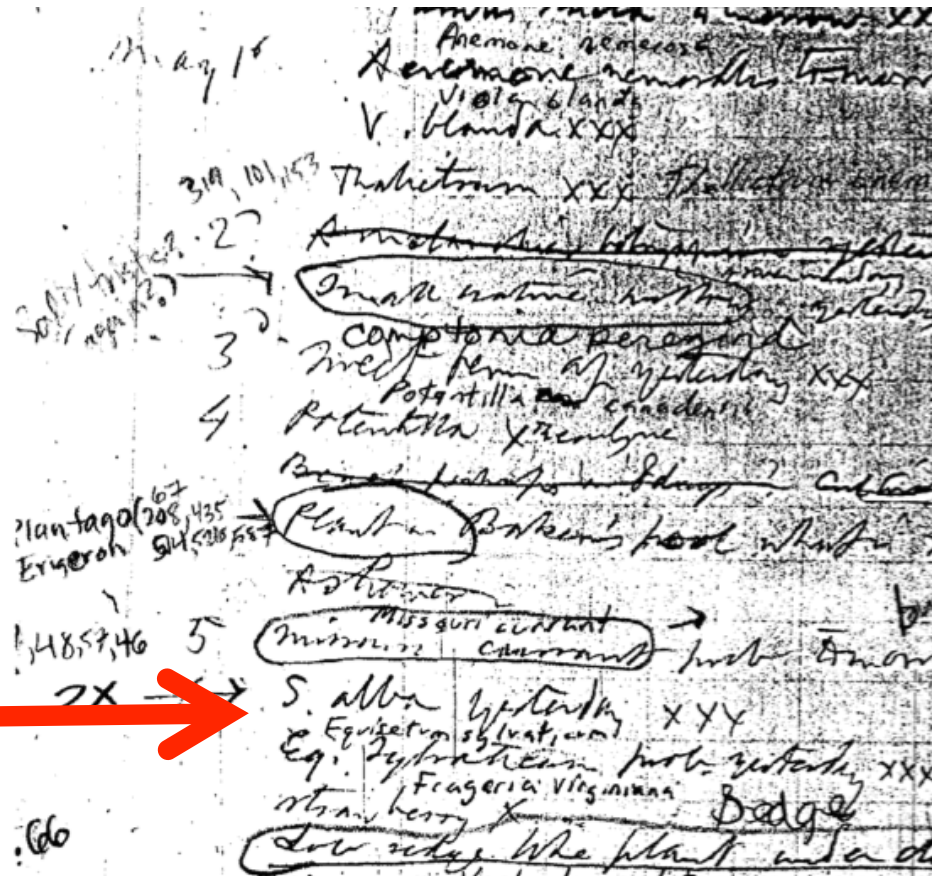


Thoreau's Journals

May 1st 1855



(meadowsweet;
Spiraea alba)



"One has as much as he can do to observe how flowers successively unfold" (June 15, 1852, Journal)



Museums have a wealth of herbarium specimens! They can be used in climate change research.



Primack et al. 2012; Miller-Rushing et al. 2009.

Photographs



20 June 1926



American Fringe Tree
Chionanthus virginicus

7 May 2003

Photographs from Lowell Cemetery



30 May 1868

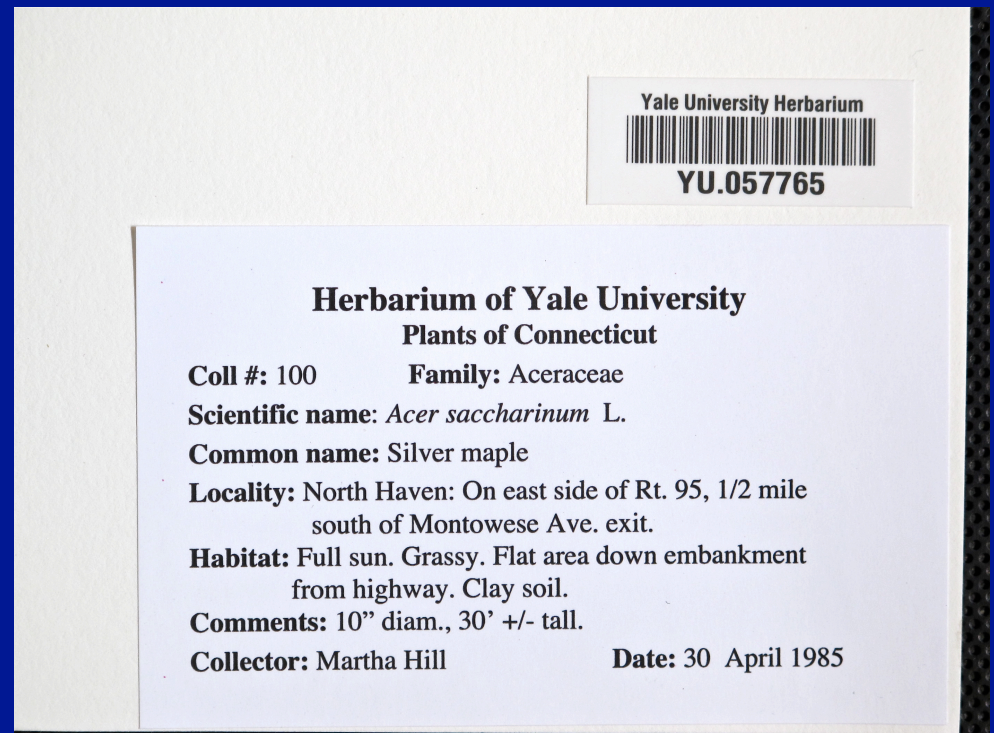
Abbott brothers



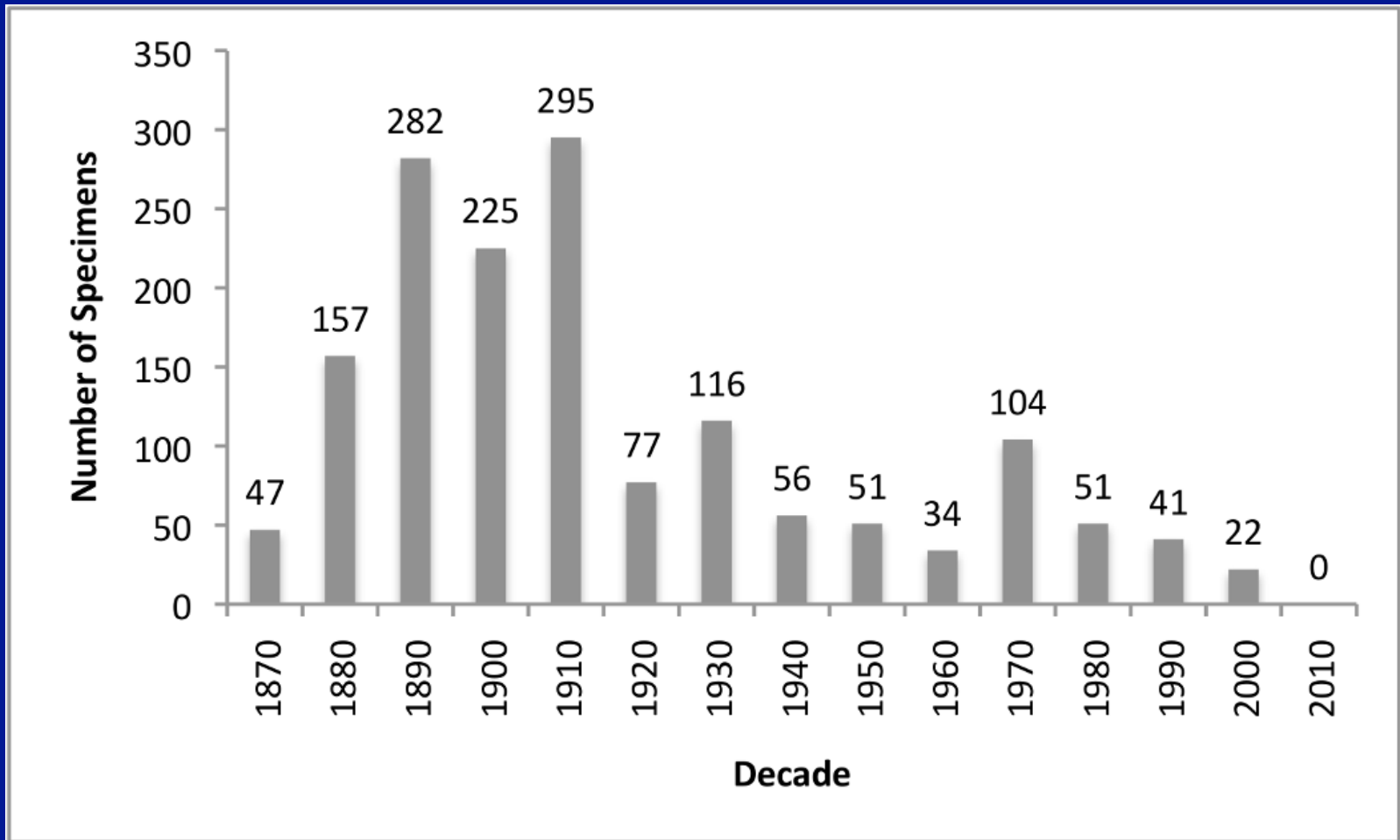
22 May 2010

Miller-Rushing et al. 2006

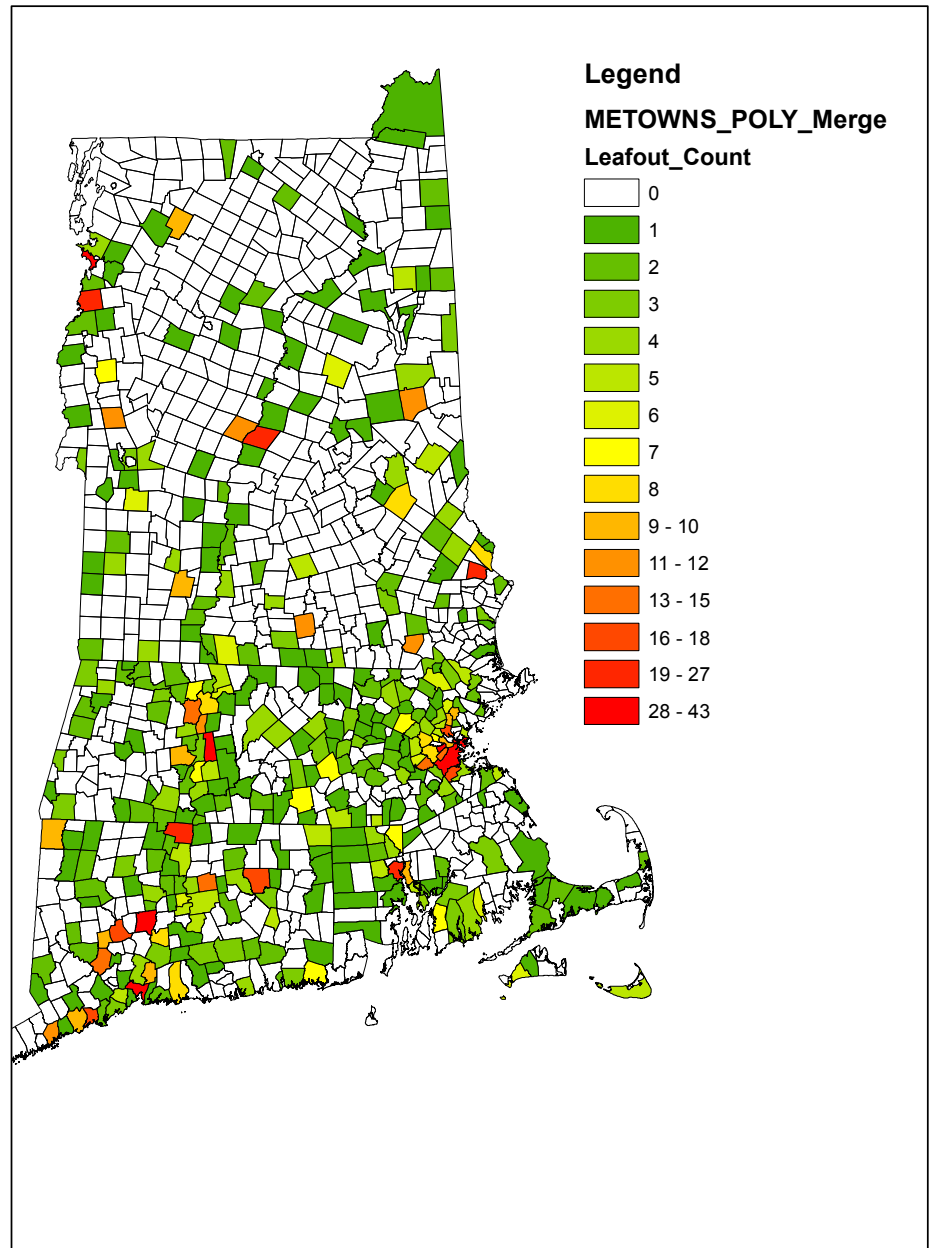
New focus on leafing out; Combining herbarium specimens and remote sensing



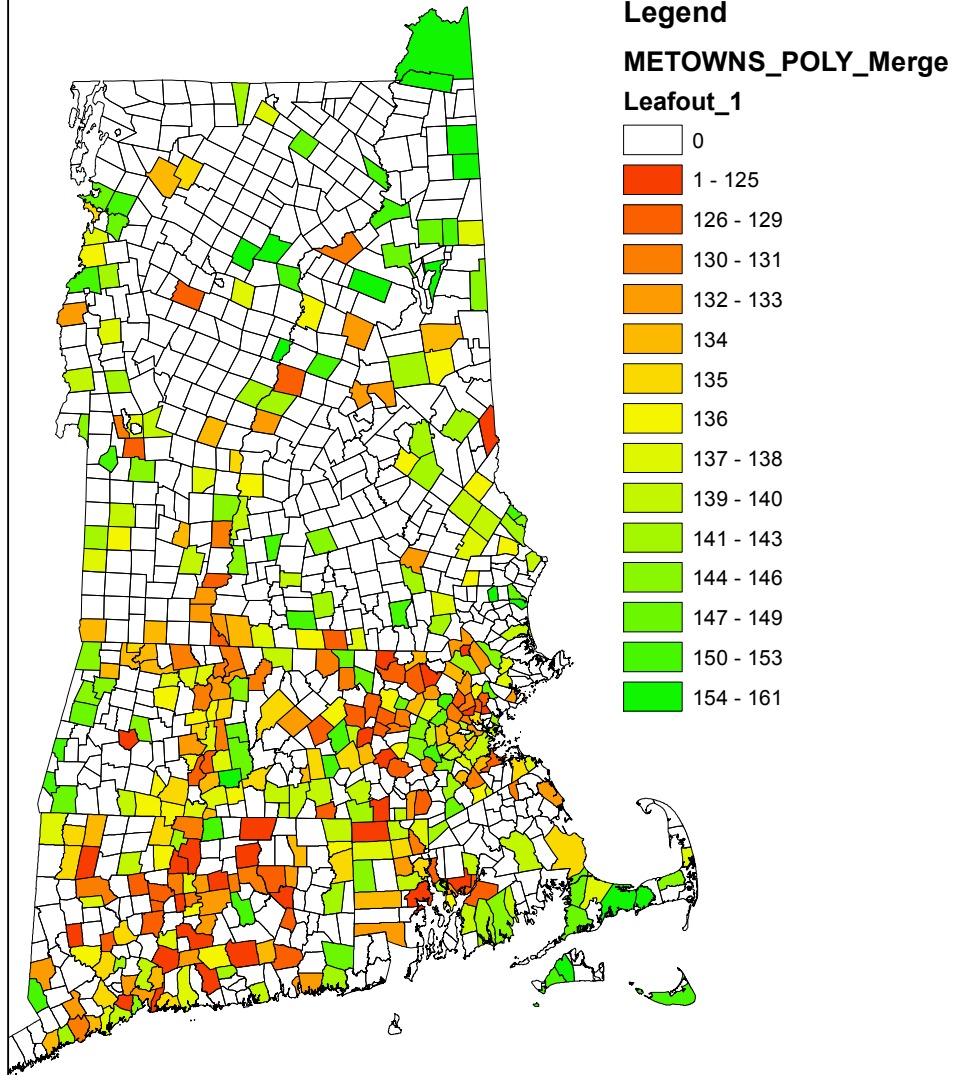
There is a abundant data for tree leafing out!



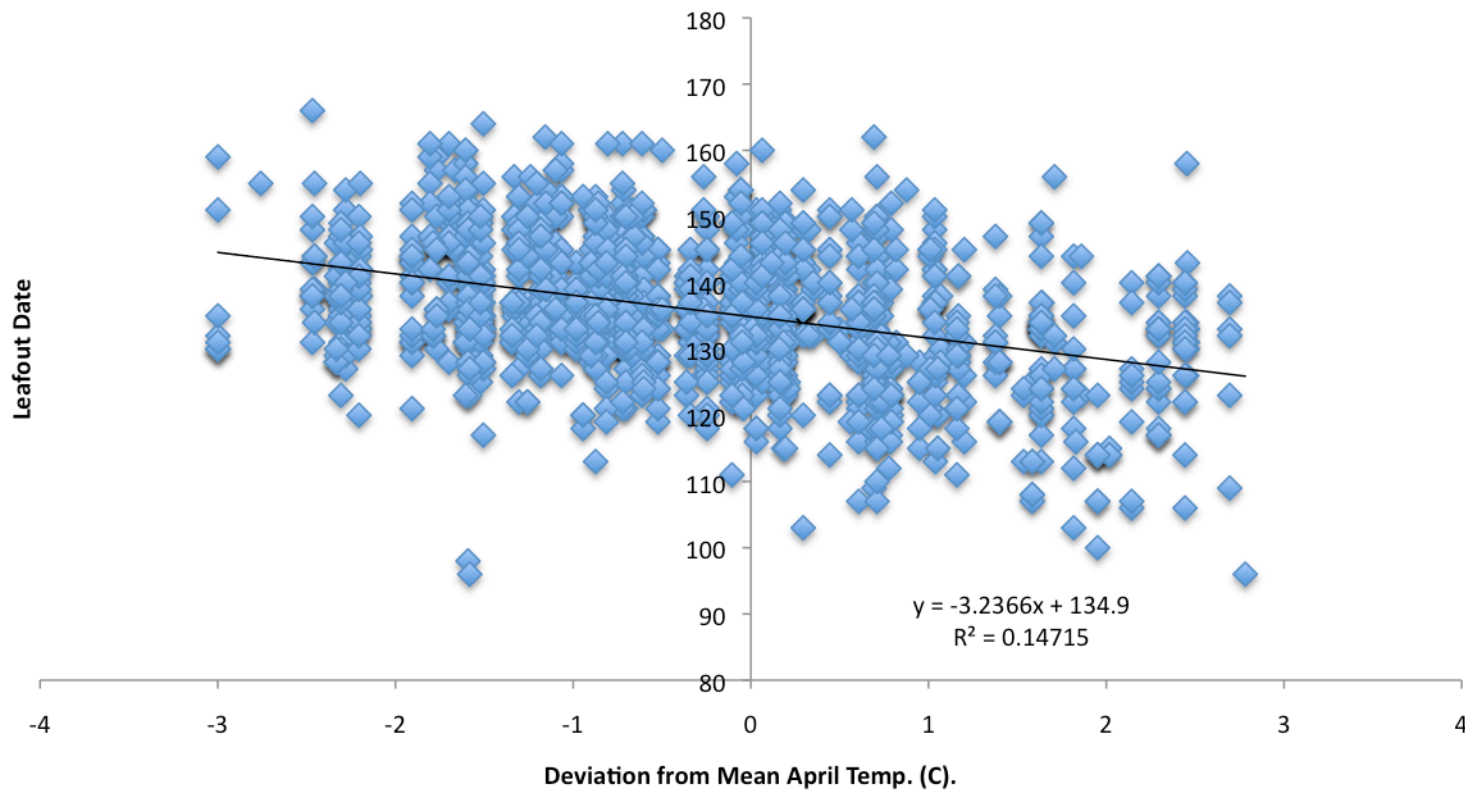
Distribution of leaf out specimens



Leaf out dates



Uncorrected Leafout vs. mean April Dev.



New Directions:
Combining herbarium
specimens, remote sensing,
and citizen science

**NELOP: New England Leaf
Out Project**

**National Phenology Network
Project Budburst
Field Station Concordia**



Populus grandidentata
Big-toothed aspen

New direction: Crowd-sourcing phenology data; linking with computer science and society

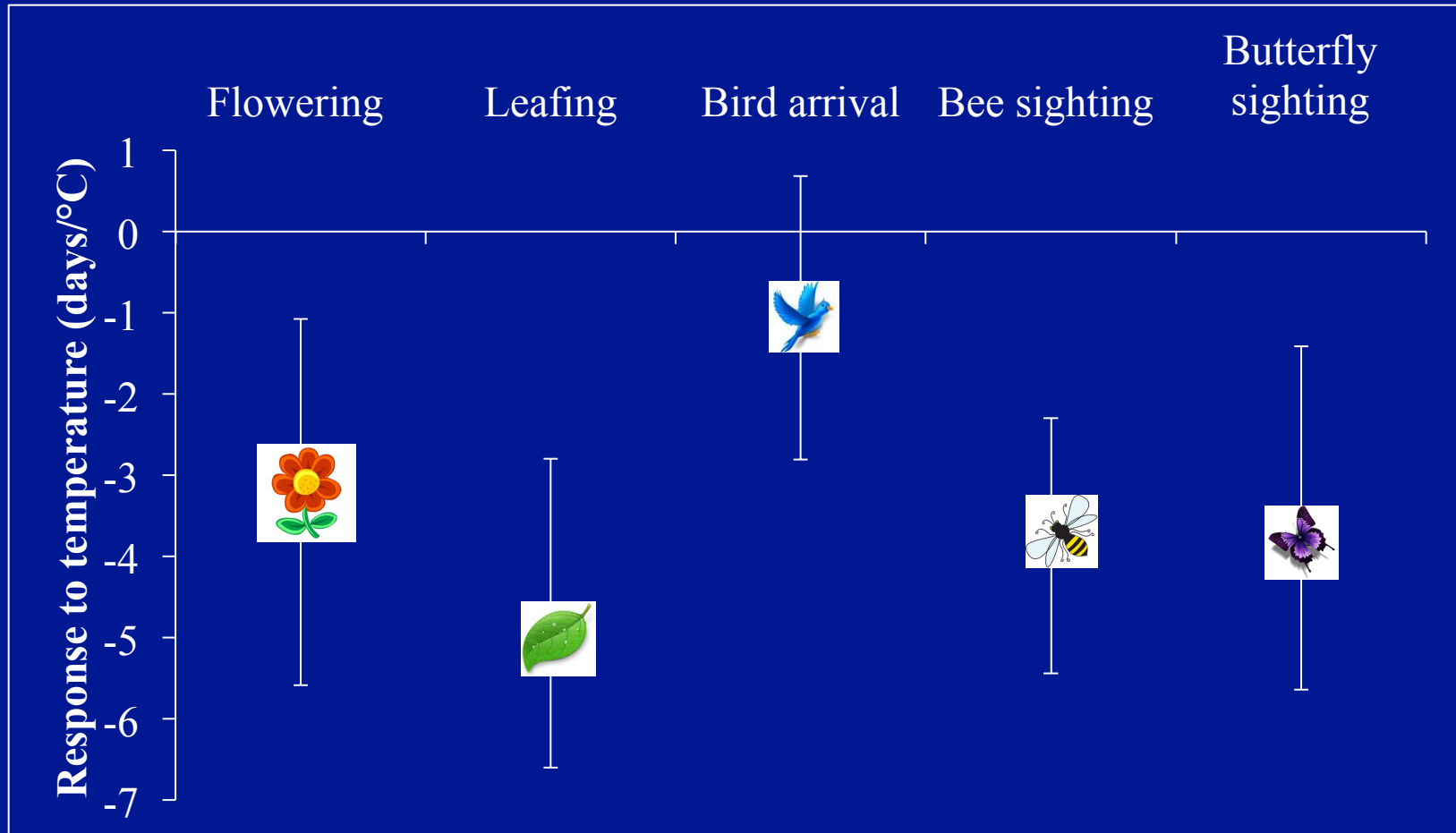


Populus tremuloides



P. grandidentata

Combining data from multiple sources



From Polgar et al. 2013.

What does it all mean?



Pinus strobiformis

- Historical records, herbarium specimens, photos, modern observations and remote sensing can be combined to detect the past effects of climate change, and predict future response.
- Time-sensitive events, such as flowering and leafing out times, are changing. Plants and animals may be affected differently.
- The use of museum specimens in climate change research is still in an early stage of development.

A close-up photograph of a vibrant red cardinal perched on the edge of a piece of graph paper. The cardinal's beak is pointed downwards, resting on the paper. A white rectangular note is stuck to the paper, tilted slightly. The note contains the text 'Thank you for your attention!'. The background is blurred, showing what appears to be a person's head and shoulders. The entire image is set against a solid blue background.

Thank you
for your
attention!

And thanks to
all my
collaborators,
participating
institutions, and
funding
sources