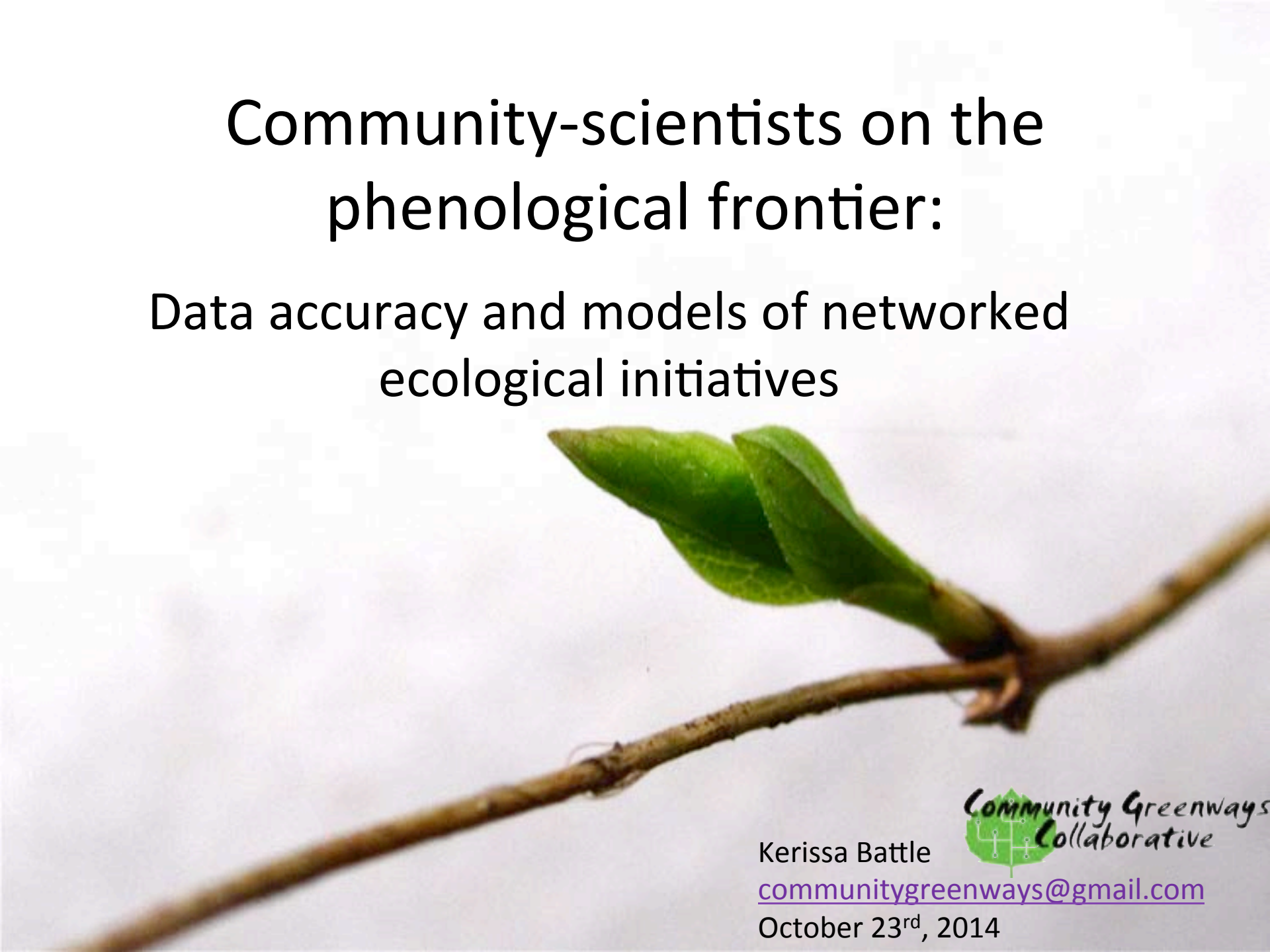
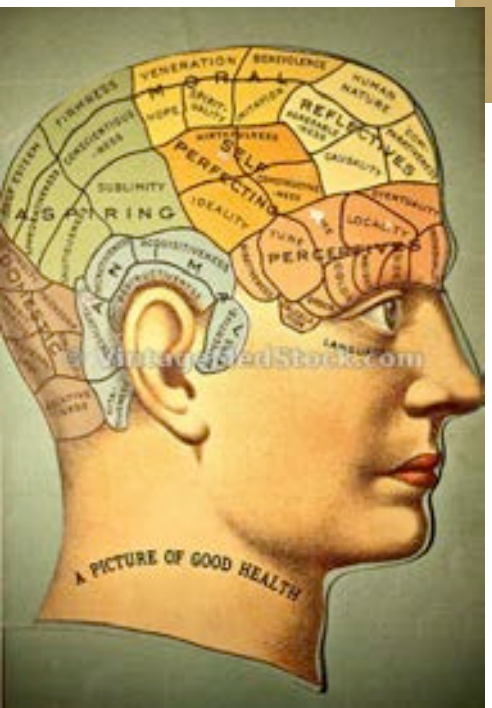
Community-scientists on the phenological frontier:

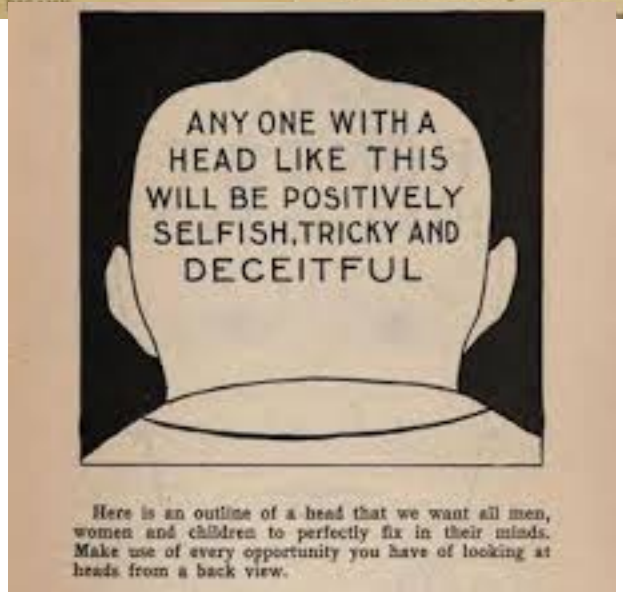
Data accuracy and models of networked ecological initiatives

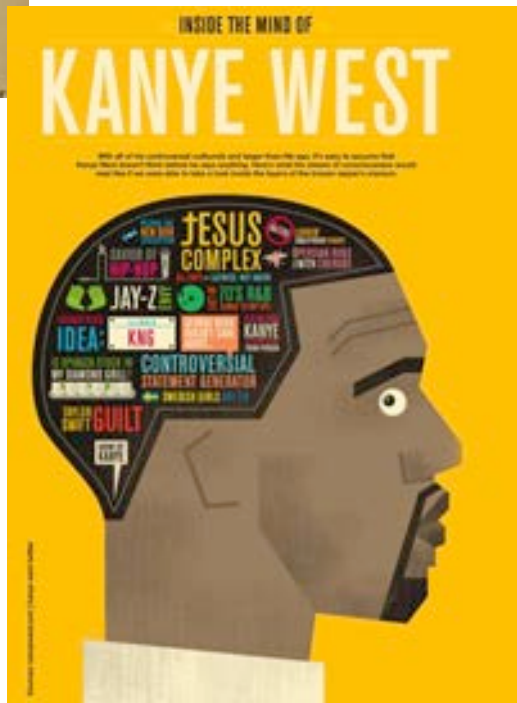


Kerissa Battle
communitygreenways@gmail.com
October 23rd, 2014

What Phenology Isn't.

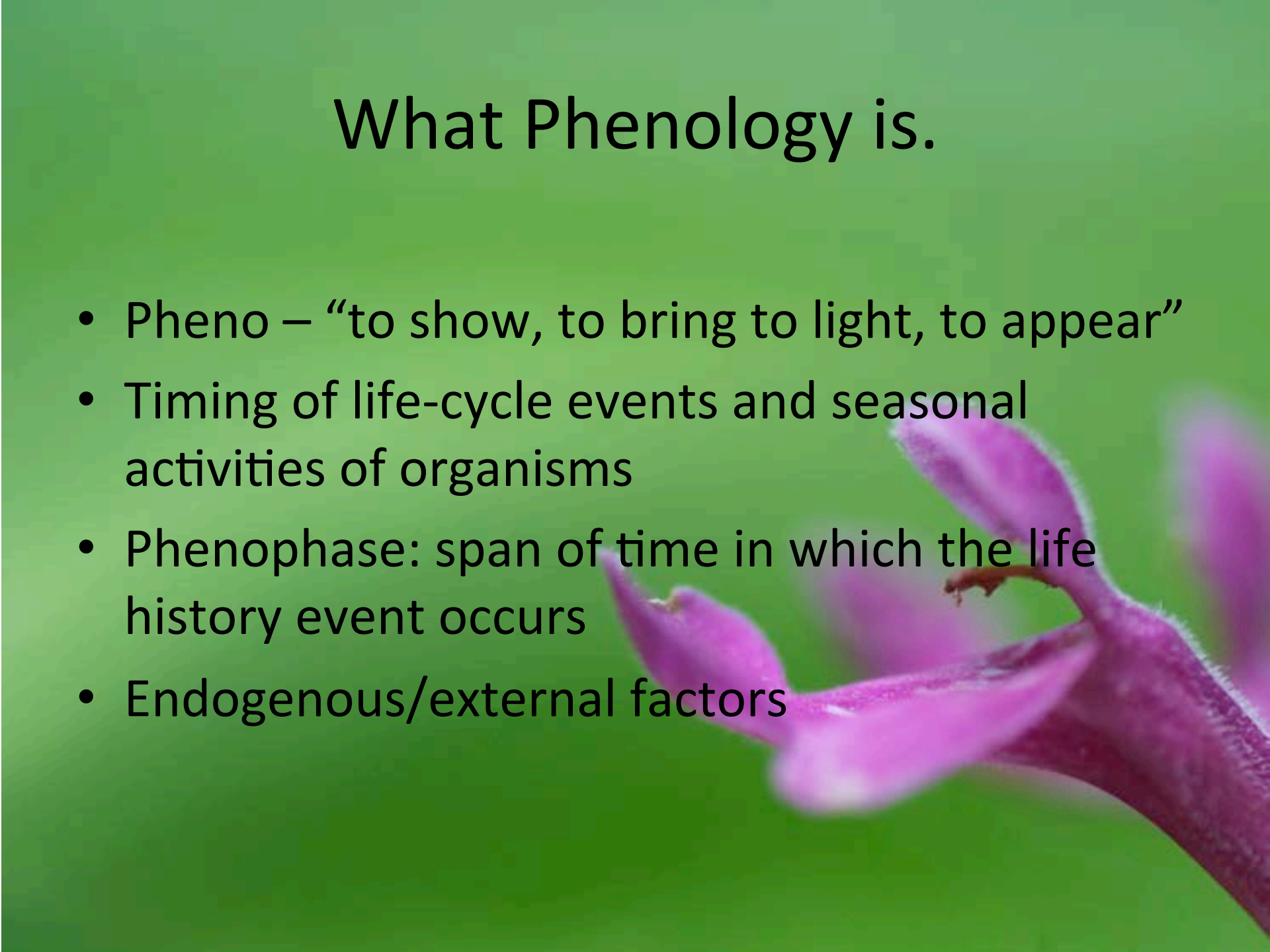






What Phenology is.

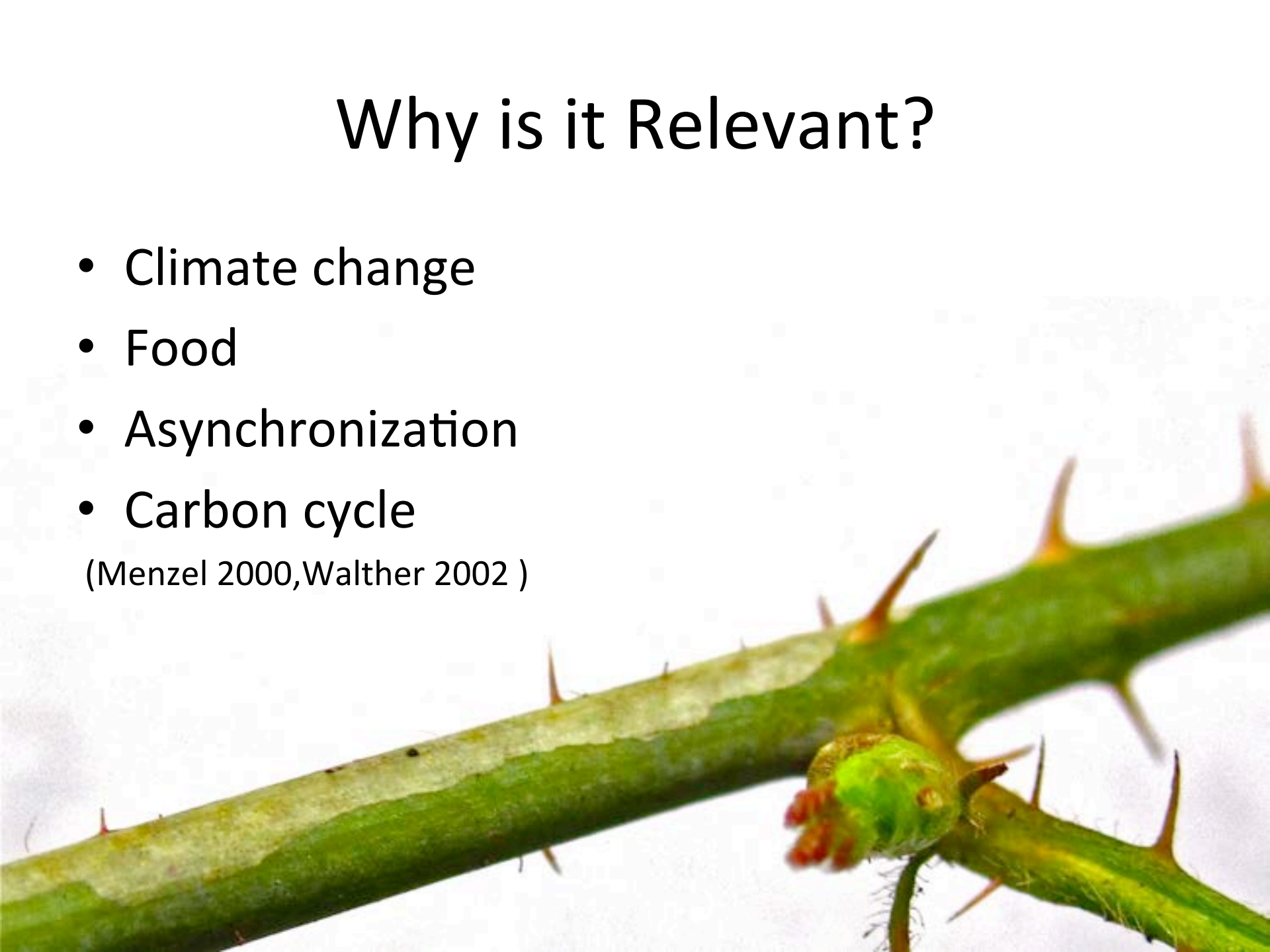
- Pheno – “to show, to bring to light, to appear”
- Timing of life-cycle events and seasonal activities of organisms
- Phenophase: span of time in which the life history event occurs
- Endogenous/external factors



Why is it Relevant?

- Climate change
- Food
- Asynchronization
- Carbon cycle

(Menzel 2000,Walther 2002)



Evidence of Changes

- Leafing/flowering advancing 2 days per decade last 30-50 yrs (Walther 2002, Menzel 2006, Cleland 2007)
- 78% of all records advancing (Menzel 2006)
- Range Shifts 6.1 km per decade (Parmasean & Yohimbe 2003)

- Increased temperature , Shifting precipitation patterns, Elevated CO^2 , Urban Heat Island Effect (Shwartz 2006)

Asynchrony in species interactions

English Oak

EARLIER

Winter Moth

EARLIER

Pied Flycatcher

SAME TIME EACH YEAR

Phenology and Climate Change

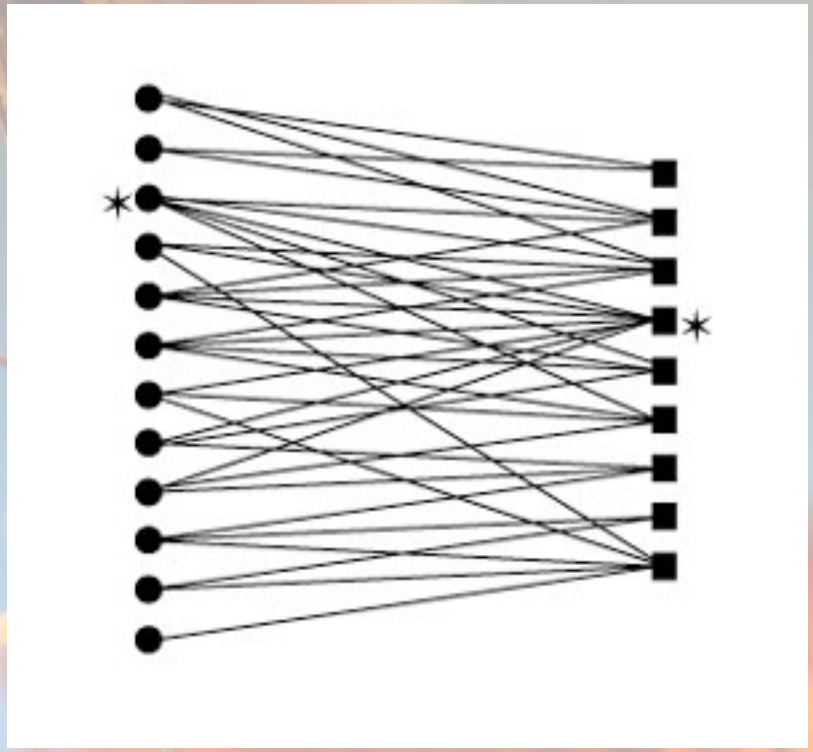
Research, spring timing and range

A three-way mismatch

Both et al. 2006 Nature

Are plants/pollinators tracking each other?

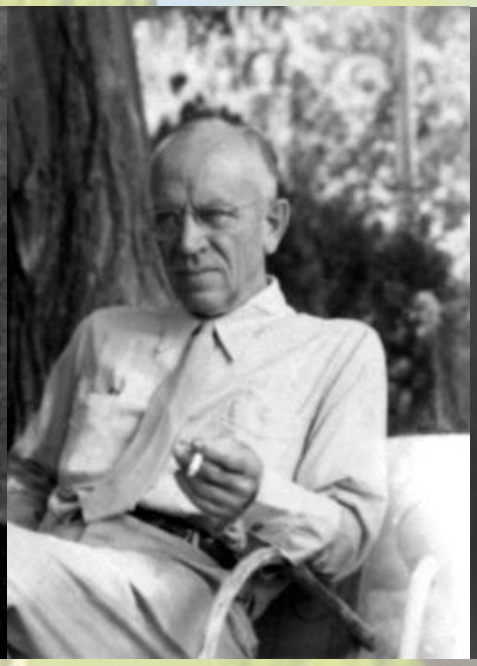
- facultative/ obligate
- The effects on pollinators likely more severe
- Evidence in both directions Gordo & Sanz (2005), Kudo et al. (2004), Memmott et al. (2007), Fortuna & Bascompte (2006)



Lack of empirical studies – need community scientists!

Historic Phenological Records

Henry David Thoreau



Aldo Leopold

John Burroughs

Daniel Smiley

Old Records: Amateurs? Professionals?
Observations amenable to community science – networks….But…..is it valid?

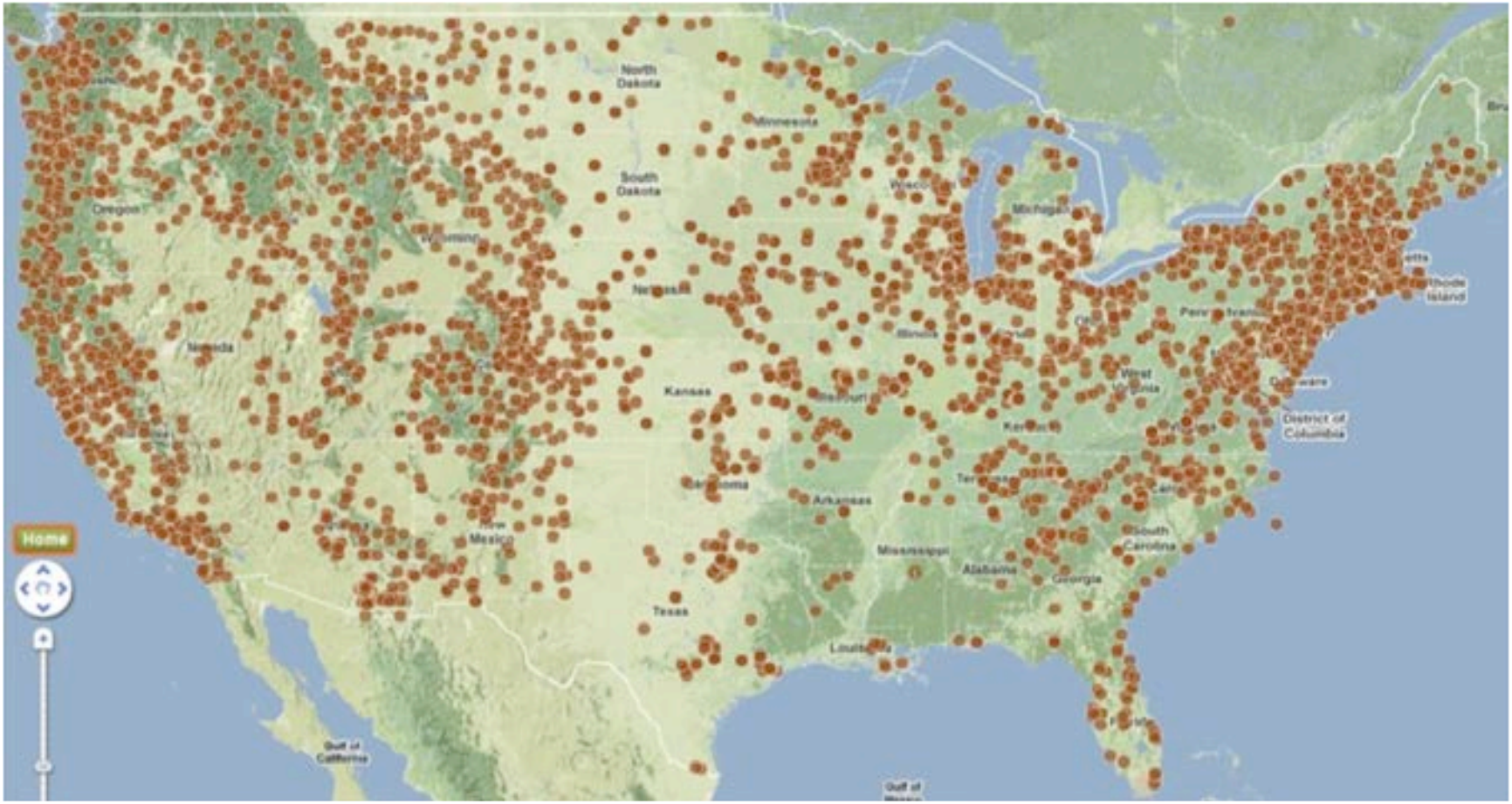
Interpreted Results

- Used protocols established by USA-NPN
- 28 volunteers, 14,000 observations, 16 weeks

- Accuracy 91% overall, 70% transitional
- Less experienced observers same
- Species and phenophases varied
- NPN refined protocol as a result

- *Fuccillo K.K., Crimmins, T. M., deRivera, C. E., and Elder, T. S., "Assessing accuracy in citizen science-based plant phenology monitoring", International Journal of Biometeorology, 2014.*

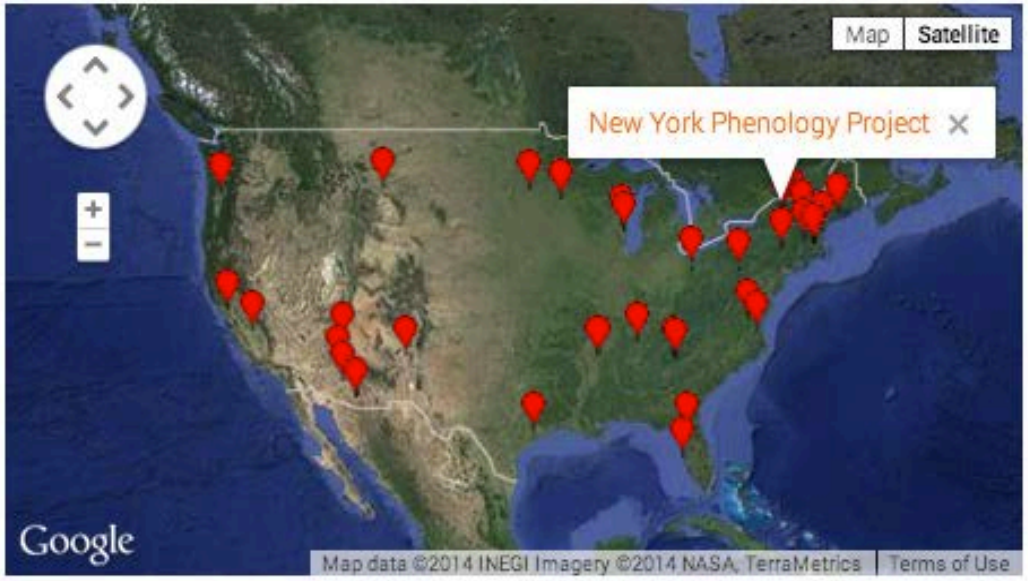
Citizen Scientists Using USA-NPN



Geographic Affiliates of NPN

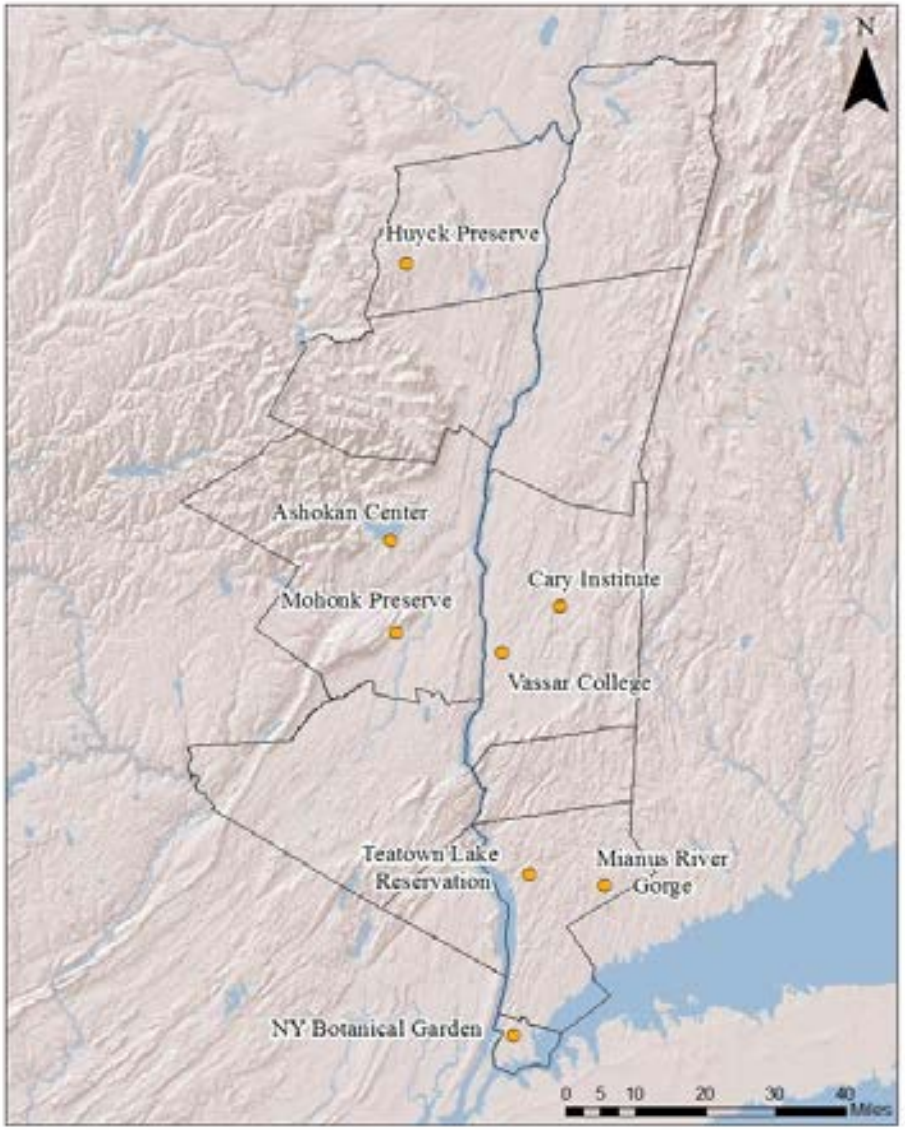
Connect Regionally

View | Edit



Learn who's using *Nature's Notebook* in your area! The map above depicts

The New York Phenology Project



- *NYBG, Mohonk Preserve, Cary Institute, Vassar College, Tea Town Preserve, Mianus River Preserve, Huyck Preserve, Gateway National Recreation Area, Westchester County Parks (Ward Pound Ridge), Community Greenways Collaborative, Gateway National Recreation Area*
- *EMMA (Environmental Monitoring and Management Alliance)*

- Tagged plants along a "phenology trail" Pollinator component (phase 2)
- Common species list along a latitudinal and urbanization gradient

- Bioregional resource http://www.nyphenologyproject.org

THE NEW YORK PHENOLOGY PROJECT

Community Greenways Collaborative

USA npn National Phenology Network

Organization name

Organization Logo

Common name: Common Milkweed **Genus Species: *Asclepias syriaca***

Photo credit: Hallie Schwab, mohonkpreserve.org

Description: Common milkweed is a perennial herbaceous plant growing 1.9 to 6.5 feet tall. Its small, green to purple flowers have both male and female parts. Flowers are grouped into showy clusters.

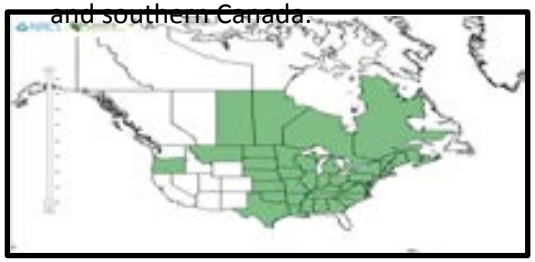
Habitats: Common milkweed is found along banks and flood plains of lakes, ponds, and waterways, and in prairies, forest margins, roadsides, and waste places.

Phenology highlights: Common milkweed is used by many insects including butterflies and bees, and the alert observer may see pollinators, eggs, or caterpillars on milkweed.

Species facts

- Milkweed pollinators include monarchs, other butterflies, bees, and other beneficial insects.
- Milkweed is required for monarch reproduction. The female butterfly must lay her eggs on milkweed since that is the only food the caterpillars can eat.
- Compounds in milkweed sap make the flesh of caterpillars feeding on the plants distasteful to most predators.
- People have used milkweed for fiber, food, and medicine across the U. S. and southern Canada.

Photo credit: Kerissa Battle, communitygreenways.org



Map credit: USDA, NRCS. 2014. The PLANTS Database (http://plants.usda.gov, 22 August 2014).

Why observe this species? Common milkweed has been selected for monitoring by a Nature's Notebook partner, Monarch Watch, because monarch butterflies require milkweeds for their survival. Monarch populations have declined over 90% since the 1990's.

Tip for observing this species: For common milkweed, be sure to wait until the fruits split open to expose the seeds before recording 'yes' for the "ripe fruits" phenophase.

For more information about phenology and the New York Phenology Project (NYPP), please visit the NYPP website (www.nyphenology.org) and the USA-NPN website (www.usanpn.org)

THE NEW YORK PHENOLOGY PROJECT

Community Greenways Collaborative

USA npn National Phenology Network

Common Milkweed (*Asclepias syriaca*)

***Note**: flower and fruit phenophases are nested so you may need to record more than one phenophase for each; for example, if you record **Y** for "open flowers" you should also record **Y** for "flowers or flower buds."*

Initial growth New growth is visible after a period of no growth (winter or drought) as new shoots or seedlings break through the soil surface. Growth is "initial" until the first leaf has fully unfolded.

Leaves One or more live fully unfolded leaves are visible. Count only true leaves and not the small leaves (cotyledons) found on the stem right after a seedling germinates. Do not include fully dried or dead leaves.

Flowers or flower buds One or more fresh open or unopened flowers or flower buds are visible. Include developing flower buds but do not include wilted or dried flowers.

Open flowers One or more open fresh flowers are visible. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible. Do not include wilted or dried flowers.

Fruits One or more fruits (pods) are visible on the plant. Common milkweed fruit is large and pod-like. Unripe fruits are green. Do not include empty fruits that have already dropped all of their seeds.

Ripe fruits One or more ripe fruits are visible on the plant. For common milkweed, a fruit is ripe when it has turned tan or brown and has split open to expose seeds with fluff. Do not include empty fruits.

Recent fruit or seed drop One or more mature fruits or seeds have dropped, blown away, or been removed since your last visit. Do not include empty fruits that had long ago lost all of their seeds.

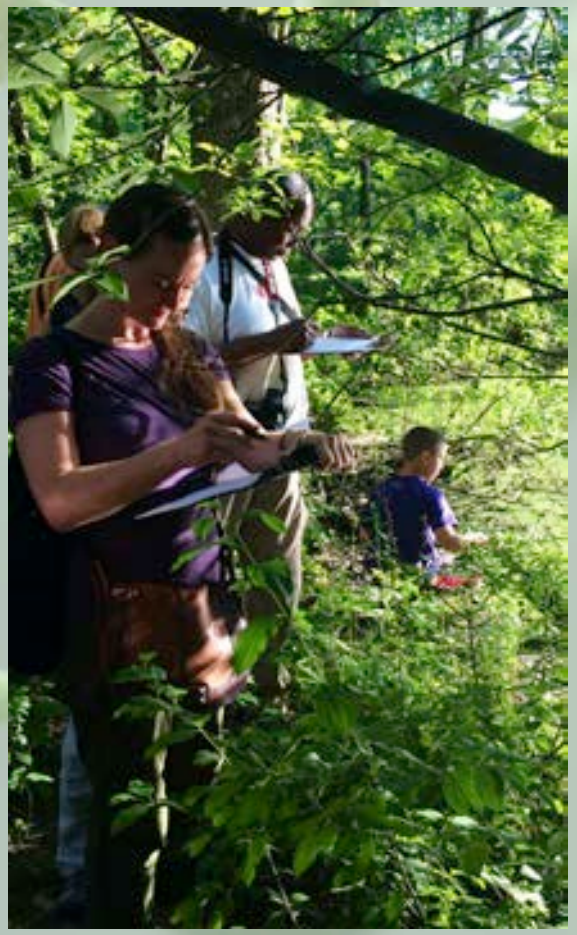
Monarchs and Milkweeds The loss of milkweed from natural and agricultural areas is one of the primary threats to monarchs. Milkweed is the only food that monarch caterpillars eat and a major nectar source for adults.

All phenophases are pictured here.

Version 1 September 2014

What makes a good phenology network site?

- A site people are drawn to
- Staff dedicated to monitoring and developing resources around the program (monitor 2X week)
- Staff with interpretive skills/ educational staff
- Organization committed to civic ecology, restoration, connectivity and education



Community scientists at Mohonk collecting data

What else has to happen for network success?

- Volunteer program with trainings, potlucks, organized listserve to engage constituents
- Leaders as learners and part of a network themselves (EMMA, LPL listserv)
- Institution dedicated to staff/volunteer professional growth
- Participants know they are part of larger initiative – feel valued, empowered to contribute to development

Why do orgs particpate?

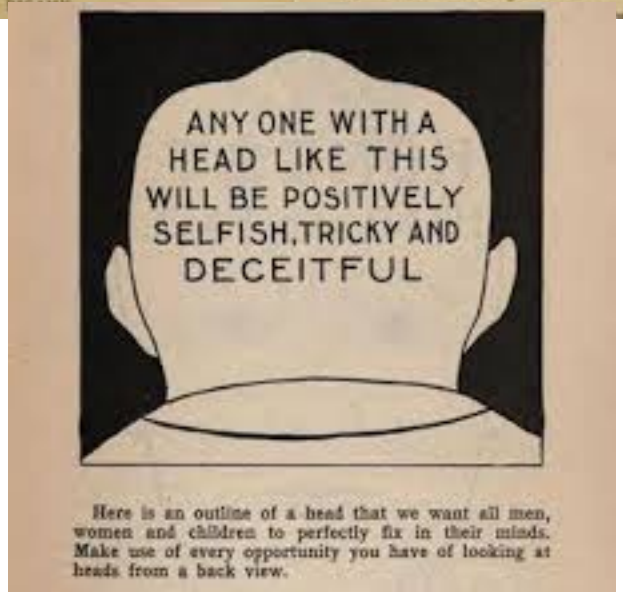
- Establish baseline data
- Digitize records
- Ask regional questions
- Education/teacher training
- Explore different models of successful research and education programs
- Science and climate literacy
- Civic participation

What's the opportunity?

- Connect phenology trails with school gardens, community gardens, other natural resource areas
- Nodes become training and demonstration site for orgs and individuals to establish phenology trails and pollinator gardens – replicable networks.
- Create robust regional dataset on plant/pollinator synchronization
- - Create an ARMY of citizen/community scientists in New York!!
- Build new curriculum and resources (maps, brochures, almanacs etc)
- Experiment with models of participation/network building to contribute to multiple fields

Long Live Phrenology!

$



$

Works Cited

- Luijten, S. H., Dierick, A., Gerard, J. J., Oostermeijer, B. B., Raijmann, L. L., & Den Nijs, H. M. (2000). Population Size, Genetic Variation, and Reproductive Success in a Rapidly Declining, Self-Incompatible Perennial (Arnica montana) in The Netherlands. Conservation Biology, 14(6), 1776-1787
- Memmott, J., P. G. Craze, et al. (2007). "Global warming and the disruption of plant–pollinator interactions." Ecology Letters 10(8): 710-717.
- Menzel, A. 2000. Trend in phenological phases in Europe between 1951 and 1996. International Journal of Biometeorology. 44:76-81
- Menzel A. et. al 2006. European phenological response to climate change matches the warming pattern. Global Change Biology. 12:1969-1976
- National Research Council of the National Academies, 2007.Status of Pollinators in North America. National Academy of Science, Washington, D.C. 303 pp.
- Roux, F. et al. (2006) How to be early flowering: an evolutionary perspective . Trends in Plant Science, Volume 11, Issue 8, 375-381.
- Shwartz, M. Phenology: An integrated environmental science. Tasks for vegetation science -39. Kludwer Academic Publishers, the Netherlands. 2003.
- Walther, G. et al. 2002. Ecological responses to recent climate changes. Nature. 416:389-395