

2017 Phenology Report *Environmental Sentinel*

The Phenology Project of The 606 park and trail system, Chicago, IL Phenology Volunteers document the art and science of a blooming trail

1. Program description

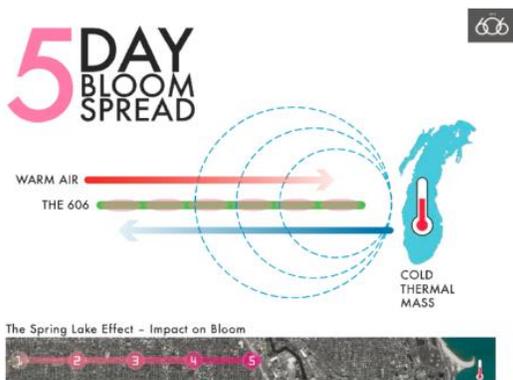
The Trust for Public Land, together with the Chicago Park District, the City of Chicago, and the community, transformed an early 20th century elevated railroad embankment on the city's northwest side into a 2.7-mile long recreation trail for walkers, runners, and cyclists. More than 1.5 million people visit The 606 park and trail system each year.



Environmental Sentinel is the title of the trail-wide flowering spectacle and plant-based artwork of The 606. The idea for *Environmental Sentinel* is rooted in Japan's Cherry Blossom Festivals. The people of Japan began keeping meticulous records to document the bloom times of cherry trees year to year, in order to know when to schedule cherry blossom celebrations. Japan's cherry blossom monitoring and record keeping, though begun to support a cultural celebration, today forms the longest-running data set that we know of that documents a changing climate.

Frances Whitehead, The 606 lead artist and creator of *Environmental Sentinel*, wondered if we could create a climate/culture planting for The 606, similar to the cherry trees in Japan. Could native Serviceberry trees offer Chicagoans an annual flowering spectacle? Whitehead wanted more than just a blossom celebration. She also considered how proximity to Lake Michigan might

affect the bloom times of cloned flowering trees planted the length of the trail. Could the blossoms visualize the famous 'lake effect'? Further, could monitoring the timing of seasonal changes in the plants help us understand Chicago's microclimate over time?



The nearly three-mile long trail runs due east-west. The east end of The 606 is about 2 miles from Lake Michigan; the west end is about 5 miles from Lake Michigan. If we planted cloned, temperature-sensitive blooming trees the length of the trail, could

we notice a difference in the bloom times of the plants on the west end versus the bloom times of the same species of cloned plants on the east end of the trail? In other words, does where a plant is located along the 2.7-mile long trail make a difference as to when it blooms? To put it another way, does Lake Michigan affect the bloom-times of the temperature sensitive plants of The 606?

Cloned plants are genetically identical to each other, thereby eliminating genetics as a factor for differences in bloom times within the same species across the trail.

The anticipated bloom spread is from west to east. We anticipate that the Amelanchier x grandiflora 'Autumn Brilliance' (serviceberry trees) and the Chinese lilacs (Syringa x chinensis 'Red Rothomagensis') nearer to the west end of the trail will begin to bloom on average 5 days earlier than the amelachiers and lilacs nearer to the east end of the trail. Temperature may be the key. Lake Michigan may keep the east end of the trail cooler deeper into spring, slightly delaying the bloom time of temperature-sensitive trees. Would the same be true for the maturation of the fruit of these trees? These temperature-sensitive blooming plants will serve as bio-indicators of microclimate change along this dynamic site: environmental "sentinels" for Chicago's future. (See APPENDIX B, pg 14-16 for spring phenological differences study from Dr. Mark Schwartz for The 606.)

Tracking subtle changes in hundreds of plants takes community-based commitment. The Chicago office of The Trust for Public Land conducts workshops to train neighbors of The 606 park and trail system to conduct phenological observations as part of the living work of art, culture, and science, *Environmental Sentinel*. Phenology is the study of recurring seasonal changes in the life cycles of plants and animals, for example, when birds migrate, insects emerge, and plants leaf out and flower. Using protocols and tools developed by The USA-National Phenology Network (usanpn.org) community members conduct weekly observations of selected plants along The 606 using data sheets or phone app from the USA-NPN's *Nature's Notebook* program.

Environmental Sentinel explores the following questions:

- 1) How does proximity to Lake Michigan affect the bloom times of temperature sensitive cloned plants situated along the east-west transect of The 606 park and trail system located in Chicago?
- 2) How can we support and encourage adults and youth to develop skills to accurately collect and share phenological data?
- 3) What will data collected along The 606 reveal about Chicago's microclimate over time?

2. Observation Quantity

We follow the USA-NPN's guidelines for monitoring plants of the same species. We worked with Student Conservation Association youth who helped identify a subset of the total number of each of two plant species to monitor along the 2.7 mile-long elevated linear trail. We divided the trail into 15 subsections to offer volunteers roughly equivalent monitoring experiences in terms of plant numbers and walking distance.



The 606 Workday December 2, 2016

Student Conservation Association youth and Trust for Public Land staff use georeferenced tree maps to identify and select specific individual plants to observe in preparation for launching The 606's phenology project in early 2017.

Plant species of *Environmental Sentinel* of The 606 park and trail system in Chicago



Amelanchier x grandiflora
'Autumn Brilliance' Serviceberry

169 plants
65926 observations in 2017

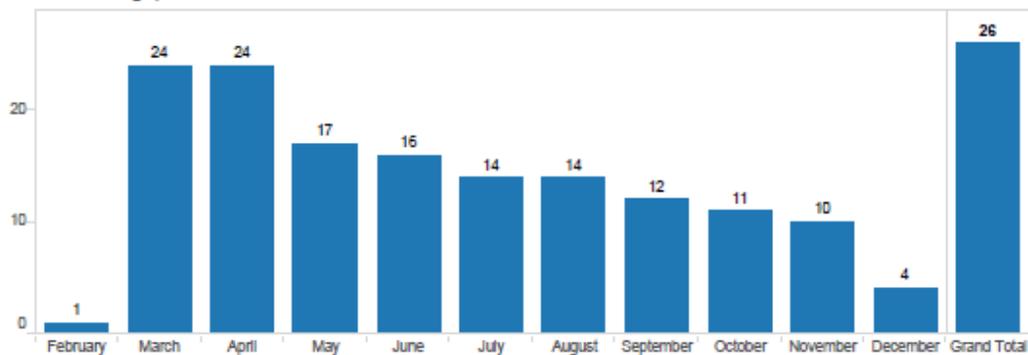


Syringa x chinensis
'Red Rothomagensis' Chinese lilacs

25 plants
5066 observations in 2017

Frequency of site visits: The original request was for volunteers to observe their set of plants on a weekly basis during 2017, the inaugural year of the phenology project of The 606. We had a small handful of volunteers who adhered to that schedule with zeal. On the other end of the spectrum, we had a few volunteers who set up accounts and never made any observations. We had a few volunteers start strong with account set-up and weekly observations and then fade off over the summer due to a variety of life events. We also had a few volunteers who documented the full arc of the growing season, but with more than a week between observations.

Active observers by month,
The 606-Chicago, 2017



3. Observer Activity

Recruitment & Training

We conducted two 1-day, 4-hour training sessions for community members at two different neighborhood public libraries located within walking distance to The 606

February 25	11 am-3 pm	11 attendees	Humboldt Park Library
March 4	12 pm-4 pm	24 attendees	Bucktown-Wicker Park Library

We recruited volunteers at a public program, our first Tavern Talk of 2017 in conjunction with a presentation about the project, and sent invitations to people on our email list. Prospective volunteers signed up via Eventbrite in January-February. Here is a link to our Eventbrite page.

https://the_606_march4_phenology_volunteer_workshop.eventbrite.com

Retention:

In December 2017, we created and emailed a survey to our phenology volunteers to learn about their experiences as first-time phenology volunteers in our new program. Below is a link to our survey results. We received 18 completed surveys. Final Question—Would you like to continue observing in 2018? Yes= 10 ; No= 4; Unsure= 4

<https://www.surveymonkey.com/results/SM-236XYF7X8/>

Takeaways from the year-end volunteer survey include 1) create photo guides for each of the distinct stages or phenophases for each plant species we monitor; 2) offer more botany basics in training and during monitoring; 3) continue emailed communications to the volunteers to answer questions; 4) offer opportunities for group activities, especially group observations following training to boost observers' confidence. Phenology volunteers report they most valued becoming stewards for The 606 and improving their skills as nature observers. What most concerned volunteers was at the beginning not fully understanding what they were doing and wondering if they were conducting observations correctly.

Field trip to The 606 during Phenology volunteer training workshop.

February 25, 2017



4. Phenology Data Summary for Year One

In Year One of the phenology project of The 606, volunteers contributed just shy of 71,000 observations. The visualizations that follow in this report graphically represent volunteers' observations. Phenology protocols ask observers to look closely at a plant or animal and determine if "YES" a particular change called a *phenophase* is occurring or "NO" a phenophase is not occurring. For example, do you see open flowers? If observers see open flowers, they mark "YES" on their data sheet or phone app. However, if observers looked for open flowers and did not find any, they mark "NO." A 'YES' indicates that a phenophase was visible during a site visit. A 'NO' or a series of 'NOs' before and after a 'YES' observation helps pinpoint the timing of the transition from one phenophase to the next. Pinpointing the dates when phenophases occur helps researchers and citizen scientists 1) better understand the timing of these events within a single year; 2) anticipate phenophases in subsequent years; and 3) determine if shifts in the timing of phenophases across years is occurring, which may indicate a changing climate.

Following are four charts generated by the USA-NPN's Visualization Tool. The graphics illustrate the observations made by the phenology volunteers of The 606. Small, vertical lines represent one observation and are grouped by phenophases and the timing of the observation.

The top graphics on page 6 and page 7 illustrate the 'YES' observations for each plant species. The bottom graphic on the same pages also includes the 'NO' observations, indicated with the addition of vertical grey lines.



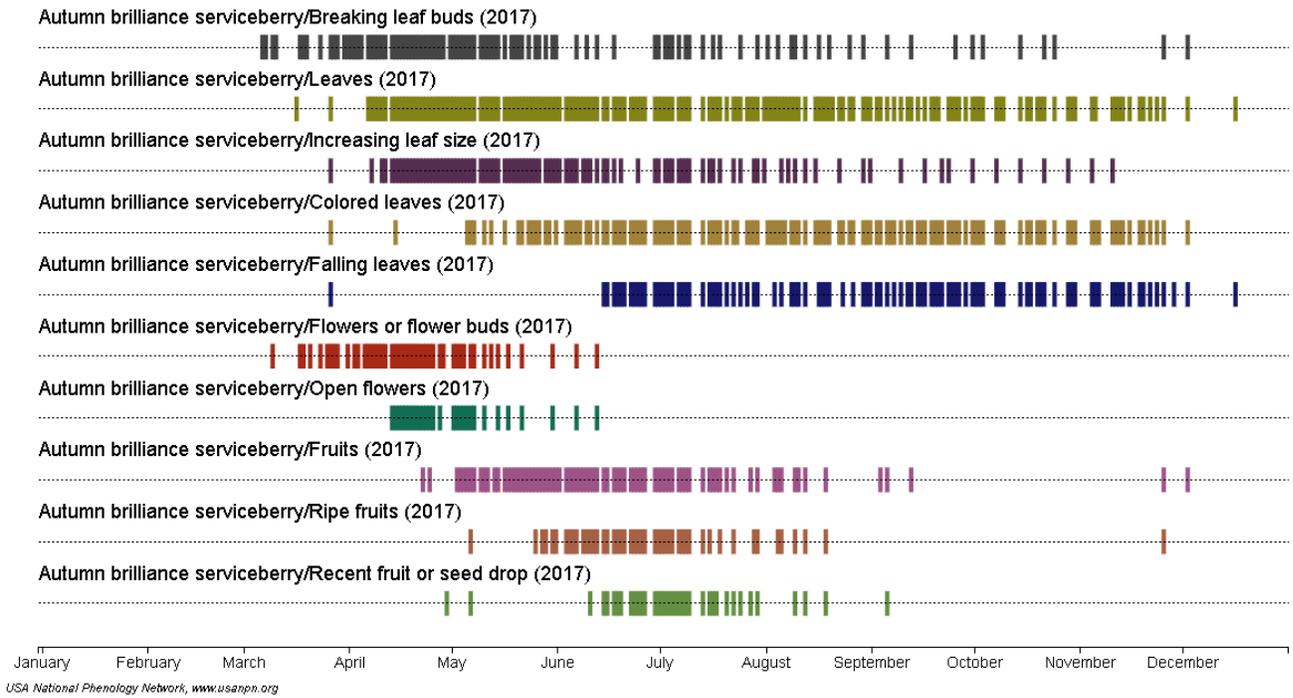
We liked the graphic display so much we turned it into t-shirts and gave them to our top observers at a recent event celebrating the culmination of Year One.



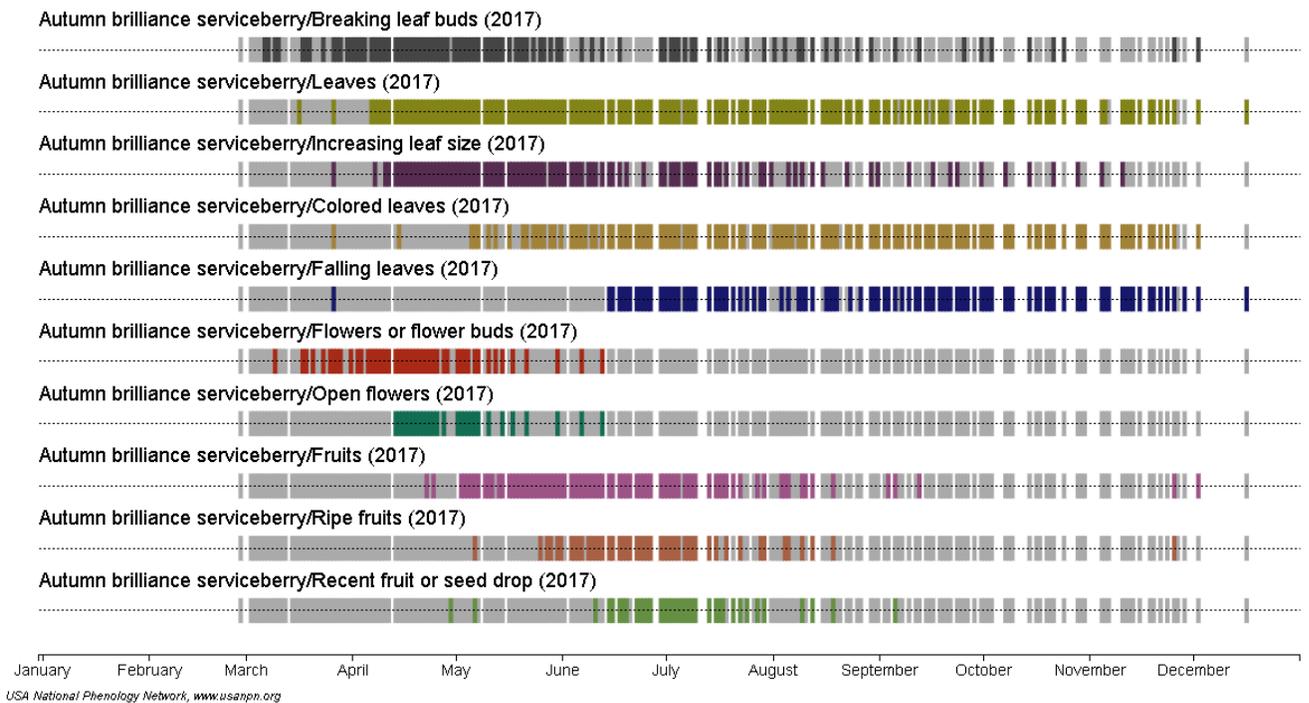
Please note: Volunteers indicate that they observed colored leaves beginning in May and continuing through the end of the year. This is not a mistake. Drought forced many of the serviceberry trees into fall color by June.

Near Wood Street access ramp
June 15, 2017

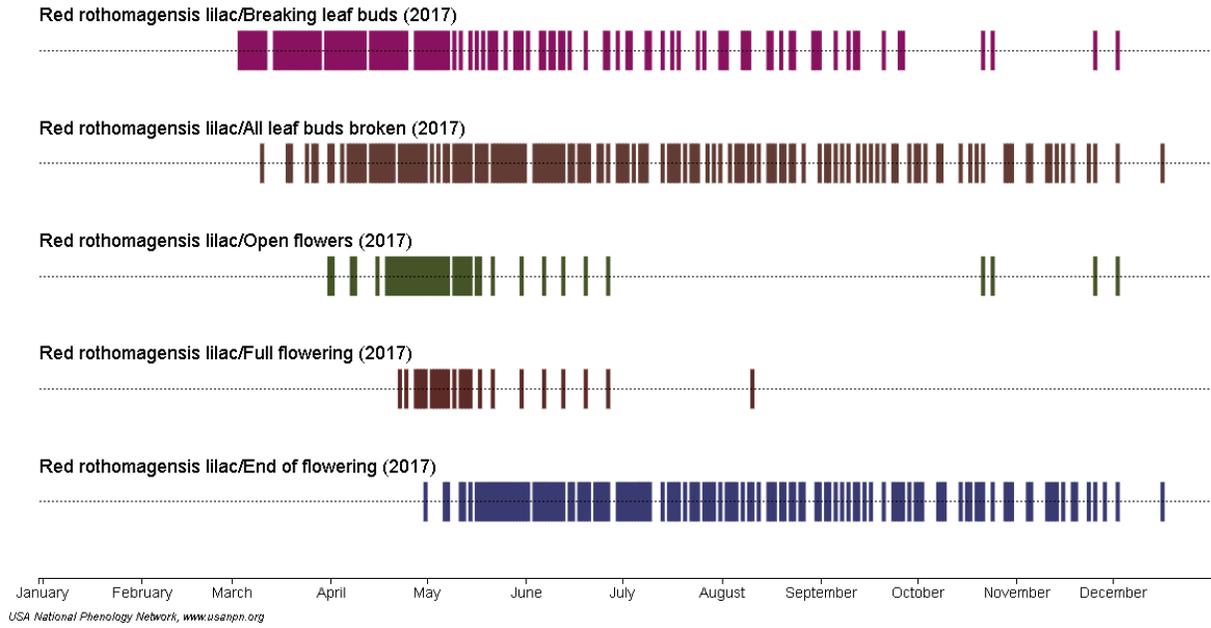
2017 Amelanchier x grandiflora (Serviceberry) YES observations only



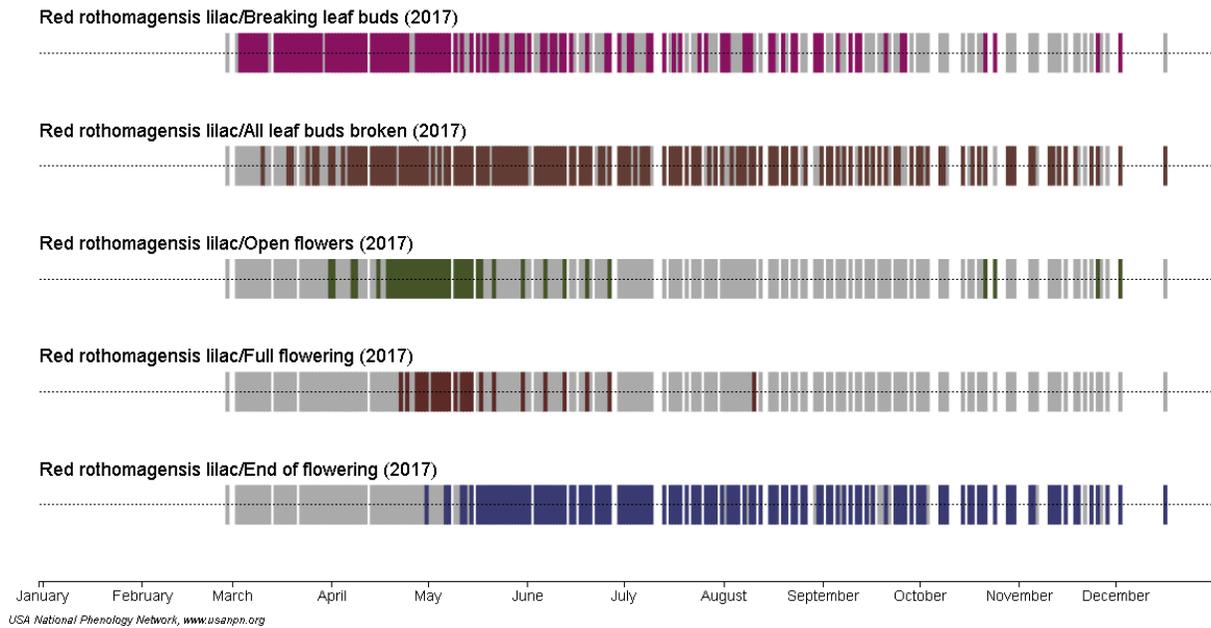
2017 Amelanchier x grandiflora (Serviceberry) YES and NO observations



2017 Syringa x chinensis 'Red Rothomagensis' Lilac YES observations only



2017 Syringa x chinensis 'Red Rothomagensis' Lilac YES and NO observations



5. Weather data

Though poet T.S. Elliot bemoaned April as the cruelest month, for phenology observers in Chicago, April is an exciting month of wild temperature fluctuations and explosions of blossoms. In 2016 as we prepared to launch the phenology program, we began to monitor informally seasonal changes in our signature plants: Amelanchier x grandiflora ‘Autumn Brilliance’ serviceberry, and Syringa x chinensis ‘Red Rothomagensis’ Chinese lilacs. These informal observations also included temperature monitoring.

April 2016 dates and low/high daily temperatures

4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
41	45	48	54	55	48	54	57
61	70	75	81	82	61	72	72

April 2017 dates and low/high daily temperatures

4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21
46	63	61	45	45	46	48	46
68	81	73	70	77	70	73	52

The grey boxes indicate the day in each year the Amelanchiers first began blooming along The 606. In 2016 and again in 2017, the Amelanchiers bloomed within 48 hours after an 80-degree day. This observation helps us understand the timeframe for hosting public events to celebrate the blooming spectacle of the Amelanchiers along The 606. To understand better the nuanced relationship among temperature, humidity, and position of individual Amelanchiers along the trail to their specific first blooming may require more formal weather monitoring, and also, a deeper understanding of the existing mapping tools for spring indices and Accumulated Growing Degree Days of the USA-NPN, a project goal for 2018.

6. Results and Interpretation

In 2017, the Trust for Public Land’s Chicago office assembled the first team of community volunteers to begin monitoring the signature plants of *Environmental Sentinel* of The 606. First year data establish a basic timeline for onset of each phenophase for the project’s signature plant species.

- **Volunteers:** This information supports offering training workshops for new community volunteers in late winter so they will be poised to begin observations in March, aligning volunteers’ initial enthusiasm with the onset of spring phenophases, especially flowers and fruit. These data also help support more frequent monitoring from March through June.
- **Teacher & Students:** April-June, the most active period for phenophase onset for our project’s plants, also coincides with spring field trip season and renewed interest in nature explorations and garden work for school-based audiences. This offers a prime opportunity for hands-on introductions to phenology observations for the students and teachers within a 10-minute walk of The 606 both along the trail and in schoolyards.
- **Community:** With a better understanding of the timing of particular phenophases, we will be able to target social media messaging and public programming throughout the growing season, increasing awareness of phenology and introducing more community members to phenology monitoring through hands-on activities along The 606.

- Project Questions:
 - Year One monitoring activities of the *Environmental Sentinel* project of The 606 form a solid foundation for comparing data across subsequent seasons to address the question of bloom time for individual plants and their position along The 606 system, and also what these data may reveal about Chicago's microclimate over time.
 - Adult community volunteers gained skills to conduct observations. More work in 2018 to encourage and support student and teacher engagement with phenology observations.

7. Lessons Learned

Year One of the phenology monitoring project of The 606 in Chicago opened up exciting opportunities for learning for trail neighbors, school students and their teachers, and Trust for Public Land staff, as well as contributing to the USA-NPN's national data base.

- **Adopting a Project Mantra: We'll figure it out.** There was a lot to figure out in Year One. For example, how to operationalize the artist's project concept, use the USA-NPN monitoring protocols, assess volunteer availability and readiness, plus staff skill level, weather, drought, and the sudden appearance of new plants replacing some of the designated project plants. **Lesson Learned:** Participating in the Local Phenology Leader Training program helped enormously to build knowledge and skills as we worked to establish our phenology program. In addition to learning basic content and how to navigate the *Nature's Notebook* website for content and resources, we gained a learning community of phenologists who manage their own programs across the country. We are especially appreciative of the USA-NPN staff who are ever willing to work with us to help us figure it out.
- **Learning Out Loud** We jumped in, launching phenology monitoring of our newly established landscape of The 606 in January 2017. We brought on a group of community volunteers and we learned alongside them. We all had so many questions when we first embarked on monitoring, with the basic question being, Am I doing this right? We had to make a significant course correction around week 6 of monitoring. I along with our other volunteers were not seeing what the phenophase descriptions said we were supposed to be seeing, namely emerging tips of green leaves. This dissonance and subsequent communications with USA-NPN staff helped us to understand that Serviceberry trees have mixed buds—flowers and leaves emerge from the same bud. **Lesson Learned:** This was a true a-ha moment. First, understanding how mixed buds develop helped improve the accuracy of our field observations and data collection immensely, though, in the moment, it was frustrating for volunteers who had uploaded weeks of observations under the incorrect understanding of our plants. Second, it affirmed that we could trust our developing discernment of our plants' phenophases. Finally, our volunteers learned that we didn't know everything when we began, but we had enough experience to know how to seek clarity when we found a question we couldn't answer.
- **The Making of Plant Whisperers** One 4-hour training session was not enough to get community members fully comfortable with all of the aspects of the trail and the phenology project including basic botany, the science of phenology, how to monitor, and where to find

specific plants along the trail. Therefore, following our volunteer workshops, we began sending weekly emails to our volunteers that contained targeted content and video links from the *Nature's Notebook* website, for example, how to measure intensity, which we chose not to cover in the initial workshop. I also sent links to relevant articles about phenology and climate implications. What turned out to be especially valuable to our new volunteers was sharing out their questions and answers to the whole group rather than only to the individual who posed the original question. **Lessons Learned:** We did not wait until we had all the answers before starting up the public aspects of our phenology project. If we had waited, we would not have a year's worth of rich data collected by community members, and answers to questions we uncovered as we moved together through the seasons and the accompanying phenophases. I believe we learned more about our project by bringing on a community of active learners when we did. These terrific volunteers helped accelerate our learning through their questions and discoveries. We will fold this learning into our next volunteer training sessions scheduled for February and March 2018.

- **Timing is Everything** Out of the gate we had a very enthusiastic group of volunteers who created Nature's Notebook accounts and started observing. Our directive to volunteers was to conduct weekly observations of particular sets of plants. We had a handful of volunteers drop out completely or drop off at some point in the year. We also had uneven monitoring of some of the trail's subsections. **Lessons Learned:** For the upcoming year, we need to rethink the idea of weekly observations to ensure more complete trail monitoring and to keep volunteers engaged. April-June may require more frequent visits due to the pace of phenophase onset, while July-September may warrant less frequent observations due to the slowed pace of phenophase change. We will also introduce insect and animal observation this year. Though not a part of the initial science question, important additions to ensure volunteer engagement over time.

8. Education and Outreach activities

In 2017, The Trust for Public Land's Chicago office kicked off the year by introducing *Environmental Sentinel*, the phenology project of The 606 park and trail system. This is a summary of Year One programming.

November 2016	Georeferenced tree inventory of The 606 completed by David Bier, Futurity, Inc.
	Successful completion of the Local Phenology Leader certificate program of the USA-National Phenology Network/Nature's Notebook by The Trust for Public Land's Exelon Fellow for Education.
December 2016	Student Conservation Association trail workday—using new georeferenced site maps, SCA youth helped select specific plants for phenology study.
January 2017	Tavern Talk: <i>The Art and Science of a Blooming Trail</i> . Over craft beers and pub food, we introduced <i>Environmental Sentinel</i> , the phenology project of

	The 606. Speakers included the project artist, Frances Whitehead; David Bier, landscape architect who created georeferenced tree inventory; Jean Linsner, educator who discussed the value of phenology monitoring and opportunities to participate.
February 2017	Hands-on phenology volunteer workshop, Humboldt Park Public Library/ 11 participants
March 2017	Hands-on phenology volunteer workshop, Bucktown-Wicker Park Public Library/ 24 participants Volunteers began monitoring Amelanchier x grandiflora 'Autumn Brilliance' Serviceberry and Syringa x chinensis 'Red Rothomagensis' Chinese lilacs Phenology introduction and field trip to trail for three classes of 8 th grade students from McAuliffe school.
April 2017	Artist/cartographer Molly O'Halloran created a watercolor map of the landscape and gardens of The 606 including a description of <i>Environmental Sentinel</i> , the phenology project of The 606. Community celebration- <i>A Walk with Blossoms</i> - scheduled but postponed due to inclement weather.
May 2017	<i>A Walk with Blossoms</i> –festival event celebrating the arrival of spring with citizen science introduction, flower bikes, and special signage introducing the serviceberry trees, and a serviceberry photo 'booth.' (Photos page 13)
June 2017	Monitoring continues; drought forced several of the monitored serviceberry trees into premature autumn color. Outreach to volunteers to ensure accurate documentation.
March-December	Written communications sent 2-4 times per month to volunteers responding to questions, sharing links to articles, photographs, and USA-NPN videos, etc. to support volunteers.
November 2017	Several tree replacements on the trail offered an opportunity to review phenology-monitoring protocols with volunteers and landscape crews.
December 2017	Year One survey sent to volunteers; received 18 completed surveys Planning for 2018 phenology volunteer workshops with improvements based on feedback from respondents.

9. Summary and next steps

In March 2017, The Trust for Public Land and community volunteers, together with support from the Chicago Park District, began monitoring phenophases of cloned Autumn Brilliance Serviceberry trees and Chinese Lilacs as part of the *Environmental Sentinel* project of The 606 park and trail system in Chicago, Illinois. The primary question for this project: Does where a plant is located along the 2.7-mile long trail make a difference as to when it blooms? Or to put it another way, does Lake Michigan affect the bloom-times of the temperature sensitive plants of The 606?

What changes to *Environmental Sentinel* will The Trust for Public Land make based on Year One plant monitoring and data collection?

- Build in more celebrating of our volunteers' accomplishments.
- Encourage phenology volunteers to cover the end sections and the center sections of the trail first in order to ensure adequate monitoring of these sections to be able to answer our primary question over time. Monitor all of the subsections of the trail as volunteer corps grows.
- Become more familiar with and use the Spring Indices and other maps available through the Nature's Notebook visualization tool in order to use accumulated growing degree-days to predict more accurately the timing of the phenophase transitions of the plants of The 606.
- Encourage more students and teacher participation in phenology monitoring by aligning phenology activities with the Next Generation Science standards, especially the 8 practices for science and engineering and grade specific content areas.
- Add insect and bird observations to the project for volunteer engagement and for learning more about the pollinators of The 606 park and trail system.

10. Location of Project Components

All data are entered online via *Nature's Notebook* and are stored in the USA-NPN National Phenology Database, available for download via the Phenology Observation Portal at

www.usanpn.org/results/data

APPENDIX A



Walk with Blossoms May 7, 2017 A community festival celebrating Spring's arrival
English and Spanish versions of trail signs introducing the 458 native Serviceberry trees of The 606.



Walk with Blossoms Serviceberry photo "booth." Cyclist on flower bike distributed new landscape maps to trail visitors during the community celebration.

Photo and graphics credits:

Page 1, 3, 5, 13

Jean Linsner

Page 1 graphic

Frances Whitehead

Page 2

Joshua Lott

Page 3, 6, 7 graphics

Generated using tools from USA-National Phenology Network
Nature's Notebook

APPENDIX B

**Potential for Spring Phenological Differences
Along a Transect
Perpendicular to the Coast of Lake Michigan
In the City of Chicago, IL**

This short study was undertaken to assess the potential for spring phenological differences along a linear park that is proposed for construction parallel to Lake Michigan in the City of Chicago (Figure 1).

After scanning available air temperature records, two stations were located at a similar distance apart and orientation to the Lake Michigan coast compared to the linear park location, which had multiple years of data during the same time period (Figure 1). The one closer to the lake was located at the Chicago Botanic Gardens (42.12°N, -87.77°W, 192.0 m elev., #111497), and the one farther away was Glenview NAS (42.08°N, -87.83°W, 196.9 m elev., #14855). The years of daily maximum/minimum air temperature available were 1985-1994.

For the available years, Spring Indices (SI) First Leaf and First Bloom spring phenological model dates (day-of-the-year, Jan 1st = 1, Schwartz et al. 2006) were calculated at each weather station, as well as total degree-day accumulation (base temperature 31°F) for the first 150 days of each year (roughly January-May). The raw results are shown Table 1.

Table 1: Comparative Raw Spring Indices Dates and Degree-day Accumulations

Year	Station	SI First Leaf	SI First Bloom	Degree-days
1985	14855	missing	missing	1947
1985	111497	missing	missing	1825
1986	14855	89	116	1988
1986	111497	90	118	1739
1987	14855	95	120	2093
1987	111497	102	130	1771
1988	14855	91	125	1788
1988	111497	95	131	1463
1989	14855	missing	missing	1687
1989	111497	missing	missing	1446
1990	14855	74	117	1965
1990	111497	85	124	1722
1991	14855	missing	missing	2058
1991	111497	missing	missing	1930
1992	14855	102	132	1665
1992	111497	108	135	1465
1993	14855	110	129	1532
1993	111497	114	132	1421
1994	14855	93	119	1743
1994	111497	96	124	1601

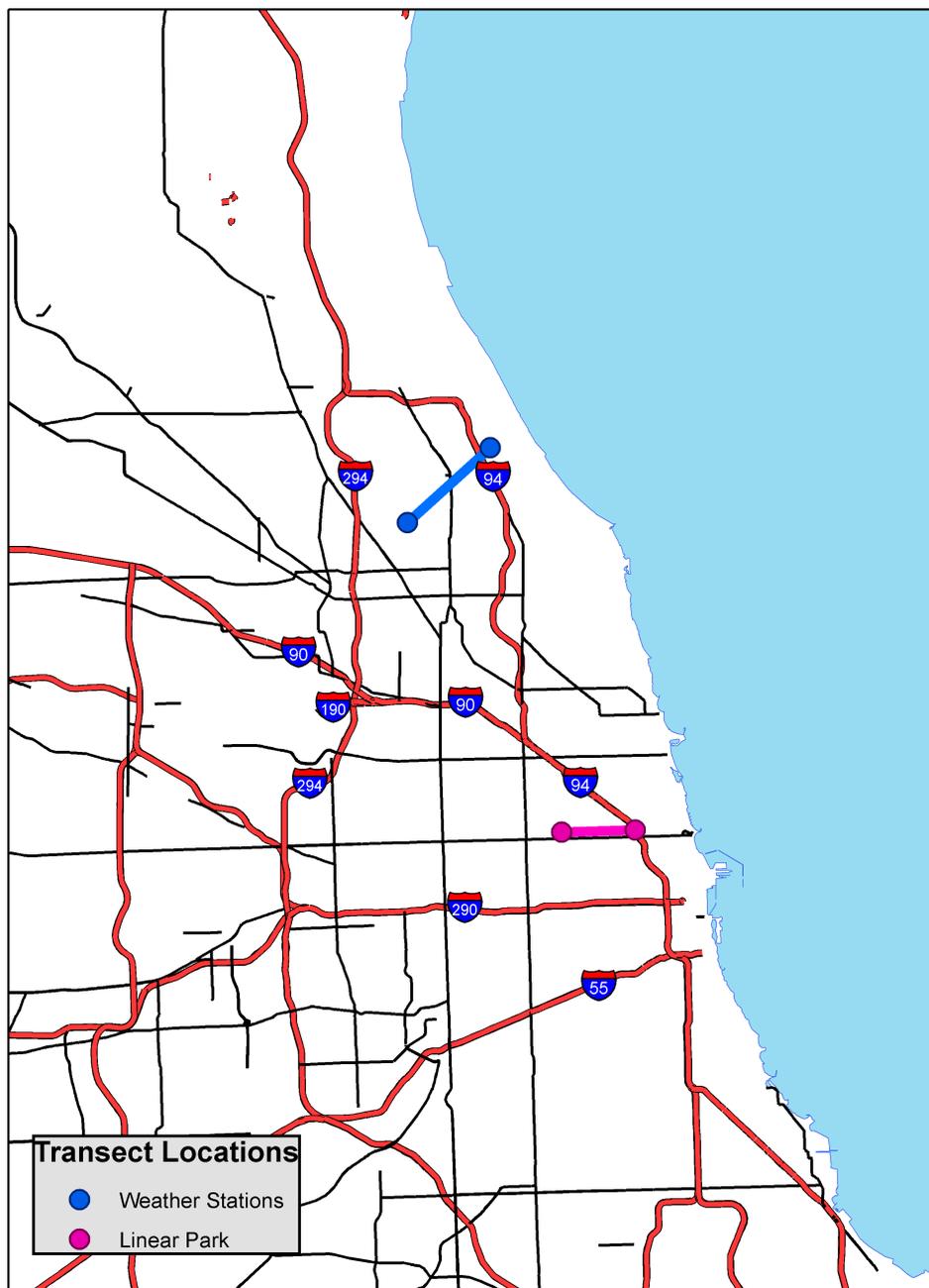


Figure 1: Linear Park and Comparative Weather Station Locations in Chicago, IL

Summarizing the results, the SI models did not produce results in 1985 (due to lack of autumn 1984 data), 1989, or 1991 (both due to too many missing days). The average differences for both SI model outputs over the seven available years were 5 days earlier inland than at the station closer to the coast, with a minimum of 1-2 days, and a maximum of 10-11 days. The degree-day difference over all ten years averaged 208 less at the station closer to the coast, with a minimum difference of 111 and a maximum of 325.

Table 2: Summary of differences between Coastal and Inland Weather Station Locations

Variable	Min. Difference	Average Difference	Max. Difference
SI First Leaf Date	+1	+5	+11
SI First Bloom Date	+2	+5	+10
Degree-day Accumulation	-111	-208	-325

Conclusions

The weather stations are somewhat farther apart than the length of the proposed linear park. Nevertheless, their orientation should be comparable and give a reasonable estimate of the air temperature differences at the proposed linear park location. Thus, the park should typically experience about 3-5 days difference in phenological development from the end nearest the lake to the more inland end, with a minimum difference of 0-1 days, and a maximum difference of 9-10 days.

Reference

Schwartz, M. D., Ahas, R., & A. Aasa, 2006: Onset of Spring Starting Earlier Across the Northern Hemisphere. *Global Change Biology* **12**(2): 343-351.

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The 606 park and trail system's phenology project and school and community programming are made possible through generous support from the following:



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Presenting sponsor of *Walk with Blossoms* and quarterly community festivals



Phenology protocols, training materials, national database, plant and animal descriptions, data sheets and phone app., and professional development



2017 Phenology Report for Environmental Sentinel of The 606 in Chicago

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