Holliday Park
2019 Phenology Report
# Table of Contents

Introduction 3  
Program Description 3  
Methods 4  
  Data Collection 4  
  Monitoring Sites 5  
  Observation Quantity 6  
Data Summary 8  
Climate Data 12  
Results 13  
  Phenophase Activity 13  
  Sycamore Activity 14  
Education / Outreach 15  
Lessons Learned 16  
  Visiting Frequency / Volunteer Recruitment 16  
  Site Creation 16  
  Collaboration with Holliday Park 16  
Summary & Next Steps 16  
Location of Project Components 18  
Works Cited 18
Introduction
Phenology is the study of recurring life cycle changes in plants and animals, such as leaf drop, flowering, and animal migration. Research indicates that the timing of phenological events is influenced by changes in weather and climate. Plant phenology is a great indicator of environmental change, and studying phenology can offer important information about species response to climate change. Long-term changes in climate can have extensive ecological ramifications, such as changes in species interaction, primary productivity periods of species, and the proliferation of invasive species.

Indiana Phenology engages people of all ages in phenology observation using Nature’s Notebook, a citizen science data collection platform developed by the USA National Phenology Network (USA-NPN). Indiana Phenology was founded in September 2018 and observations at Holliday Park, our pilot partner site, began shortly after our founding. In 2019, our first full year of data collection, 11 observers made 14,966 observations at 12 Indiana Phenology sites. Eight additional observers made 2,857 observations at 13 other sites in Indiana, although those sites were not officially affiliated with Indiana Phenology. These observations were made across 11 of Indiana’s 92 counties.

The purpose of this report is to provide information on the amount of data collected during 2019 and to note any phenological patterns in the data. While this report includes information about Indiana Phenology as a whole, the data summary and results sections are limited to data collected at Holliday Park during 2019. Not only does the data collected at Holliday Park contribute to ongoing research about climate change and phenology, but it can also inform the park’s education and management decisions. As this was our first full year of data collection, the data in this report mainly serves as a baseline for future years. The report also includes lessons learned in our first year of operations and a series of next steps. These sections contain important material about the continued development of our program and our goals for the future.

Program Description
Indiana Phenology was founded in September 2018. Indiana Phenology engages volunteer observers throughout the state of Indiana in gathering data on the leafing, flowering, and fruiting of native and common plants. This data is collected using the Nature’s Notebook app and stored in the national USA-NPN database. Indiana Phenology is made up of three programs designed to cultivate a sense of place and connection to nature among observers, while also teaching them valuable skills and knowledge. These programs are outlined below:

- **Indiana Backyard Observers**: Individuals and families establish their own observation sites on their property. They observe plants on these sites year-round and record observations using Nature’s Notebook.
- **Indiana Schoolyard Phenology**: Schools create Nature’s Notebook monitoring locations on school grounds to be incorporated into their science curriculum. Students can experience science in action by making regular observations of seasonal change in
nature. These observations are tied to scientific concepts being learned in the classroom, such as life-cycles and climate change.

- **Indiana Phenology Trail**: Partner organizations, such as nature centers or state parks, establish one or more phenology walks on their property and recruit volunteers to make regular observations. These phenology walks encourage engagement in park activities by local residents and can also help to fulfill partner organizations’ specific education, management, or research goals.

The goal of Indiana Phenology is to document the leafing, flowering and fruiting of common native plants in all 92 Indiana counties. The purpose of collecting data in all 92 counties is two-fold; it will offer a large pool of geographically diverse data, and it will allow for educational engagement opportunities throughout the entire state of Indiana. The data collected by Indiana Phenology observers will be used to answer site-specific, program-specific, and national science questions regarding climate change and other environmental phenomena. All of the data collected by observers is entered into a national database, where it is used in USA-NPN campaigns and is accessible to numerous scientists. At a program-specific level, Indiana Phenology is guided by our own science questions:

- How does the timing of leafing, flowering and fruiting change from year to year?
- How does the timing of phenology of plants vary across Indiana?

Specific sites that participate in the Indiana Schoolyard Phenology or Indiana Phenology Trail programs are encouraged to develop their own science questions that are catered towards their location or their program’s specific goals. In addition to these three programs, we hold workshops, create and share resources, provide additional training and education opportunities, and share a monthly newsletter. Through our three programs and additional educational outreach we hope to develop a culture of place-based environmentalism and scientific learning. We hope to engage the public more deeply with the world around them, connect observers with their communities, and inspire a new level of scientific curiosity.

**Methods**

**Data Collection**

Observations were made approximately three times a month during the growing season. For each observation session, the phenophase status of the leaves, flowers and fruits of each tree were assessed and recorded using the *Nature’s Notebook* app, in accordance with the USA-NPN protocols. All observations were automatically uploaded to the USA-NPN database.

The following phenophases (life-cycle events) were assessed each visit for each of the 16 trees monitored, with the observer indicating whether or not a phenophase was present at the time of observation. These definitions are abbreviated versions of the definitions found in the USA-NPN Plant and Animal Phenophase Definitions (pp. 6-8). See the full document, linked at the end of this report, for complete definitions.
Leaf Phenophases
- **Breaking leaf buds**
  One or more breaking leaf buds are visible on the plant. A leaf bud is considered "breaking" once a green leaf tip is visible at the end of the bud.
- **Leaves**
  One or more live, unfolded leaves are visible on the plant.
- **Colored leaves**
  One or more leaves show some of their typical late-season (fall) color, or yellow or brown due to drought or other stresses.
- **Falling leaves**
  One or more leaves are falling or have recently fallen from the plant.

Flower Phenophases
- **Flowers or flower buds**
  One or more open or closed flowers or flower buds are visible on plant.
- **Open flowers**
  One or more open flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible.

Fruit Phenophases
- **Fruits**
  One or more unripe or ripe fruits are visible on the plant.
- **Ripe fruits**
  One or more ripe fruits are visible on the plant.
- **Recent fruit or seed drop**
  One or more ripe fruits or seeds have dropped or been removed from the plant since the last time you visited.

*Monitoring Sites*
This report focuses on data collected at Holliday Park, one of the partner observation locations for the Phenology Trail Program. The Holliday Park Site was created in September 2018, and observations have been recorded monthly since. The Holliday Park Site consists of 16 trees of six different species: American sycamore, bur oak, Canadian serviceberry, eastern redbud, tulip tree, and sugar maple. These species were selected to be easily identifiable, conveniently located near the parking lot and Nature Center, and diverse. Three specimens were selected of each species, except the American sycamore. Only one American sycamore was selected, as only one is present in this area of the park. These specimens were chosen based on the health of the tree and accessibility of trees along a circular route that originates and terminates in the parking lot. Below are descriptions of each selected species.

- **American sycamore** - This prominent tree with patchy gray and white bark stands tall over the parking lot. It has large leaves and ball shaped fruits.
- **bur oak** - Several bur oak trees alternate with serviceberry shrubs the length of the parking lot. Another stands on the grassy mound between the parking lot and the Nature
Center (see the map below). These trees have very large leaves and large acorns with big shaggy caps.

- Canadian serviceberry - These large shrubs or small trees fill in the spaces between the bur oaks along the length of the parking lot. They have white flowers in early spring and edible berries that ripen mid-June. The berries are reminiscent of blueberries in size, color and flavor.
- tulip tree - This species was selected partly because it is the state tree of Indiana. It has large yellow flowers with orange stripes that mature into bundles of numerous unique seeds arranged in a cone shape. As the seed cones open up, the tree appears to have dry brown flowers.
- sugar maple - This species of maple is famous for its sweet sap that is tapped to be made into syrup. The Nature Center hosts yearly progaraming focused on maples, maple tapping and maple syrup.
- eastern redbud - This species is most showy in early spring when it is covered in masses of magenta-pink blossoms festooning the branches. Other eye-catching features include the heart-shaped leaves and the flat seed pods that often remain on these small trees into the winter.

![Holliday Park Phenology Walk](image)

Figure 1. Map of Holliday Park Phenology Walk. Satellite image courtesy of google maps, labels added by Indiana Phenology.

**Observation Quantity**

Observation quantity data was compiled using the Local Phenology projects Dashboard page (www.usanpn.org/nn/groups/dashboard). The data in this section focuses exclusively on Holliday Park. Observation visits to Holliday Park began in September 2018. In 2018, 1,151 observations were made over the course of seven visits. 170 of these observations were of the honeylocust, which was removed from the trail in early 2019 to streamline the observation circuit. In 2019, 4,924 observations were made over the course of 30 visits. The number of
observations are broken down by month, phenophase type, and species type. The charts below only include data from 2019.

The following chart shows the number of visits made to Holliday Park by month. Visits were made each month, with increasing frequency as the spring buds began to break open. While weekly visits were the goal, visits occurred an average of 3 times per month during the growing season from March to November. Visits occurred less frequently during the winter months, when species were undergoing phenophase changes less rapidly. A total of 30 visits were made to Holliday Park in 2019.

![Site visits by month, Holliday Park, 2019](image)

Figure 2. Summary of visits made to Holliday Park in 2019, by month.

The table below shows the number of phenology records collected per month. One phenology record represents one response to a yes/no question about a given phenophase status, while an observation refers to all phenology records made at one time for a given species. As with the number of visits, the number of records collected were higher during the growing season, compared with the winter months.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Year Tot.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holliday Park</td>
<td>197</td>
<td>207</td>
<td>368</td>
<td>498</td>
<td>817</td>
<td>500</td>
<td>667</td>
<td>501</td>
<td>561</td>
<td>334</td>
<td>167</td>
<td>167</td>
<td>4,924</td>
</tr>
<tr>
<td>Grand Total</td>
<td>197</td>
<td>237</td>
<td>368</td>
<td>498</td>
<td>817</td>
<td>500</td>
<td>667</td>
<td>501</td>
<td>561</td>
<td>334</td>
<td>167</td>
<td>167</td>
<td>4,925</td>
</tr>
</tbody>
</table>
Figure 3. Summary of phenology records collected by month. Number of records collected corresponds to season, with more records being collected during the growing season compared to the winter.

The following pie charts break down the phenology records by phenophase category (flowers, fruits, or leaves) and by species. Approximately half of the phenophase records fall into the leaves category, while the other records are split relatively evenly among flowers and fruits, with slightly more records for fruits. The number of records was approximately the same for each species, with the exception of honeylocust and American sycamore. The small number of observations for honeylocust can be attributed to the fact that it was removed from the trail in early 2019 due to its inconvenient distance from the parking lot. The smaller number of observations for the American sycamore is due to the fact that there is only one sycamore at the site, while there are three of each other tree.

![Records by phenophase category, Holliday Park, 2019](image1)

![Records by species, Holliday Park, 2019](image2)

Figure 4. Summary of phenology records by phenophase and species. The phenophases are split into three categories: leaves (consists of breaking leaf buds, leaves, colored leaves, and falling leaves), flowers (flowers or flower buds, open flowers), and fruits (fruits, ripe fruits, recent fruit or seed drop).

**Data Summary**

Below is a series of phenology calendars for the species observed at Holliday Park. These calendars were prepared using the USA-NPN visualization tool (www.usanpn.org/data/visualizations). Colored lines indicate dates when a 'yes' observation was recorded for the specified phenophase. These calendars offer a visual representation of the frequency of observations made for a specific species. They also show timing of phenophase activity for selected species. The calendars show the start and end date of each phenophase, indicated by the first and last colored bar for that phenophase, as well as whether or not a phenophase occurs multiple times per year, indicated by periods of colored lines interrupted by periods without lines. As this was our first year of data collection, these calendars mainly serve
as a baseline. In future years, we can compare phenophase activity across years, allowing us to pinpoint trends in the data.

Figure 5. Calendar plot showing bur oak phenophase activity for 2019. Colored bars indicate a day when a “yes” observation; gray bars indicate a day when a “no” observation was made.

Figure 6. Calendar plot showing eastern redbud phenophase activity for 2019. Colored bars indicate a day when a “yes” observation; gray bars indicate a day when a “no” observation was made.
Figure 7. Calendar plot showing Canadian serviceberry phenophase activity for 2019. Colored bars indicate a day when a “yes” observation; gray bars indicate a day when a “no” observation was made.

Figure 8. Calendar plot showing sugar maple phenophase activity for 2019. Colored bars indicate a day when a “yes” observation; gray bars indicate a day when a “no” observation was made.
Figure 9. Calendar plot showing American sycamore phenophase activity for 2019. Colored bars indicate a day when a “yes” observation; gray bars indicate a day when a “no” observation was made.

Figure 10. Calendar plot showing tuliptree phenophase activity for 2019. Colored bars indicate a day when a “yes” observation; gray bars indicate a day when a “no” observation was made.
Climate Data
A summary of climate data is included to examine connections between climate and weather patterns and phenology data. There are no clear trends among average temperature or total precipitation in 2019 compared to the 30-year normal. Most months in 2019 were warmer than the 30-year normal, although January, March, June, and November were colder. The months with the largest average temperature deviations from the 30-year normal were March, September, November, and December (see Table 1). The first four months of 2019 (Jan- April) saw significantly higher rates of precipitation than the 30-year average. The following three months (May-July), saw lower rates than average. There was no clear trend in precipitation after July (see Table 2). Climate data from 2019 was downloaded from NOAA’s National Centers for Environmental Information (https://www.ncdc.noaa.gov/cdo-web/search). 30-year normal data was also compiled by and downloaded from NOAA (https://www.ncdc.noaa.gov/cdo-web/datatools/ normals). It should be noted that the 30-year normal data is based on the years 1981-2010.

Table 1. Temperature summary for Indianapolis Eagle Creek Airport, IN US weather station. Departure from 30-year normal is based on years 1981-2010 (NOAA 2020, July 2).

<table>
<thead>
<tr>
<th>Month</th>
<th>Avg Temp (F)</th>
<th>Departure from 30-yr Normal (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>27.4</td>
<td>-0.7</td>
</tr>
<tr>
<td>February</td>
<td>33.6</td>
<td>1.6</td>
</tr>
<tr>
<td>March</td>
<td>38.4</td>
<td>-4.0</td>
</tr>
<tr>
<td>April</td>
<td>53.6</td>
<td>0.5</td>
</tr>
<tr>
<td>May</td>
<td>63.9</td>
<td>1.1</td>
</tr>
<tr>
<td>June</td>
<td>71.4</td>
<td>-0.9</td>
</tr>
<tr>
<td>July</td>
<td>78.4</td>
<td>3.2</td>
</tr>
<tr>
<td>August</td>
<td>74.3</td>
<td>0.2</td>
</tr>
<tr>
<td>September</td>
<td>72.8</td>
<td>5.7</td>
</tr>
<tr>
<td>October</td>
<td>56.2</td>
<td>1.4</td>
</tr>
<tr>
<td>November</td>
<td>37.6</td>
<td>-6.4</td>
</tr>
<tr>
<td>December</td>
<td>36.7</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Table 2. Precipitation summary for Indianapolis Eagle Creek Airport, IN US weather station. Departure from 30-year normal is based on years 1981-2010 (NOAA 2020, July 2).
<table>
<thead>
<tr>
<th>Month</th>
<th>Total Precip. (in)</th>
<th>Departure from 30-yr Normal (F)</th>
<th>Percent of 30-yr Normal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.62</td>
<td>0.41</td>
<td>119%</td>
</tr>
<tr>
<td>February</td>
<td>4.16</td>
<td>2.03</td>
<td>195%</td>
</tr>
<tr>
<td>March</td>
<td>4.43</td>
<td>1.13</td>
<td>134%</td>
</tr>
<tr>
<td>April</td>
<td>5.46</td>
<td>1.56</td>
<td>140%</td>
</tr>
<tr>
<td>May</td>
<td>3.76</td>
<td>-1.51</td>
<td>71%</td>
</tr>
<tr>
<td>June</td>
<td>3.97</td>
<td>-0.42</td>
<td>90%</td>
</tr>
<tr>
<td>July</td>
<td>2.31</td>
<td>-1.95</td>
<td>54%</td>
</tr>
<tr>
<td>August</td>
<td>4.65</td>
<td>1.46</td>
<td>146%</td>
</tr>
<tr>
<td>September</td>
<td>0.93</td>
<td>-1.32</td>
<td>41%</td>
</tr>
<tr>
<td>October</td>
<td>4.29</td>
<td>1.18</td>
<td>138%</td>
</tr>
<tr>
<td>November</td>
<td>2.47</td>
<td>-1.23</td>
<td>67%</td>
</tr>
<tr>
<td>December</td>
<td>2.23</td>
<td>-0.85</td>
<td>72%</td>
</tr>
</tbody>
</table>

**Results**

Since 2019 was our first full year of operation, the main purpose of data collection was to establish a baseline of phenophase activity. In future years, comparisons can be drawn between different geographic regions and time periods, allowing us to answer our main science questions: How does the timing of phenological events vary from year to year?, and how does the timing of phenological events vary by region in Indiana? Although the 2019 data mainly serves as a baseline for future years, some conclusions can still be drawn.

**Phenophase Activity**

For all species, breaking leaf buds were first recorded at the beginning of April, with leaf growth lasting through May or June. Flower buds and open flowers were recorded beginning in April and ending sometime in May for all species except tulip tree and American sycamore. The first recording of flowers for tulip tree was made at the beginning of May, and open flowers were recorded through the beginning of June. No flowers were observed on the American sycamore, which was likely due to sycamore anthracnose. Colored and falling leaves were observed beginning in July or August for most species. The activity periods for fruit phenophases varied the most among species. Fruits were first recorded between April and June for all species, aside from American sycamore, which did not produce any fruit. Fruit or seed drop began anywhere between May and October, depending on the species. Very little phenophase activity was observed between December and April, aside from the occasional observation of fruit or fruit drop.
This data indicates three time periods when phenophase activity should be observed most frequently. The first period, between April and June, is when most growth occurs. The second period, between July and September, is when most fruits begin to ripen and leaves begin to change color and fall. The third period, November, is when most phenophase periods end, aside from some fruits that may remain into the winter. During these three periods, observations should be made weekly or biweekly, to most accurately capture the changes in phenophase activity. During the other months, observations do not need to be made as frequently.

Sycamore Activity

Like the other species, leaf out occurred for the Sycamore between April and June. However, leaf fall occurred for much of the growing season, from June through December, and no flowers or fruits were ever observed. The Holliday Park Sycamore appeared sickly and had few leaves long after most of the other trees had fully leafed out. One possible explanation is sycamore anthracnose disease. Sycamore anthracnose disease is caused by a fungal infection that is common during persistent cool, wet weather like we had between late April and early May. During the three week period starting April 15 and going through the first week of May, we had only 4 days without precipitation.
Numerous news sources across the Midwest reported a high number of sycamore anthracnose cases this spring, suggesting that it was caused by a cool and wet growing season (Bonkowski, Donne, Evans). Anthracnose fungus survives through the winter in infected portions of trees, as well as dead leaves and twigs. When spring arrives, the spores of the fungus can be moved by wind and rain, making the disease more harmful under cool and wet conditions. Sycamore anthracnose results in dead areas on leaf veins or margins, and eventual leaf fall. The fungus can also cause twig death, leaving tree limbs looking deformed with little to no leaf out, and cankers may appear on smaller branches. The damage to twigs and shoots explains the lack of fruit and flowers, as the damaged buds were never able to develop into flowers and therefore no fruit was produced.

While sycamore anthracnose impedes leaf out, most accounts reported that once the wet and cold weather subsides, sycamores will generally leaf out later in the growing season. Such was the case with the Holliday Park sycamore. By the first week of July the tree was at near full canopy (>95% of canopy spaced filled with leaves). Two potential lingering effects of the fungal infection were the absence of fruits and a steady fall of (presumably damaged) leaves throughout the summer. In spite of the falling leaves, the canopy remained full and only isolated colored leaves were observed until late August, when autumn leaf color change began in earnest. While the sycamore had a slow start this year, it appears to have recovered, finishing out the season healthy and strong. Infections in future years will depend on the weather conditions. Healthy trees commonly survive yearly anthracnose infections (Bonkowski) and the Holliday Park sycamore will, too.

**Education / Outreach**

Indiana Phenology had numerous education and outreach initiatives throughout 2019 to share our work with a greater audience and to recruit volunteers. We have a website that has freely available phenophase guides for local species, to be used by Indiana Backyard Observers. We also have a monthly newsletter with information about past observations and upcoming events that is posted on our website and directly emailed to over 100 subscribers. We participated in two large events this year, Earthday Indiana, in April, and Indiana Native Plant Society Annual Convention, in November. We had a table at each of these events where we engaged participants and shared information about our programs. We also published an article in the Indiana Native Plant Society Journal about backyard phenology observing.

In addition to these events, we hosted two phenology workshops at Holliday Park, with a total of 15 attendees across both workshops. Both workshops were approximately two hours and involved both educational and interactive components. Our first workshop in the spring provided information about the basics of phenology and making observations, as well as specific information about our programs and how to get involved. The fall workshop discussed phenology and its importance by focusing specifically on the science behind fall leaf color. Both workshops concluded with a hike, which gave attendees an opportunity to explore the Holliiday Park Phenology Walk and to practice their observation skills.
**Lessons Learned**

*Visiting Frequency / Volunteer Recruitment*

The data suggests three periods throughout the year with high phenophase activity. These periods are April to June, July to September, and November. To ensure that all phenophase changes are observed and to increase the accuracy of recorded phenophase start and end dates, visits should be made more frequently during these periods, at least once a week. The number of regular observers during these periods should be higher than other periods, to allow for increased observation without putting too much strain on a few individual volunteers to collect all of the data.

Visits to the Holliday Park site were made, on average, about three times a month. Increasing the number of active observers at Holliday Park would facilitate increasing visit frequency to weekly or even twice weekly throughout the growing season. Possible ways to promote these programs and to retain volunteers are to hold additional workshops like the ones provided at Holliday Park in 2019 and to increase signage around the park regarding the program and how to get involved. Having workshop participants sign up for volunteer shifts before leaving the workshop could increase volunteer retention among workshop participants.

*Site Creation*

The honeylocust was removed from the Holliday Park Phenology Walk after a couple of months because of its inconvenient distance from the other trees. Keeping sites small and in convenient locations, such as near the Holliday Park parking lot, will allow for observations to be completed more efficiently. Inconvenient or inefficient data collection is a barrier to volunteer retention. Creating sites with this in mind will allow us to more easily recruit and retain volunteers.

*Collaboration with Holliday Park*

The location of the trail and selection of plants was done now that we have completed the first year of observations at the park, the time is ripe for reflection of how the observation program and collected data can be improved or packaged to meet the needs of Holliday Park staff. One idea is to collaborate with park staff to develop site-specific science questions that will yield useful information for educational programs or to support management decisions. Site-specific science questions will help us to better target our future observation efforts. Are there other areas of the park that would be helpful for us to observe? Are their other species for which staff would appreciate phenology data? Additionally, the data we have and will continue to collect can be utilized to develop educational materials for the park in the form of signs or displays that share the data or in handouts and visual aids to enhance existing park programming.

*Summary & Next Steps*

Indiana Phenology has successfully completed our first full year of operations. This section outlines short-term and long-term goals for the continuation of our program, and offers steps to reach them.
Short-term goals

1. Further develop programming at Holliday Park site to engage more volunteers.
   ○ Create a display with discoveries from our past year of data collection to be featured in the Holliday Park nature center.
   ○ Ask Holliday Park to promote our program in their newsletters, educational materials, etc.
   ○ Work with Holliday Park staff to develop site-specific science questions that help them reach specific educational or management goals while also engaging volunteers.
   ○ Continue to hold workshops specifically to train volunteers to be Holliday Park Observers. Have attendees sign up for volunteer shifts at Holliday Park before leaving. This will limit the number of attendees who never sign up for a shift.

2. Expand scope of and educational resources provided at the Holliday Park site
   ○ Create phenophase guides for all species observed.
   ○ Present additional workshops or lectures at Holliday Park to share our results with the general public.
   ○ Offer seasonal phenology hikes focusing on spring, summer, fall and winter phenology at Holliday Park
   ○ Consider creating a second site within the park. This would allow for comparison among parking lot and trail species.
   ○ Consider adding additional species to be observed. Adding invasive species or animal species could allow for interesting comparisons between plant and animal activity, or invasive vs. native species activity.

3. Expand Indiana Phenology Trail program to include additional sites
   ○ Share the results presented in this report with Holliday Park and Indy Parks staff.
   ○ Reach out to individual parks, in Indianapolis and other regions across Indiana, about participating in the phenology trail program. Focus on parks that already have education or phenology programs that align with the goals of Indiana Phenology.
   ○ Recruit volunteers in Indianapolis and other regions across Indiana.
   ○ Participate in additional events and conferences, such as Earthday Indiana, where we could meet potential partners.

Long-term goals

1. Expand our network
   ○ Recruit partners in regions across Indiana, including creating observation sites at state, regional and local parks.
   ○ Engage Indiana Master Naturalists in making observations and assisting at partner sites.
   ○ Develop an internship program to engage college students and others in program development and delivery.
   ○ Pilot a schoolyard program to engage K-12 students in collecting observations on their school grounds.
○ Enlist volunteer regional coordinators, to work with partner sites in their region of Indiana and to consult about educational programming and recruitment.
○ Create a forum for partner sites to share information and advice with each other. Could be added as a feature of our website.

2. Retain observers
○ Hold periodic training events (annual, bi-annual) to review observer protocols, get feedback from observers, and give observers an opportunity to engage with each other and meet new people.
○ Create site-specific science questions catered towards the needs of partner organizations and the interests of their observers.

3. Educational development
○ Continue to upload all educational resources to the website.
○ Offer more opportunities for observer interaction with the website. Potentially include a blog section that features writing from observers or employees at partner sites.
○ Compile data to answer Indiana Phenology science questions.
○ Share data and analysis with observers, partner sites, and other interested parties. Upload all reports, such as this one, to our website.

**Location of Project Components**
All data is entered online via Nature's Notebook and is stored in the USA-NPN database, available for download at [www.usanpn.org/results/data](http://www.usanpn.org/results/data).

More information about Indiana Phenology can be found on our website, [www.indianaphenology.org](http://www.indianaphenology.org) and [observers.indianaphenology.org](http://observers.indianaphenology.org)

**Works Cited**


Evans, Chad. May 9, 2019. Chad’s Garden: What is Wrong with the American sycamore Trees? [www.wifi.com](http://www.wifi.com).
