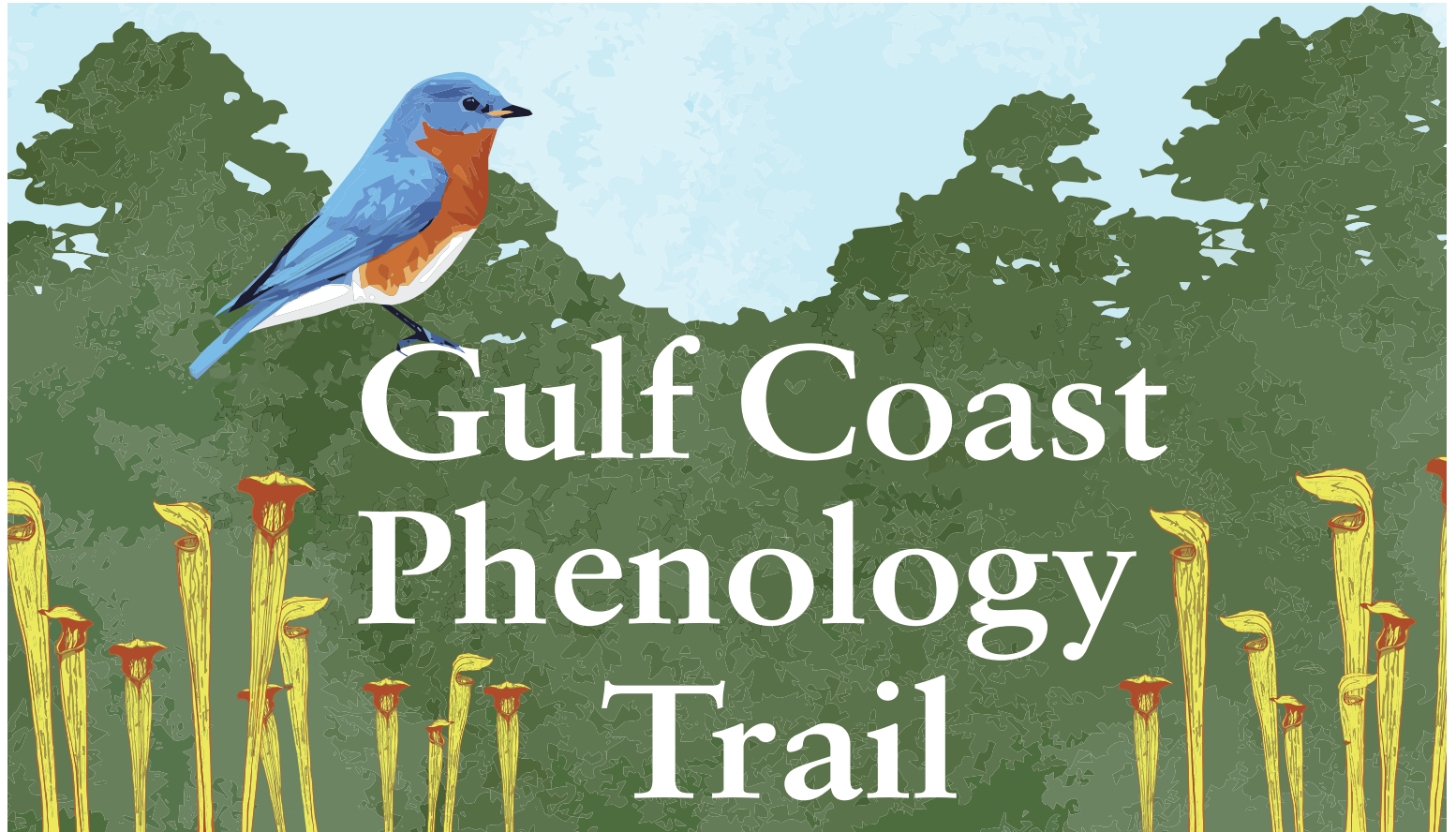


2024

GULF COAST PHENOLOGY TRAIL ANNUAL REPORT

A YEAR OF GROWTH AND CHANGE



MISSISSIPPI STATE
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EXTENSION



Grand Bay
National Estuarine
Research Reserve

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Gulf Coast Phenology Trail

The Gulf Coast Phenology Trail (GCPT) was established in 2016 to engage state, federal, and nongovernmental partners along the coast of Louisiana, Mississippi, and Alabama in community science-driven, long-term monitoring of phenological trends to gain a better understanding of impacts of changing climate along the north-central Gulf Coast. The region consists of unique ecosystems like pine savannas, maritime forests, estuaries, and salt marshes that support a large variety of native flora and fauna.

The support and coordination for the GCPT comes from the USA-National Phenology Network (USA-NPN), which continues to make this regional-scale project possible. Since the establishment of the GCPT, it has been funded by the U.S. Fish and Wildlife Service's Inventory and Monitoring Initiative, with coordination from Gail Bishop since 2017. One of the local phenology programs (LPPs) within the GCPT, Grand Bay National Estuarine Research Reserve, took ownership of the program in 2024 and appointed a new coordinator, Emmett Carstens, who is a plant ecologist. During the latter half of 2024, six new LPPs were added to the GCPT, three in Mississippi and three in Alabama.

Education and outreach were pivotal for making new connections within the community, which has allowed the GCPT to grow. With each passing year, the phenology dataset becomes more valuable for understanding trends associated with our target species, and our connection with the regional community continues to expand. This report details the purpose of the GCPT, outlines its activities in 2024, and provides an overview of some of the data collected during the year, including climatic variables that are commonly related to phenology.

2024 Gulf Coast Phenology Trail Observer of the Year

The GCPT would be nothing without its team of dedicated, trained community scientists. In recognition of their commitment, we honor an observer in the 2024 annual report.

Sharon Ward, 2024 Observer of the Year,
tends to her tomato plants.

The 2024 GCPT Observer of the Year is Sharon Matarelli-Ward. Sharon currently resides in Vancleave and has been involved with the GCPT since May 2022. She currently monitors phenology at the Mississippi Sandhill Crane NWR Visitor Center in Gautier and has previously monitored at the Fontainebleau Site in Ocean Springs. She has also helped with outreach events and shared her knowledge by training new observers. We asked Sharon the following questions to get her thoughts on monitoring the GCPT:

What are your favorite phenology plants?

If I can only pick one, it would be the red maple. Although some locals say they don't think much of them, I like that they are one of the few natives here that show fall colors, and they remind me of the Midwest where I spent most of my life. A close second would be wax myrtle as I had never seen them until I moved here. I was mystified the first time I saw their fruits, thinking they were some kind of insect eggs, but then I was delighted to find out so many bird species love them!

What benefits or values do you get from being an observer for the GCPT?

Most of the plants and trees of this unique part of the country were new to me when I first moved here. Walking the trails with the Nature's Notebook app and other apps, as well as the feedback of other participants, was a great hands-on way to begin learning them. The repeated visits to the same plants over time have made me feel more like I am going to visit friends in the woods than doing a scientific report.



Introduction

The Gulf Coast Phenology Trail (GCPT) consists of a network of local phenology programs (LPPs) across the coasts of Louisiana, Mississippi, and Alabama (Figure 1, Table 1). Within each of these LPPs, there are one or more sites for phenological monitoring. Currently, the GCPT is focused on observing five native species with known habitat value across all LPPs: red maple (*Acer rubrum*), red bay (*Persea borbonia*), yaupon holly (*Ilex vomitoria*), wax myrtle (*Morella cerifera*), and American beautyberry (*Callicarpa americana*). In addition to the five focal species, many other plant and animal species are monitored across the GCPT (Appendix A).

Long-term phenological data for these species can be used for multiple purposes, such as understanding long-term phenological trends, forecasting potential mismatches between organisms that rely on one another’s phenology, helping researchers understand when to sample or study

a particular species, and informing land management decisions. Community scientists including college students and K-12 students participate in monitoring phenology across the LPPs.

Each year, an annual report is written that details the activities associated with the GCPT and presents a subset of the data for volunteers and others interested in following phenological trends (see previous annual reports on the GCPT website). The guiding research questions for the GCPT include:

- Is the phenology of native Gulf Coast plants changing over time?
- Are there correlations between the phenology of native pollinators and their host plants?
- Is there a west to east gradient in the phenology of focal species?

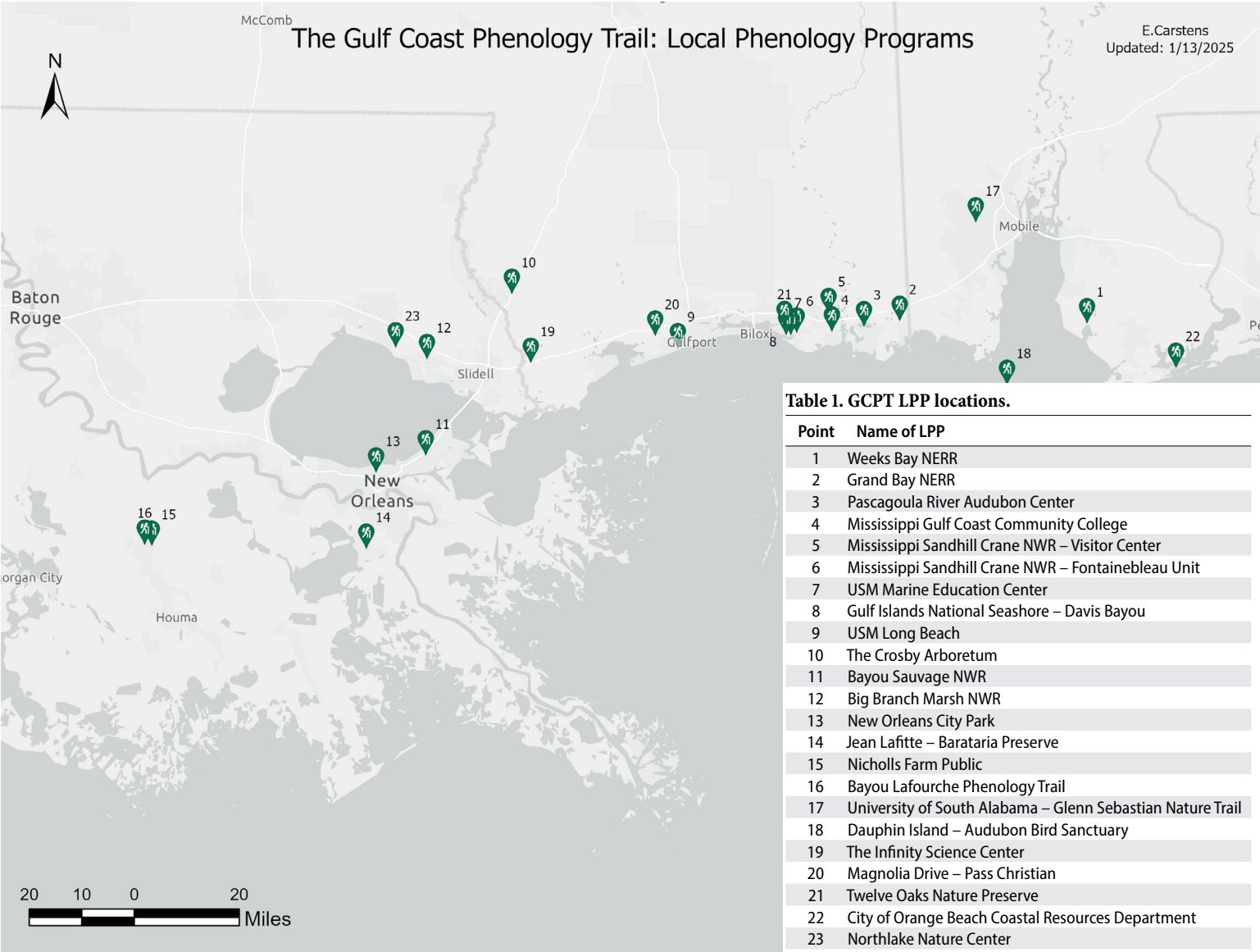


Figure 1. Map of the Gulf Coast Phenology Trail local phenology programs (LPPs). Seven new LPPs were established in 2024 into early 2025.

Trained community scientists or observers are essential to the success of the GCPT. When a person becomes an observer, they make a commitment to weekly, bi-weekly, or monthly visits to LPPs, where they use the USA-NPN Nature's Notebook app to record data on selected plants and animals. The protocols for data collection are outlined on the [Nature's Notebook website](#).

A new LPP is established through the submission of a [Local Phenology Program Request form](#) by an individual with a Nature's Notebook account. After approval, the coordinator schedules a visit to the LPP to help staff and community scientists with site selection, species identification, and the process of marking and adding the plants and animals that will be monitored.

After the site visit, observer training is scheduled and interested staff and locals are invited to attend. The training involves an informational classroom portion followed by a visit to the new site or a nearby established LPP, where the participants are trained to observe and enter phenology data into the Nature's Notebook app using a smartphone or tablet. A paper data sheet, with the same prompts as the app, may be used instead to collect phenology data that is later entered manually by the observer or coordinator into the Nature's Notebook website (Appendix B).

Animal observations are typically made during the time spent recording data on marked plants. Observers are asked, if an animal is present, what activity and life stages were seen (i.e., adults, mating, migration, interactions with plants), number of individuals, and additional metadata such as time spent searching, number of observers searching, and survey method (Appendix C). GCPT observers commit to making repeated observations on the same individual plant or animal species for more than one calendar year to capture the full range of phenological activity.

Trail Coordination in 2024

Over the summer of 2024, the new coordinator, Emmett Carstens, accompanied by Grand Bay National Estuarine Research Reserve (NERR) staff and former coordinator Gail Bishop, visited 14 of the 15 established LPPs, met with staff and volunteers, and checked out the condition of the sites. Nicholls Farm Public LPP was unresponsive and appears to no longer be active. In June 2024, an observer training was held at the Grand Bay NERR (Figure 2). Five people were in attendance from Biloxi, Mississippi, and Fairhope, Alabama.

After visiting the LPPs and assessing the need for increased visibility and promotion of the GCPT program, the coordinator, with help from Dr. Jonathan Pitchford, applied for the U.S. Environmental Protection Agency's



Figure 2. In late June 2024, former Gulf Coast Phenology Trail (GCPT) coordinator Gail Bishop and the new coordinator, Emmett Carstens, had a phenology observer training at the Grand Bay National Estuarine Research Reserve (NERR). The training consisted of a brief presentation on phenology, the GCPT, and USA-National Phenology Network and Nature's Notebook. A field portion followed at the Grand Bay NERR's boardwalk site, where new observers were able to practice making phenology observations using the Nature's Notebook app. Five people were in attendance from coastal Alabama and Mississippi.

Environmental Justice Small Grants Program administered by The Land Trust for the Mississippi Coastal Plain. The proposal included plans to establish permanent informational signs at all LPPs, develop and distribute educational materials (e.g., brochures, videos, etc.), and purchase and install bird, bee, and butterfly houses at selected sites where those species were being monitored. Unfortunately, the proposal was not selected for funding. The coordinator will continue to look for external funding and grant opportunities over the next year.

In September, the coordinator contacted Dr. Jeremiah Henning (University of South Alabama/Dauphin Island Sea Lab) to discuss establishing several new LPPs in Alabama that would be monitored and overseen by his students, as well as



Figure 3. A new LPP was established at the University of South Alabama in Mobile on the Glenn Sebastian Nature Trail and features several native species from the focal species list for the GCPT as well as a few Chinese tallow trees for phenological monitoring. Several students in the University of South Alabama biology department will take on the role of observers.

a personal site at his home in Pass Christian, Mississippi. Later in September, new LPPs were established at the University of South Alabama-Glenn Sebastian Nature Trail (Figure 3) and Dauphin Island-Audubon Bird Sanctuary (Figure 4). Observations at each site will begin in early 2025.

The Coastal Chapter of Mississippi Master Naturalists learned about the GCPT when they took their field trip to the Grand Bay NERR at the end of September. Several of the students took interest in becoming observers and helping to establish new LPPs. This phenological monitoring work will count toward their Master Naturalist volunteer hours and allow them to become more familiar with local flora and fauna.

In October, the coordinator met with Brian Alexander and Michelle Anderson Coleman at the Infinity Science Center in Pearlington, Mississippi. Plans were made to establish a new LPP, and two sites were proposed: the Possum Trail and the



Figure 4. A new LPP was established for the town of Dauphin Island, Alabama, at the Audubon Bird Sanctuary. Students and other trained community scientists will monitor several focal plant species and migratory birds.

boardwalk in front of the center. Plans were made to set up the boardwalk site in January 2025.

Later in October, Boy Scout Troop 271 of Ocean Springs, Mississippi, reached out to the coordinator with interest in earning conservation and service hours through participation with the GCPT. Subsequently, a new LPP was established at Twelve Oaks Nature Preserve in Ocean Springs (Figure 5). With the help of Troop 271, plants were selected and tagged for monitoring and observer training was scheduled for spring 2025. This LPP will be the first one in the GCPT to be monitored by a youth group or organization such as Scouts of America.

In November, the coordinator presented information about the GCPT at the Bays and Bayous Symposium in Biloxi, Mississippi. Forty-nine people attended the presentation, and several expressed interest in the program. The Wind and

Water Learning Center coordinator, Jackie McGonigal, reached out with interest in establishing an LPP for the city of Orange Beach Coastal Resources Department. This would be the easternmost LPP for the GCPT and the fourth site to be added in coastal Alabama since the trail was established. Jackie was interested in creating opportunities to teach about phenology and native plants and animals to local elementary school students and youth groups that use the Wind and Water Learning Center and facilities throughout the year. The coordinator made plans to meet with Jackie and set up some sites in Orange Beach, as well as provide observer training to teachers, colleagues, and the interested public for spring 2025.

In December, the coordinator, along with Gail Bishop and Sue Wilder, hosted a workshop with the Louisiana Master Naturalists group at New Orleans City Park LPP – Couturie Forest site (Figure 6). A brief presentation was given on phenology and the GCPT program, followed by practicing observations in the Couturie Forest using the Nature's Notebook app. Several weeks after the workshop, Alex Landry (naturalist and environmental education coordinator at Pelican Park) reached out to the coordinator with interest in creating an LPP that includes several sites at the Northlake Nature Center in Mandeville, Louisiana. A site visit and setup was planned for early 2025.

Observer Activity in 2024

In 2024, the most site visits across the GCPT were during the months of February, March, April, and August (Appendix D). During the summer (June and July), site visits were reduced

to nearly half that of those most active months. Elevated site visits in August are influenced by visits from the new coordinator that month. Overall, the number of site visits by month in 2024 was lower than those in 2021 and 2023. This was due to closures and maintenance of several sites and a lack of trained volunteers across all LPPs. The total number of active observers across the GCPT decreased from 47 people in 2023 to 35 people in 2024. Table 2 provides details about the LPPs.

The Louisiana LPPs had 33 active observers in 2023 and 16 in 2024 (Appendix E). The highest observer activity by month at Louisiana LPPs was during the winter or early spring months in 2023, with a maximum of 12 active observers in February. In 2024, the highest observer activity was during November and December, with a combined 10 active observers during those months. High observer activity at Louisiana sites during those months is most likely related to Master Naturalist observer training occurring at the New Orleans City Park LPP.

The Mississippi LPPs had 13 active observers in 2023 and 15 in 2024. The monthly visits for both years were consistent, with slightly higher observer activity in 2023.

At the only LPP in Alabama, the Weeks Bay NERR, observer activity increased from one (2023) to four (2024) active observers and more consistent monthly observer activity overall. (This was before monitoring began at recently established LPPs.)



Figure 5. In December 2024, Boy Scout Troop 271 of Ocean Springs, Mississippi, helped establish a new LPP at Twelve Oaks Nature Preserve.



Figure 6. In December 2024, the GCPT hosted a workshop with Louisiana Master Naturalists of Greater New Orleans. The group learned about the GCPT and then practiced making observations at the New Orleans City Park LPP – Couturie Forest site. Photo by Sue Wilder (USFWS).

Table 2. LPPs active in 2024 and number of sites, site names, total phenology records for 2024, and total number of site visits for 2024. Phenology records refer to a single status record (a “yes,” “no,” or “unsure/?” response to one of the phenophase definitions in the protocol). An observation refers to the entire suite of phenophase status records for an individual plant or species of animal.

Program	Sites	Site Name	2024 Phenology Records	2024 Site Visits	Notes
Louisiana					
Barataria Preserve	4	Bayou Coquille	3,798	35	Only two of four sites active due to accessibility of trails.
		Visitor Center	4,576	37	One site visit by coordinator in August.
		Palmetto Trail	–	–	
		Ring Levee Trail	–	–	
Bayou LaFourche	1	Wetlands Acadian Cultural Center	72	1	One site visit by coordinator in August.
Bayou Sauvage NWR	1	Boardwalk	5,933	20	
Big Branch Marsh NWR	3	Blue Trail	3,957	26	
		Entrance Road	831	26	
		Main Parking Lot	2,057	26	
New Orleans City Park	2	Couturie Forest	6,736	44	
		Big Lake	2,957	40	
Nicholl's Farm	1	Nicholl's Farm	–	–	No visits in 2024; removed from GCPT.
Mississippi					
The Crosby Arboretum	1	Phenology Journey	4,223	20	
Grand Bay NERR/ NWR	3	Boardwalk	8,301	35	
		Front Lawn	2,253	28	
		Savanna Trail	1,329	29	
Gulf Islands National Seashore	1	Davis Bayou	129	2	Visits in April and December only.
MGCCC Marine Education Center	1	Pine Restoration Trail	5,310	39	
Mississippi Sandhill Crane NWR	2	Visitor Center	4,883	27	
		Fontainebleau Unit	4,754	17	
USM Long Beach Campus	1	Bear Bayou East Path	99	1	One site visit by coordinator in May.
USM Marine Education Center	1	Osprey Point Nature Trail	1,707	20	Visited March to July only.
Pascagoula River Audubon Center	3	PRAC Front Lawn	–	–	Under renovation and had no visits in 2024.
		PRAC Boat Launch Trail	–	–	
		PRAC Trail 2	–	–	
Twelve Oaks Coastal Preserve	1	Old Fort Bayou Trail	–	–	Trail established in late 2024 or early 2025; no visits recorded in 2024.
Infinity Science Center	2	Boardwalk	–	–	Trail established in late 2024 or early 2025; no visits recorded in 2024.
		Possum Trail	–	–	
Pass Christian - Magnolia Drive	1	Henning residence	–	–	Trail established in late 2024 or early 2025; no visits recorded in 2024.

Program	Sites	Site Name	2024 Phenology Records	2024 Site Visits	Notes
Alabama					
Weeks Bay NERR	1	Visitor Center Boardwalk	1,412	15	Visited from January to February and May to October only.
City of Orange Beach-Coastal Resources Dept	2	Wind and Water Learning Center	–	–	Trail established in late 2024 or early 2025; no visits recorded in 2024.
		Orange Beach Elementary	–	–	Trail established in late 2024 or early 2025; no visits recorded in 2024.
Town of Dauphin Island	1	Audubon Bird Sanctuary			
University of South Alabama	1	Glenn Sebastian Nature Trail	–	–	Trail established in late 2024 or early 2025; no visits recorded in 2024.

Gulf Coast Phenology Trail Weather and Climate

Weather and climate information was acquired from several sources to better understand temperature and precipitation data during 2024 and relate it to historical data. These included the [Community Collaborative Rain, Hail, and Snow Network](#), [University of Utah MesoWest](#), [Iowa Environmental Mesonet](#), and [National Oceanic and Atmospheric Administration Applied Climate Information System](#).

The long-term climatological means of rainfall within the GCPT region ranges from 61 to 69 inches. However, year to year variance and spatial differences within years is common. Across the region, 2024 was wetter than 2023, which included a record-setting drought. There was, however, significant spatial variation in total precipitation and departures from normal in 2024 (Figure 7). The western region of the GCPT (i.e., Louisiana LPPs, Infinity Science Center, and Crosby

Arboretum) had more rain than normal. In southeast Louisiana, Orleans, Jefferson, and Lafourche Parishes (i.e., LPPs 11–16 in Figure 7) had their third, second, and fourth wettest years on record, respectively (the period of record includes data from 1895 to 2024). In coastal Mississippi and south Alabama, precipitation was more variable.

The western portion of the GCPT had large precipitation events during the first half of September 2024. Much of the rainfall in September occurred as Hurricane Francine made landfall over south Louisiana and interacted with a stalled frontal system. October, which is often the driest month of the year, was even drier than normal across the entire region in 2024. The average rainfall for Harrison and Jackson Counties was approximately 0.5 inches in October 2024.

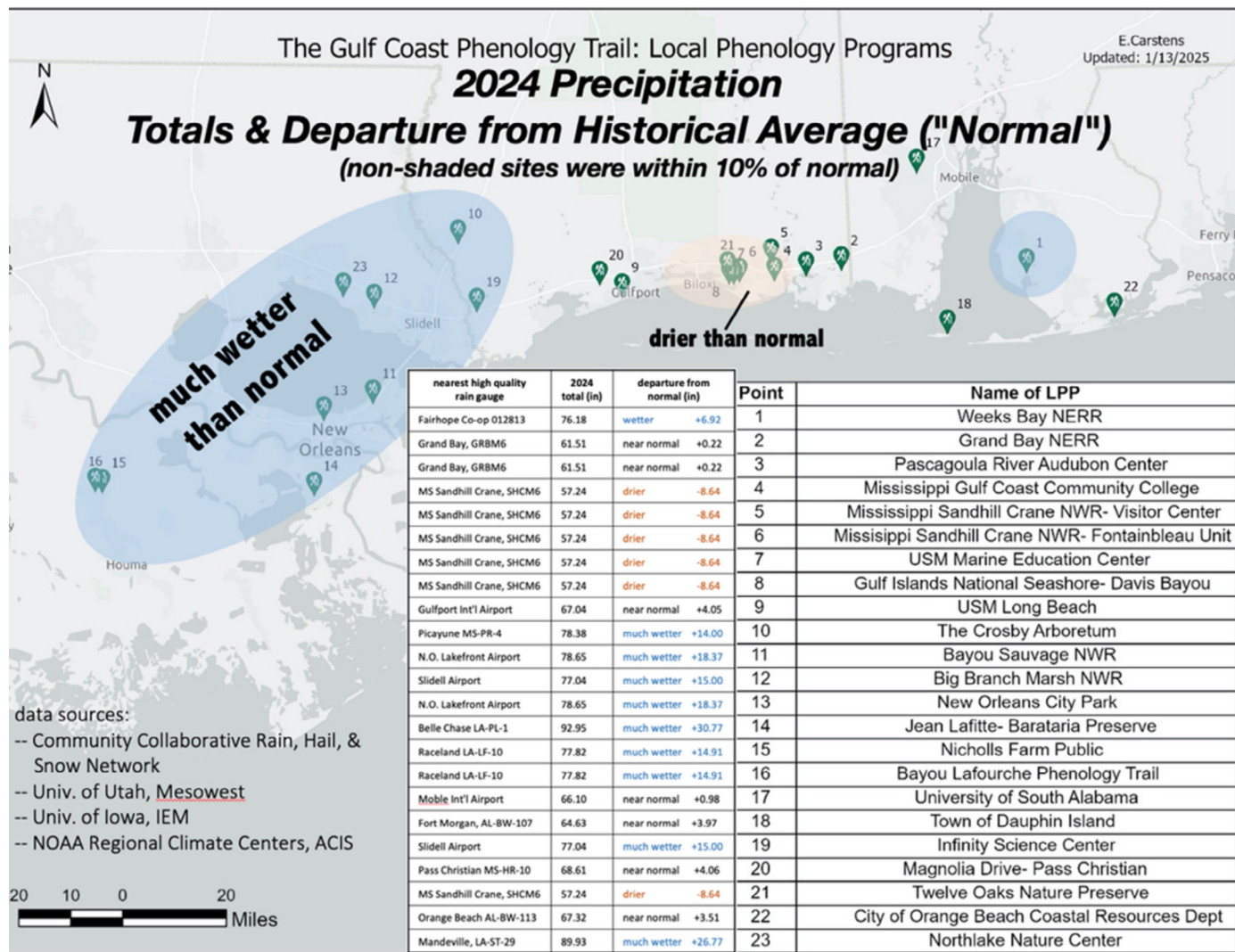


Figure 7. Annual precipitation totals for 2024 and departures from historical climatological averages (1895–2024) along the Gulf Coast Phenology Trail.

The year 2024 was the second warmest on record across the GCPT region, exceeded only by 2023. Annual average temperatures were 70–73°F, which is 2–3°F above the long-term climatological means. The last freeze in the spring of 2024 was earlier than the long-term climatological average dates at all locations across the region except for Dauphin Island (Figure 8). Usually, the first freeze in the fall and early winter occurs in late November or December in the GCPT

region. However, by the end of December 2024, the first freeze of the season had not yet occurred at most LPP sites except for Weeks Bay NERR, University of South Alabama, Nicholls Farm Public, and Bayou Lafourche (Figure 9). Even at those locations, nearby weather observations indicated that the first freeze occurred later than the climatological average date.

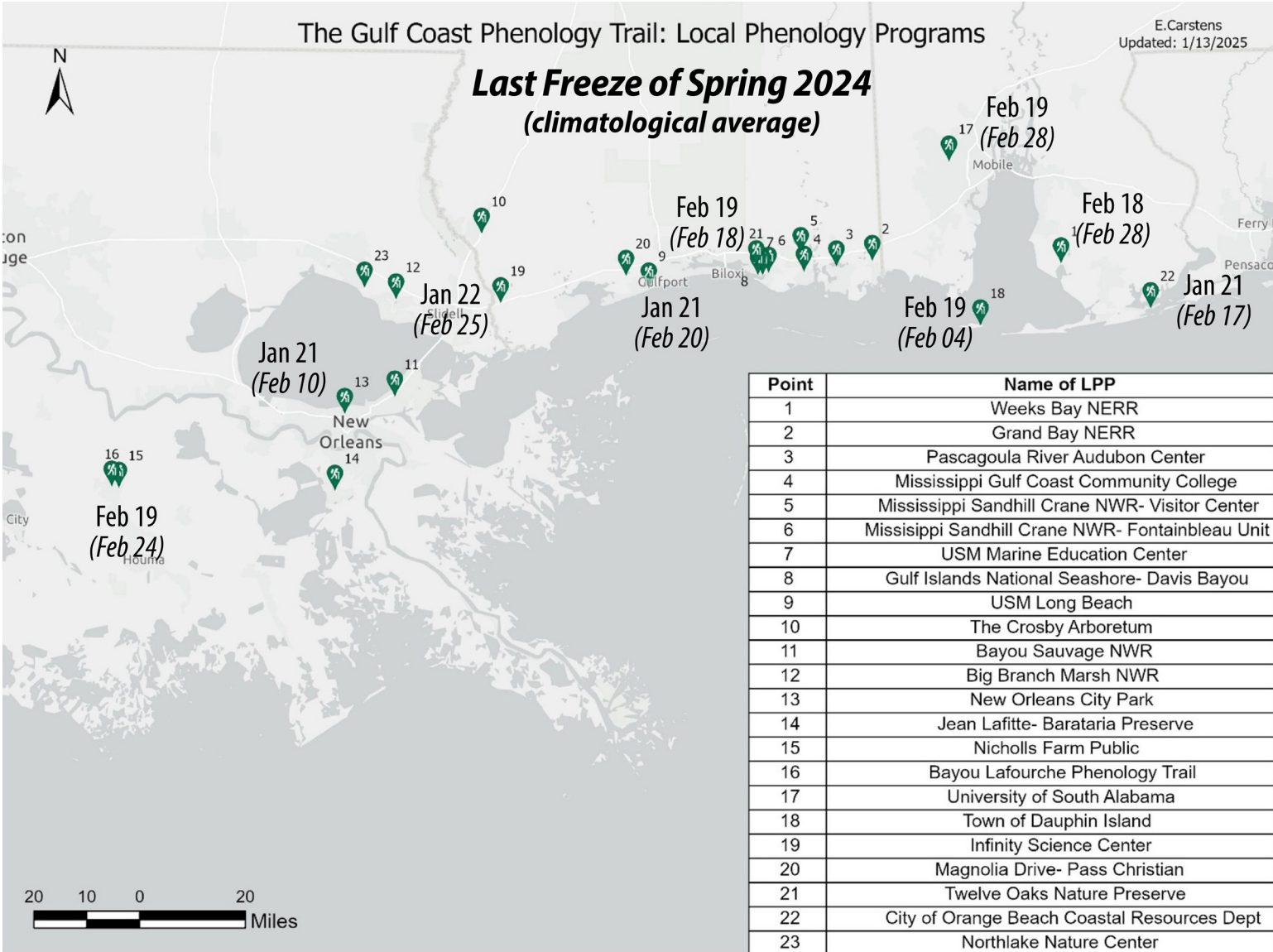


Figure 8. Last spring freeze dates of 2024 compared with climatological averages. The data comes from the nearest official stations of record from the National Oceanic and Atmospheric Administration Applied Climate Information System relative to LPP locations.

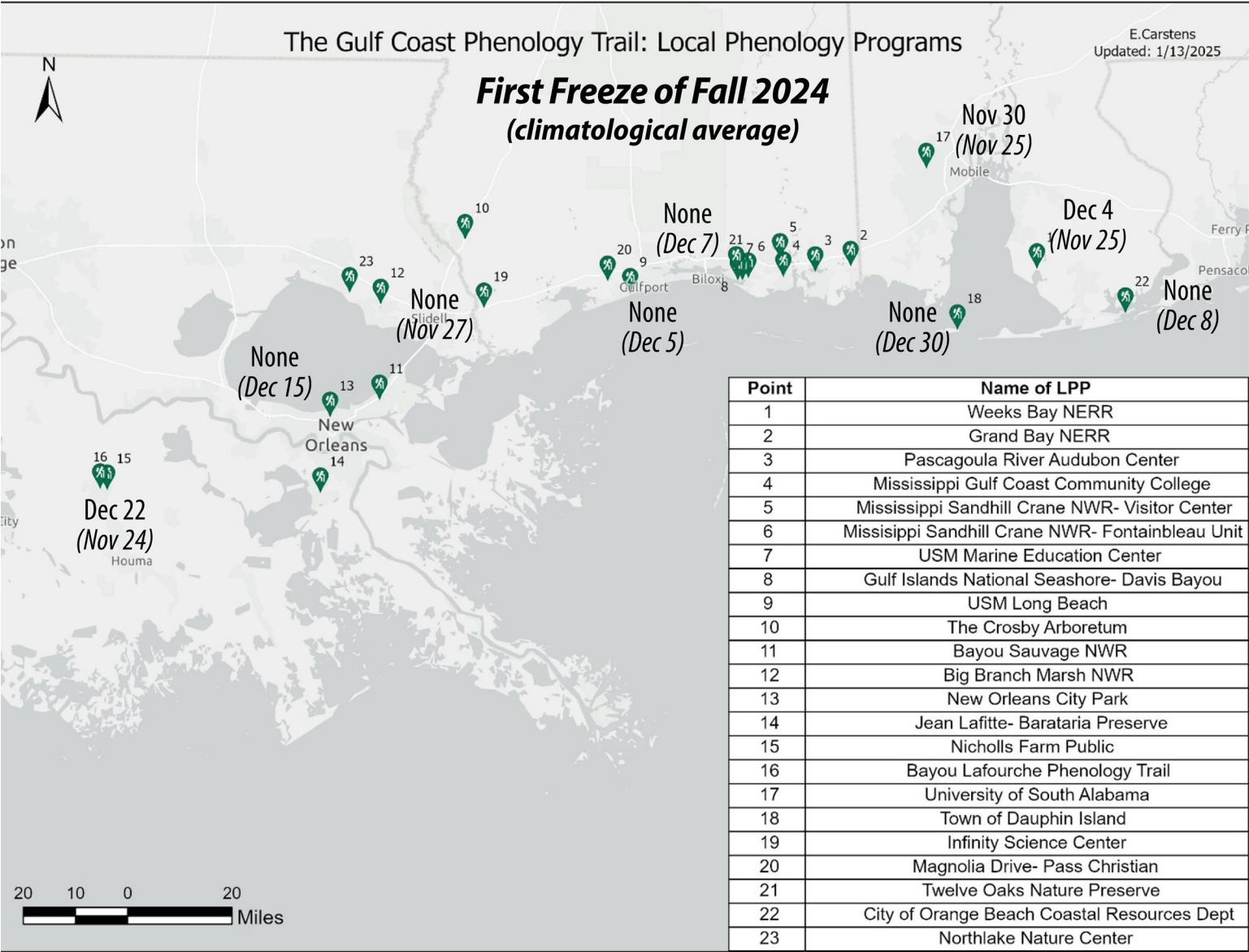


Figure 9. First fall/winter freeze dates of 2024 compared with climatological averages.
The data comes from the nearest official stations of record from the National Oceanic and Atmospheric Administration Applied Climate Information System relative to LPP locations.

Results of Phenological Analyses from Data Collected Through 2024

Data collected through 2024 was used to answer our guiding research questions. With so many species being monitored and so many possible phenological characteristics being tracked, we focused our efforts on focal species that were monitored across all or most of the LPPs. We focused on red maple (*Acer rubrum*) for the first research question: **Is the phenology of native Gulf Coast plants changing over time?**

Red maple is a deciduous tree that can grow up to 50 feet tall when mature. It is often the first sign of spring, as it is one of the earliest trees to produce flowers in the southeastern U.S. Red maple is polygamo-dioecious, meaning individual plants can produce all male, all female, or a combination of male and female flowers (Figure 10). Many animals, like white-tailed deer, eastern gray squirrels, and rabbits, are known to consume red maple fruits, also known as samaras. All active LPPs across the GCPT monitor at least one red maple, with many sites having three or more plants monitored.

Red maple flower production has varied by several weeks over the last couple of years (Figure 11). In 2021, flowers were recorded throughout the month of February. The first freeze during that year for much of the Gulf Coast was in late December and may have had an impact on the development and formation of flower buds. Additionally, the total winter (December to February) precipitation was less than 10 inches, which may have inhibited several growth and development mechanisms in red maple and led to drought-like conditions.

In 2022, flowers were recorded from mid- to late February and into early March. The date of the first freeze for 2022 was in early January, and the total winter precipitation was again less than 10 inches. The combination of these two factors has likely contributed to red maple flower and subsequent fruit production occurring later in winter.

In 2023, the first freeze was in late November to late December, and total winter precipitation was 10–15 inches. Flowers were recorded in mid-January through late February.

In 2024, flowers were seen on red maples during the first half of February. The total winter precipitation was more than



Figure 10. Red maple with male flowers (left) and female flowers (right).

15 inches, which was a wet winter compared with the last several years. The first freeze in 2024 was late December (of 2023) through mid-January across the GCPT sites.

While these results show some evidence of phenological trends over time for red maple, additional years of monitoring are needed to improve our understanding of these phenomena.

The fruiting of red maple across the GCPT has shifted over the last several years of monitoring (Figure 12). In 2019 and 2020, fruits were recorded in mid-January through mid-March. However, in 2021 and 2022, fruits were recorded in mid-February through early April. In 2023 and 2024, fruits were recorded during visits in mid-February through March.

Three LPPs had consistent red maple fruit observations from 2019 to 2024, Mississippi Sandhill Crane National Wildlife Refuge (NWR), Big Branch Marsh NWR, and Bayou Sauvage NWR, which allowed for comparison with weather data for those years. Figure 13 suggests a possible positive correlation

between the initial appearance of red maple fruits in late winter or spring and the date of the first moderate freeze of the winter ($\geq 29^{\circ}\text{F}$) at Mississippi Sandhill Crane NWR and Big Branch Marsh NWR. The earlier the first moderate freeze occurred, the earlier red maple fruits were observed.

It should be noted that winter temperatures at Bayou Sauvage NWR are moderated by nearby Lake Pontchartrain and Lake Borgne. Temperatures have not dropped below 32°F in about 25 percent of the winters since 1993–94 at the weather station at nearby New Orleans Lakefront Airport, making meaningful correlation of initial freeze dates with the appearance of the red maple fruit at Bayou Sauvage problematic.

Winter (December to February) rainfall totals are also shown for all three LPP sites in Figure 13, but a correlation with the appearance of red maple fruit does not appear evident. As monitoring continues, the longer time series will allow for more reliable analyses of phenological data and climate variables.

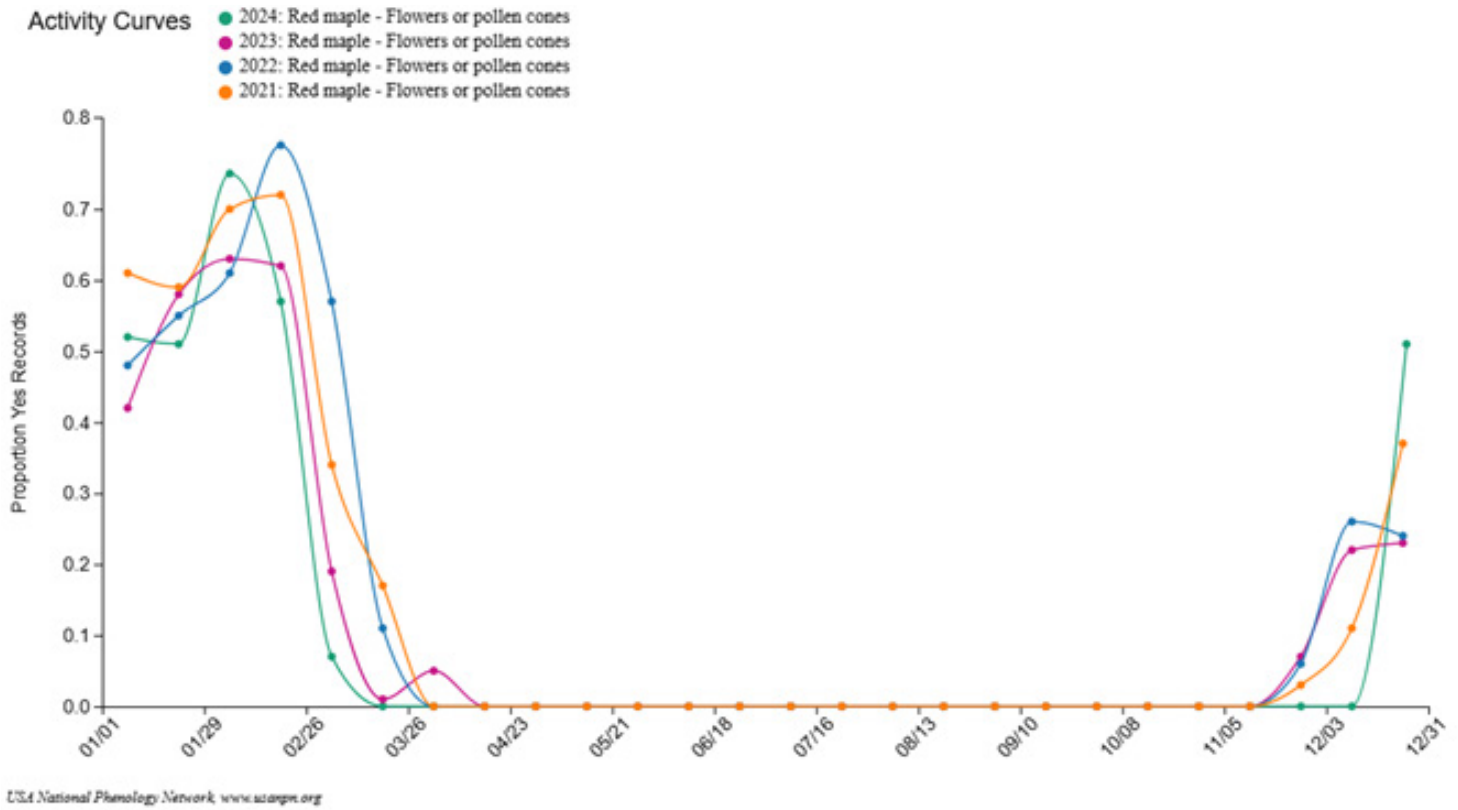


Figure 11. Bi-weekly red maple activity curves for flowers or pollen cones across the Gulf Coast Phenology Trail from 2021 to 2024. “Proportion Yes Records” refers to the percentage of observations with “yes” for a response, indicating the presence of flowers or pollen cones.

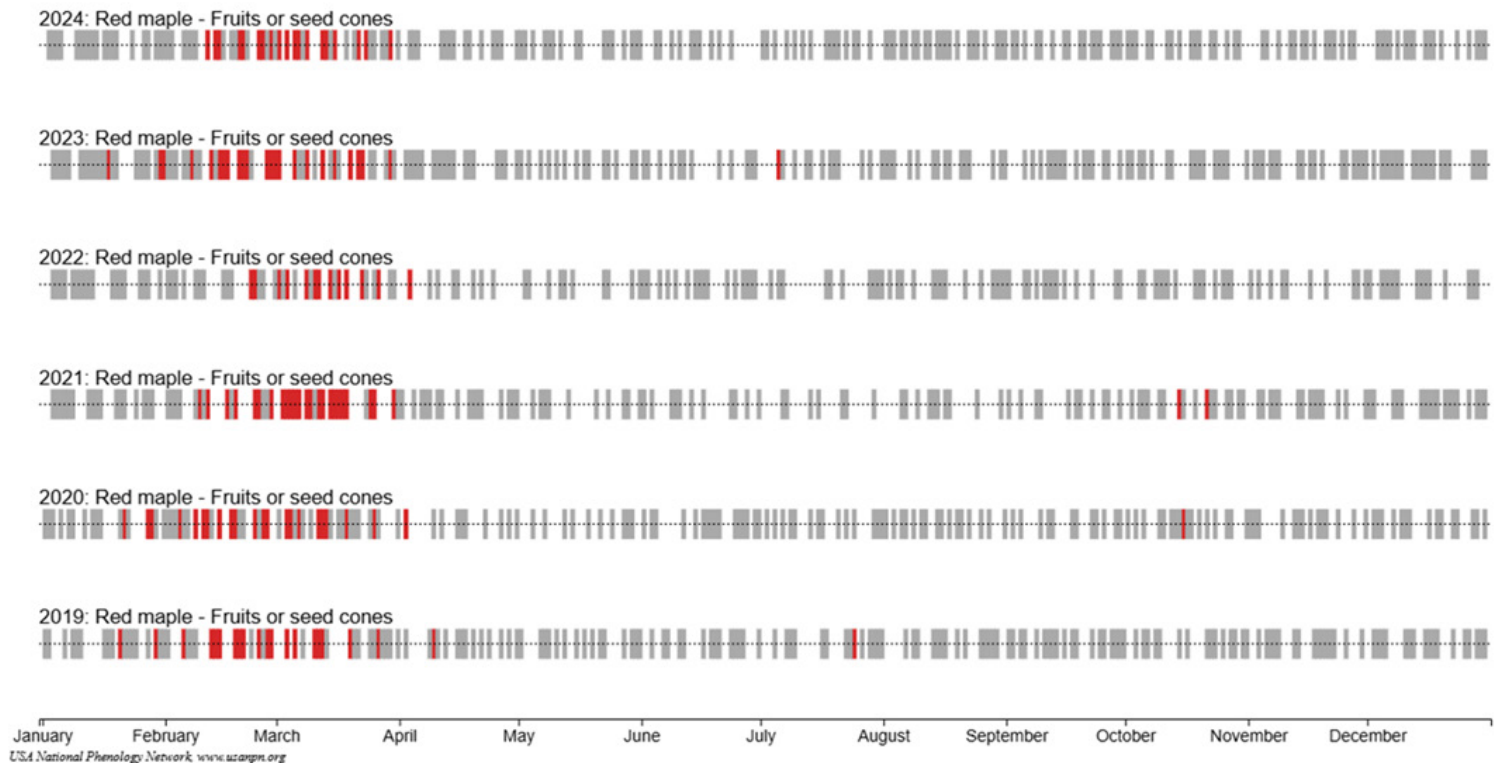


Figure 12. Red maple (*Acer rubrum*) “yes” records (red bars) for fruits or seed cones across the Gulf Coast Phenology Trail from 2019 to 2024. The gray bars indicate a “no” response from observers. “Yes” records are when a phenology observer indicates that they have observed or seen a particular phenophase on a monitored plant.

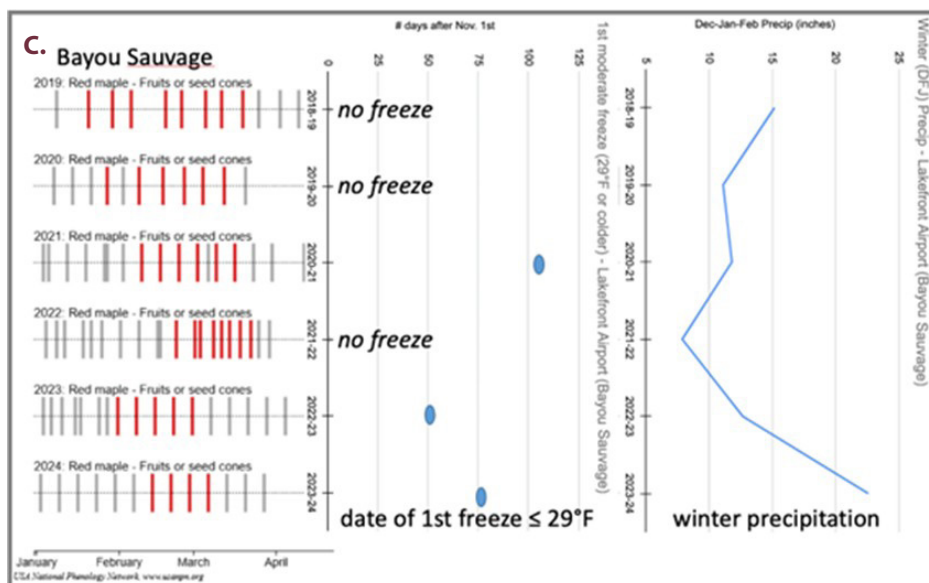
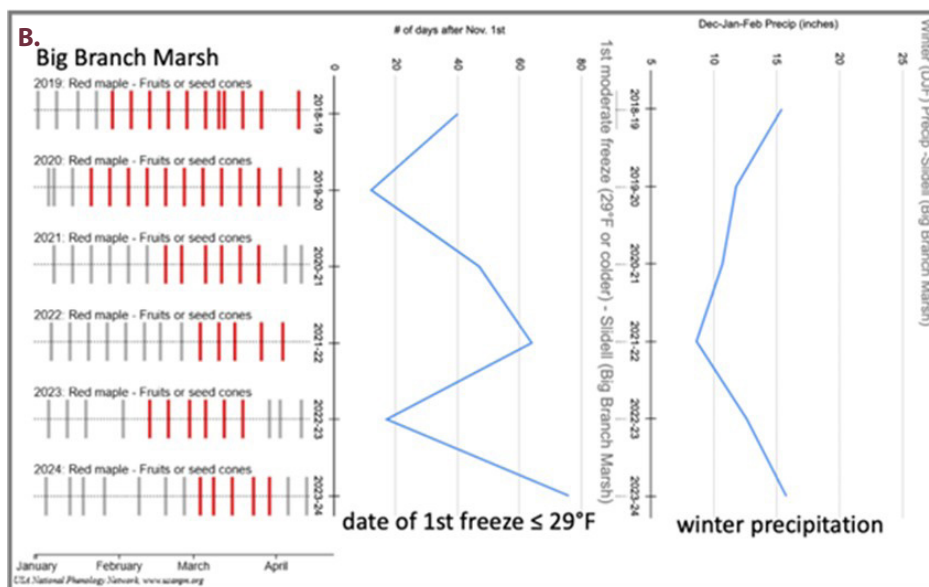
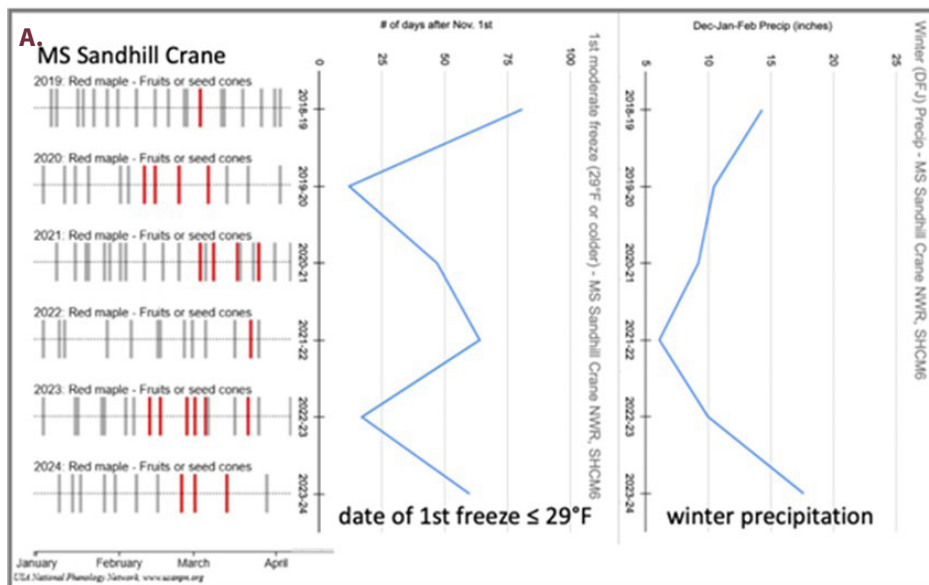


Figure 13. Phenology and weather data from a) Mississippi Sandhill Crane NWR, b) Big Branch Marsh NWR, and c) Bayou Sauvage NWR from 2019 to 2024. The first panel (from left) shows dates of red maple (*Acer rubrum*) fruit/seed cones, where red bars indicate “yes,” and gray bars indicate “no” in response to the presence of fruits. The middle panel shows the dates of first freeze related to the number of days after November 1. The right panel shows winter precipitation in inches for the combined winter months (December to February) as recorded by the nearest weather station.

We focused on eastern Baccharis (*Baccharis halimifolia*) and the monarch butterfly (*Danaus plexippus*) to answer our second research question for the GCPT: **Are there correlations between the phenology of native pollinators and their host plants?**

Eastern Baccharis, or groundsel tree, is a native deciduous plant that can range in height from 3 to 12 feet. It occurs naturally in a variety of tidally influenced habitats, including salt, freshwater, and brackish marshes, and is tolerant of low-nutrient soils. Their branches often provide habitat for small birds like wrens (family Troglodytidae) to build nests.

Baccharis is a dioecious plant with separate individuals that produce female and male flowers during the fall. The seeds produced by the female plants are then dispersed by wind. Monarch butterflies rely on nectar from the male flowers of eastern Baccharis and other fall-flowering species like common buttonbush (*Cephalanthus occidentalis*) to provide them with the energy necessary for their fall migration (Figure 14). Monarchs, unlike other butterflies, make two migrations during the year, the first during March and April from Mexico and South America to North America, and the second from September to November to return south.

In 2019, eastern Baccharis had open flowers from mid-September until November (Figure 15). However, monarch activity that year was the highest during mid-November through early December when 75 percent of observations for monarchs indicated presence (i.e., a “yes” record for monarchs).

Several years later, in 2023, eastern Baccharis was observed with open flowers in mid-October, and monarch activity was also the highest during that time (50 percent “yes” records). In 2024, open flowers were observed in mid-September, and flowering activity continued through mid-November. Overall, monarch activity in 2024 was low in comparison to all previous years (25 percent “yes” records), and the most active period for monarchs was in the summer months.

These changes in monarch activity suggest a potential mismatch arising between the phenological timing of the monarch butterflies and eastern Baccharis. Observations of animals are typically made when an observer is collecting phenological data on plants, so there is a possibility that monarchs were unaccounted for but present during their spring and fall migration periods. Additional years of observational records for both Baccharis and monarchs are necessary to determine if a mismatch is actually occurring between the two species.



Figure 14. Monarch feeding on eastern Baccharis (*Baccharis halimifolia*) flowers on a shell midden at the Grand Bay NERR in October 2024.

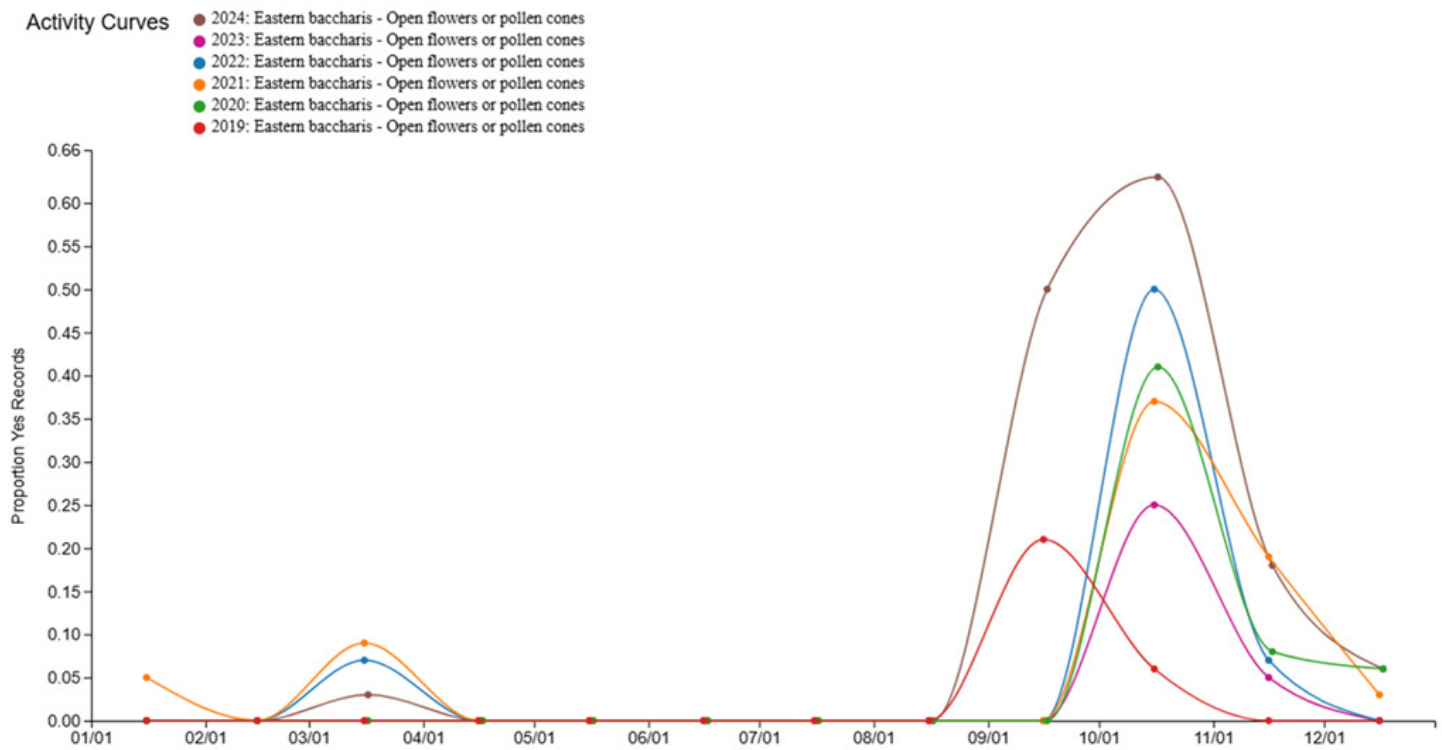
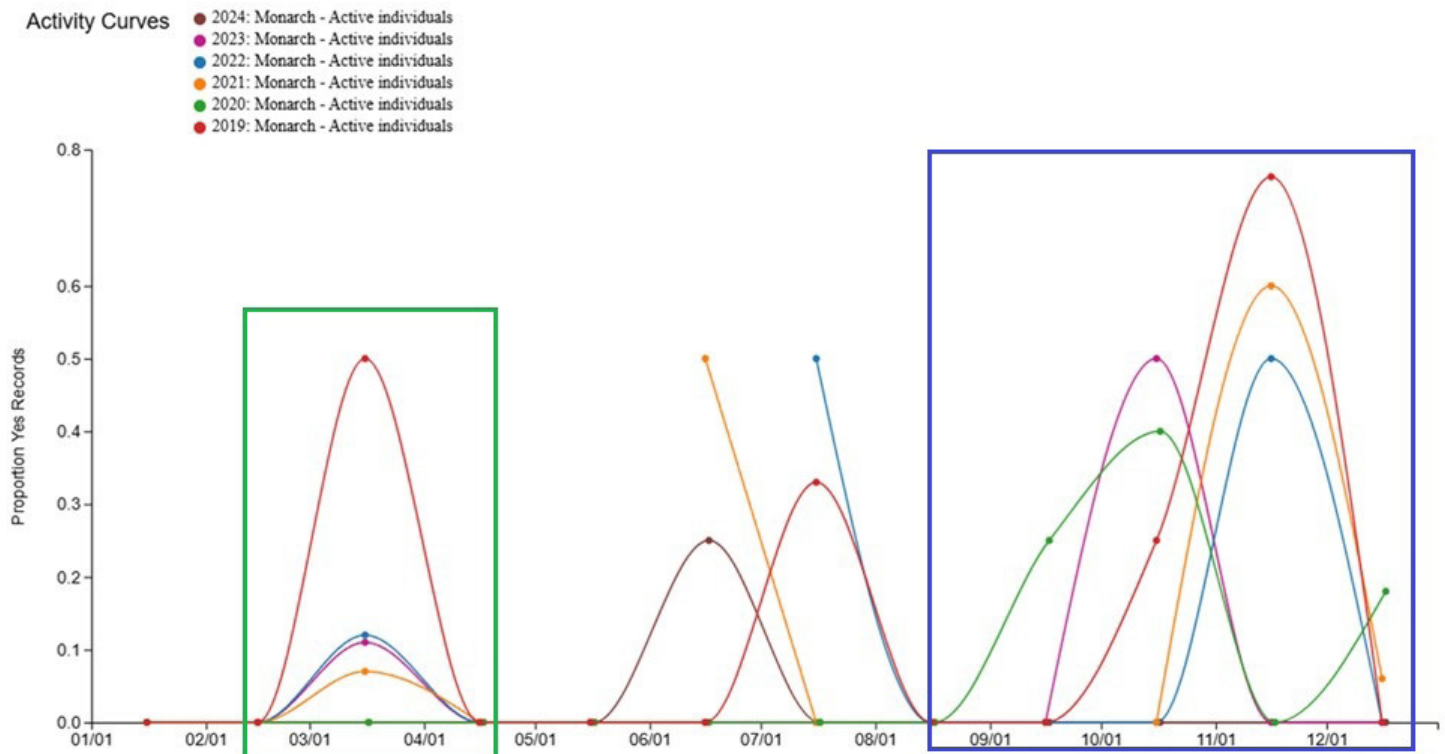
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Figure 15. Proportion of “yes” records (percentage of responses indicating presence) for a) eastern *Baccharis* open flowers and b) active individual monarch butterflies across the GCPT from 2019 to 2024. Date is shown on the x-axis. Spring migration is indicated by the green box, and fall migration is indicated by the blue box.

We focused on wax myrtle (*Morella cerifera*) to answer our final research question: **Is there a west to east gradient in the phenology of focal species?**

Wax myrtle is a fast-growing, evergreen shrub. It can thrive in a variety of habitats and is widespread in coastal regions of the southeastern U.S. This dioecious species produces small,

inconspicuous flowers down its branches in early spring. Through wind-driven pollination, they produce small, waxy, grayish-blue fruits (on the female plants) in late summer through fall (Figure 16). The fruits are a valuable source of food for many species of birds and were historically used by Native Americans to make candles, soaps, and sealing wax.



Figure 16. Wax myrtle flowers with female flowers (left) and male flowers (right).

From 2019 to 2024, the onset of wax myrtle flower production occurred in late January through mid-February at the westernmost LPPs, and mid-February through early April in the central and eastern LPPs (Figure 17). Wax myrtle fruiting occurred several weeks or months after flowers appeared. There appears to be a west to east gradient in the timing of these phenophases, where the plants monitored in Louisiana tend to produce flowers and fruits earlier than those observed in Mississippi and Alabama. It is important to note that not all of the LPPs in Louisiana and Mississippi observe wax myrtle.

Limitations of GCPT Data

Due to several factors, such as the possibility of observer error from misinterpretation of phenophases and infrequent or underreported observations across the GCPT, these trends must be interpreted with caution. These factors and the limited duration of sampling suggest that phenological factors are responsible for variance in the timing of phenophase activity among focal plants like red maple and wax myrtle, but a longer period of record is needed to elucidate trends with more confidence. Consistency in observations by observers is important for the creation of a robust, long-term dataset capable of quantifying phenological trends and making reliable comparisons with weather data.

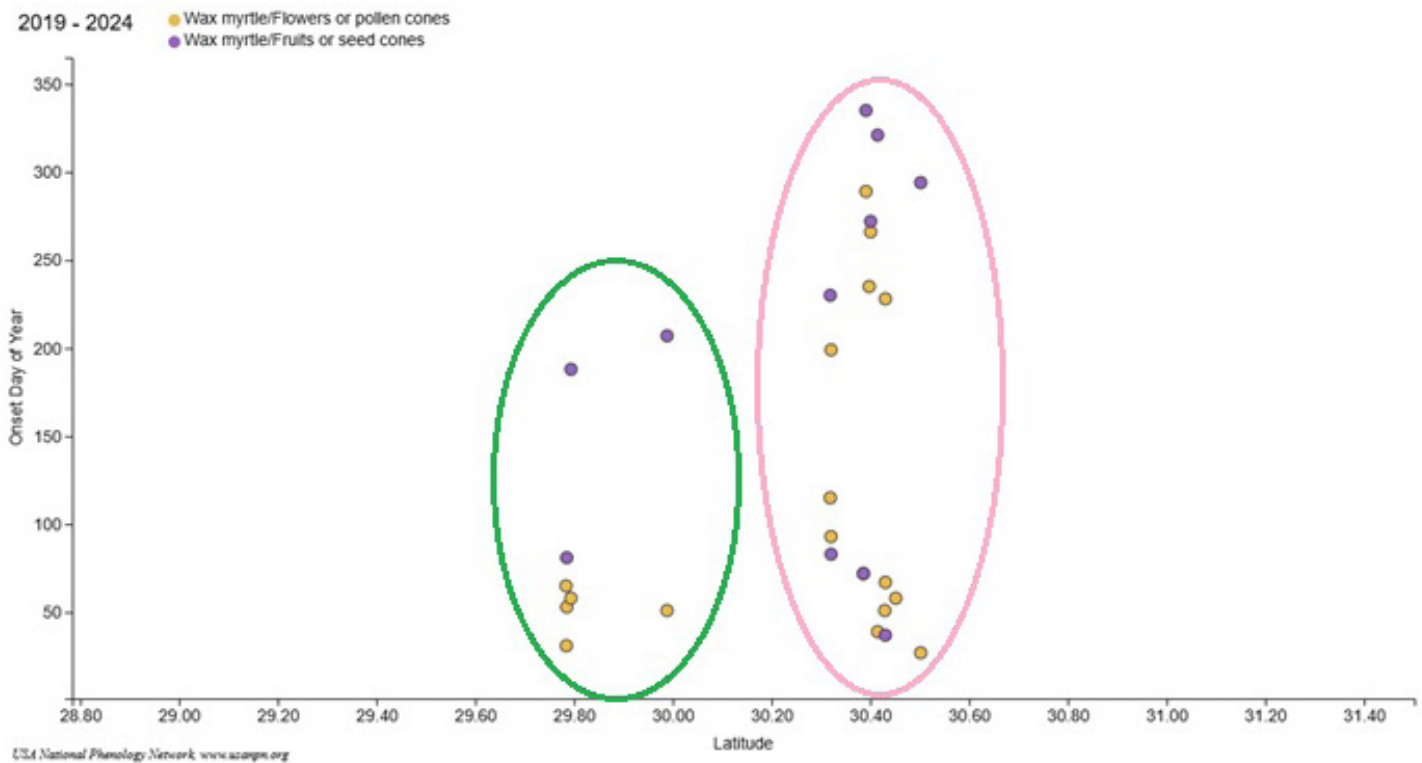


Figure 17. Onset day of the year (0–365) for wax myrtle flowers and fruits from 2019 to 2024. Latitude in decimal degrees is shown on the x-axis. Louisiana LPPs are circled in green, and Mississippi/Alabama LPPs are circled in pink.

Appendix A

Focal plant and animal species that are observed across the Gulf Coast Phenology Trail. The list can be updated on a yearly basis for each LPP based on what community scientists wish to observe.

- American alligator (*Alligator mississippiensis*)
- American beautyberry (*Callicarpa americana*)
- American beech (*Fagus grandifolia*)
- American elm (*Ulmus americana*)
- American goldfinch (*Spinus tristis*)
- American robin (*Turdus migratorius*)
- American sycamore (*Platanus occidentalis*)
- American witchhazel (*Hamamelis virginiana*)
- Bald cypress (*Taxodium distichum*)
- Bald eagle (*Haliaeetus leucocephalus*)
- Barred owl (*Strix varia*)
- Black cherry (*Prunus serotina*)
- Black willow (*Salix nigra*)
- Blue jay (*Cyanocitta cristata*)
- Boxelder (*Acer negundo*)
- Brown pelican (*Pelecanus occidentalis*)
- Bumblebee (*Bombus* spp.)
- Butterweed (*Packera glabella*)
- Button eryngo (*Eryngium yuccifolium*)
- Carolina wren (*Thryothorus ludovicianus*)
- Chimney swift (*Chaetura pelagica*)
- Chinese tallow (*Triadica sebifera*)
- Cogongrass (*Imperata cylindrica*)
- Common buttonbush (*Cephalanthus occidentalis*)
- Common hackberry (*Celtis occidentalis*)
- Common persimmon (*Diospyros virginiana*)
- Common sunflower (*Helianthus annuus*)
- Deer fly (*Chrysops* spp.)
- Eastern baccharis (*Baccharis halimifolia*)
- Eastern bluebird (*Sialia sialis*)
- Eastern box turtle (*Terrapene carolina*)
- Eastern poison ivy (*Toxicodendron radicans*)
- Eastern redbud (*Cercis canadensis*)
- Elliott's blueberry (*Vaccinium elliotii*)
- Flowering dogwood (*Cornus florida*)
- Fox squirrel (*Sciurus niger*)
- Giant blue iris (*Iris giganteaerulea*)
- Green treefrog (*Dryophytes cinereus*)
- Gulf fritillary (*Agraulis vanillae*)
- Gum bully (*Sideroxylon lanuginosum*)
- Henslow's sparrow (*Centronyx henslowii*)
- Honeybee (*Apis mellifera*)
- Honeylocust (*Gleditsia triacanthos*)
- Hooded warbler (*Setophaga citrina*)
- Laurel greenbrier (*Smilax laurifolia*)
- Little bluestem (*Schizachyrium scoparium*)
- Live oak (*Quercus virginiana*)
- Longleaf pine (*Pinus palustris*)
- Monarch (*Danaus plexippus*)
- Mountain azalea (*Rhododendron canescens*)
- Narrowleaf mountainmint (*Pycnanthemum tenuifolium*)
- Northern cardinal (*Cardinalis cardinalis*)
- Northern mockingbird (*Mimus polyglottos*)
- Northern parula (*Setophaga americana*)
- Oak toad (*Anaxyrus quercicus*)
- Osprey (*Pandion haliaetus*)
- Painted bunting (*Passerina ciris*)
- Possumhaw (*Ilex decidua*)
- Prothonotary warbler (*Protonotaria citrea*)
- Purple martin (*Progne subis*)
- Red buckeye (*Aesculus pavia*)
- Red maple (*Acer rubrum*)
- Red-bellied woodpecker (*Melanerpes carolinus*)
- Redbay (*Persea borbonia*)
- Ruby-crowned kinglet (*Regulus calendula*)
- Ruby-throated hummingbird (*Archilochus colubris*)
- Sandhill crane (*Grus canadensis*)
- Sassafras (*Sassafras albidum*)
- Savannah meadowbeauty (*Rhexia alifanus*)
- Sedge wren (*Cistothorus stellaris*)
- Siberian elm (*Ulmus pumila*)
- Slash pine (*Pinus elliotii*)
- Southern magnolia (*Magnolia grandiflora*)
- Sugarberry (*Celtis laevigata*)
- Sweetbay (*Magnolia virginiana*)
- Sweetgum (*Liquidambar styraciflua*)
- Tall blazing star (*Liatris aspera*)
- Trumpet creeper (*Campsis radicans*)
- Tufted titmouse (*Baeolophus bicolor*)
- Variableleaf sunflower (*Helianthus heterophyllus*)
- Water tupelo (*Nyssa aquatica*)
- Wax myrtle (*Morella cerifera*)
- White crownbeard (*Verbesina virginica*)
- Wild bergamot (*Monarda fistulosa*)
- Yaupon (*Ilex vomitoria*)
- Yellow trumpets (*Sarracenia alata*)
- Yellow-rumped warbler (*Setophaga coronata*)

Appendix B

Example data sheets and phenophase definitions for red maple (*Acer rubrum*) for the Gulf Coast Phenology Trail.

Trees and Shrubs *Deciduous (with pollen)*



Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.
y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).
Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.

Species: Acer rubrum
Common Name: red maple
Nickname: red maple-13
Site: _____
Year: _____
Observer: _____

	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Do you see...	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
Breaking leaf buds	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Increasing leaf size	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Colored leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Falling leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Flowers or flower buds	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Open flowers	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Pollen release	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Fruits	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Ripe fruits	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Recent fruit or seed drop	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Check when data entered online:	☐	☐	☐	☐	☐	☐	☐	☐
Comments:								

Red Maple

(*Acer rubrum*)



Phenophase Definitions

Directions:

As you report on phenophase status (Y, N or ?) on the datasheets, refer to the definitions on this sheet to find out what you should look for, for each phenophase in each species. To report the intensity of the phenophase, choose the best answer to the question below the phenophase, if one is included. Feel free not to report on phenophases or intensity questions that seem too difficult or time-consuming.

Leaves

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, but before the first leaf from the bud has unfolded to expose the leaf base at its point of attachment to the leaf stalk (petiole) or stem. For *Acer rubrum*, leaf tips may appear reddish.

How many buds are breaking?

Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Leaves

One or more live, unfolded leaves are visible on the plant. A leaf is considered "unfolded" once its entire length has emerged from a breaking bud, stem node or growing stem tip, so that the leaf base is visible at its point of attachment to the leaf stalk (petiole) or stem. Do not include fully dried or dead leaves.

What percentage of the potential canopy space is full with leaves? Ignore dead branches in your estimate of potential canopy space.

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Flowers

Flowers or flower buds

One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds or inflorescences that are swelling or expanding, but do not include those that are tightly closed and not actively growing (dormant). Also do not include wilted or dried flowers.

How many flowers and flower buds are present? For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), simply estimate the number of flower heads, spikes or catkins and not the number of individual flowers.

Less than 3; 3 to 10; 11 to 100; 101 to 1,000; 1,001 to 10,000; More than 10,000;

Open flowers

One or more open, fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible between or within unfolded or open flower parts (petals, floral tubes or sepals). Do not include wilted or dried flowers.

What percentage of all fresh flowers (buds plus unopened plus open) on the plant are open? For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), estimate the percentage of all individual flowers that are open.

Less than 5%; 5-24%; 25-49%; 50-74%; 75-94%; 95% or more;

Pollen release

One or more flowers on the plant release visible pollen grains when gently shaken or blown into your palm or onto a dark surface.

How much pollen is released?

Little: Only a few grains are released.; Some: Many grains are released.; Lots: A layer of pollen covers your palm, or a cloud of pollen can be seen in the air when the wind blows ;

Appendix C

Example cover sheet, animal checklist, and data sheets for purple martin (*Progne subis*) used on the Gulf Coast Phenology Trail.

Cover Sheet

Directions:
On this Cover Sheet, please report information to describe each visit to the site. On the Animal Checklist, please list the species of animals you are looking for at the site and record whether or not you saw or heard that species on each visit. On the Plant and Animal Phenophase Datasheets, please record the phenophases you observed on each visit for your individual plants and your animal species.

Below, please fill in the date and time of your site visit in the first rows. Then, estimate your contribution of time to the project for that visit, separating the time it took you to travel to the site and the time you spent making observations on plants and animals once you arrived at the site. If you are observing animals, report the time you specifically spent searching for animals and circle the appropriate letter for your observation method (there is no need to report time for incidental sightings):

I – incidental: chance sighting while not specifically searching

S – stationary: standing or sitting at a single point

W – walking: a single pass or transect through your site

A – area search: multiple passes through your site

If there is snow on the ground or in the canopy (treetops), please make a note of it in the third section and estimate the percent of the ground at your site that the snow is covering. After each visit, please enter the information from these datasheets online.

nature's notebook

Site: Front Lawn

Year: 2025

Observer: null null

	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
Report your contribution of time															
Time spent observing	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min
Time spent in travel	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min
Report your animal observation methods															
Time spent looking for animals	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min	hr min
Animal survey method	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a	i s w a
Report on snow															
Is there snow on the ground?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
% of ground covered															
Is there snow in the canopy?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Check when data entered online:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Comments:															

012345678910

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npne

National Phenology Network

Animal Checklist

Directions:
Please list below all the animal species from the animal checklist you created online for this site.
Fill in the date and time of your site visit in the top rows. In each row, circle the appropriate letter for that visit:
y (if you see or hear this species);
n (if you do not see or hear this species);
? (if you are not certain if you saw or heard this species)
Do not circle anything if you did not check for this species

For each species you circled y or ? (present or uncertain), please also fill out a column in your Animal Phenophase Datasheet for this species to report on the status of each of the phenophases for that visit.

For each species you circled n (not present), you do not need to fill out a column in the Animal Phenophase Datasheet, and can simply click "Circle all 'No'" (meaning you did not see or hear any phenophases for that species) when entering your observations online for that visit.



Site: Front Lawn
Year: 2025
Observer: null null



	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Do you see or hear...?	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
purple martin	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
eastern bluebird	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
fox squirrel	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
osprey	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
American robin	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
green treefrog	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Comments:													

Birds *(singing)*

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.

y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).

Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.



Species: Progne subis
 Common Name: purple martin
 Nickname: _____
 Site: _____
 Year: _____
 Observer: _____

	Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Do you see/hear...	Time:	Time:	Time:	Time:	Time:	Time:	Time:	Time:
Live individuals	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Feeding	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Calls or song	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Singing individuals	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Territorial individuals	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Courtship	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Mating	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Nest building	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Occupied nest	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Nestlings	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Fledged young	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Dead individuals	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Dead nestlings or fledglings	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Individuals at a feeding station	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____	y n ? ____
Check when data entered online:	☐	☐	☐	☐	☐	☐	☐	☐
Comments:	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?

Animal Phenophase Datasheet

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Network

Purple Martin

(Progne subis)



Phenophase Definitions

Directions:

As you report on phenophase status (Y, N or ?) on the datasheets, refer to the definitions on this sheet to find out what you should look for, for each phenophase in each species. For reporting animal abundance, if a specific question is included below the phenophase, choose the best answer to the question. If there is no specific question, enter the number of individual animals you observed in each phenophase. Feel free not to report on phenophases or abundances if they seem too difficult or time-consuming.

Activity

Live individuals

One or more individuals are seen or heard moving about or at rest.

Feeding

One or more individuals are seen feeding or foraging. If possible, record the name of the species or substance being eaten or describe it in the comments field.

Calls or song

One or more individuals are heard calling or singing.

Singing individuals

One or more individuals are heard singing. Singing refers to stereotypical, simple or elaborate vocalizations (most commonly by males) used as part of territorial proclamation or defense, or mate attraction. It does not include relatively simple calls used for other forms of communication.

Territorial individuals

One or more individuals are seen or heard defending a territory. This may be indicated by calls or song used as part of a territorial proclamation, chasing of an individual of the same species from a breeding area (but do not confuse this with courtship behavior, which in some species may involve chasing), or calls or displays directed at individuals of the same or a different species to defend a feeding area.

Reproduction

Courtship

A male and female are seen near one another and are engaged in courtship behavior. Do not include male displays in the absence of a female.

Mating

A male and female are seen coupled in a mating position, usually with the male on top of the female.

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USA npn
Natural Phenology Network

Nest building

One or more adults are seen constructing a nest or carrying nesting material.

Occupied nest

One or more adults are seen sitting on a nest, entering or leaving a nest site under circumstances indicating its use for nesting (including nest defense behavior), or live eggs or nestlings are seen in a nest.

Development

Nestlings

One or more young are seen or heard in a nest.

Fledged young

One or more young are seen recently departed from the nest. This includes young incapable of sustained flight and young which are still dependent on adults.

Dead individuals

One or more dead individuals are seen.

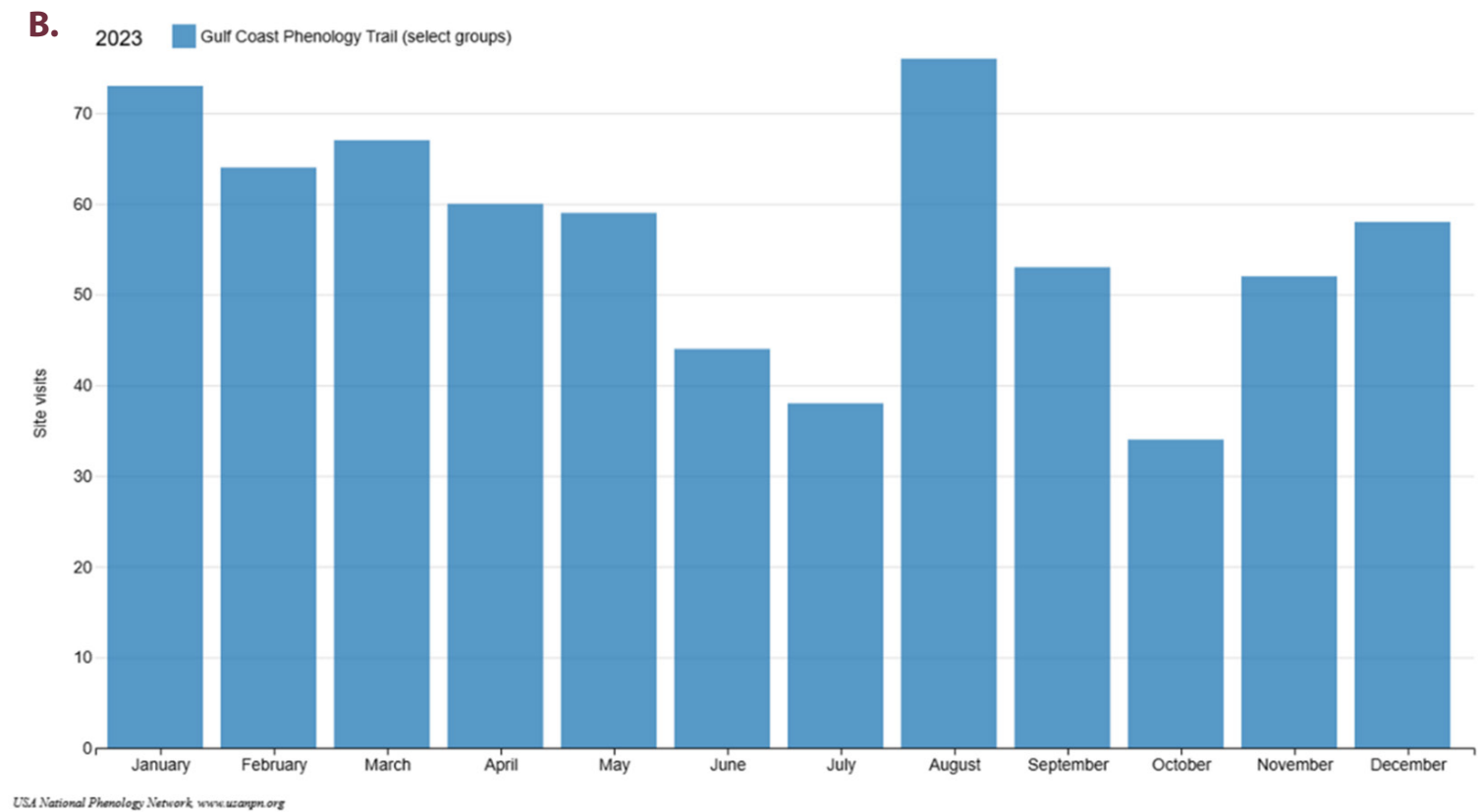
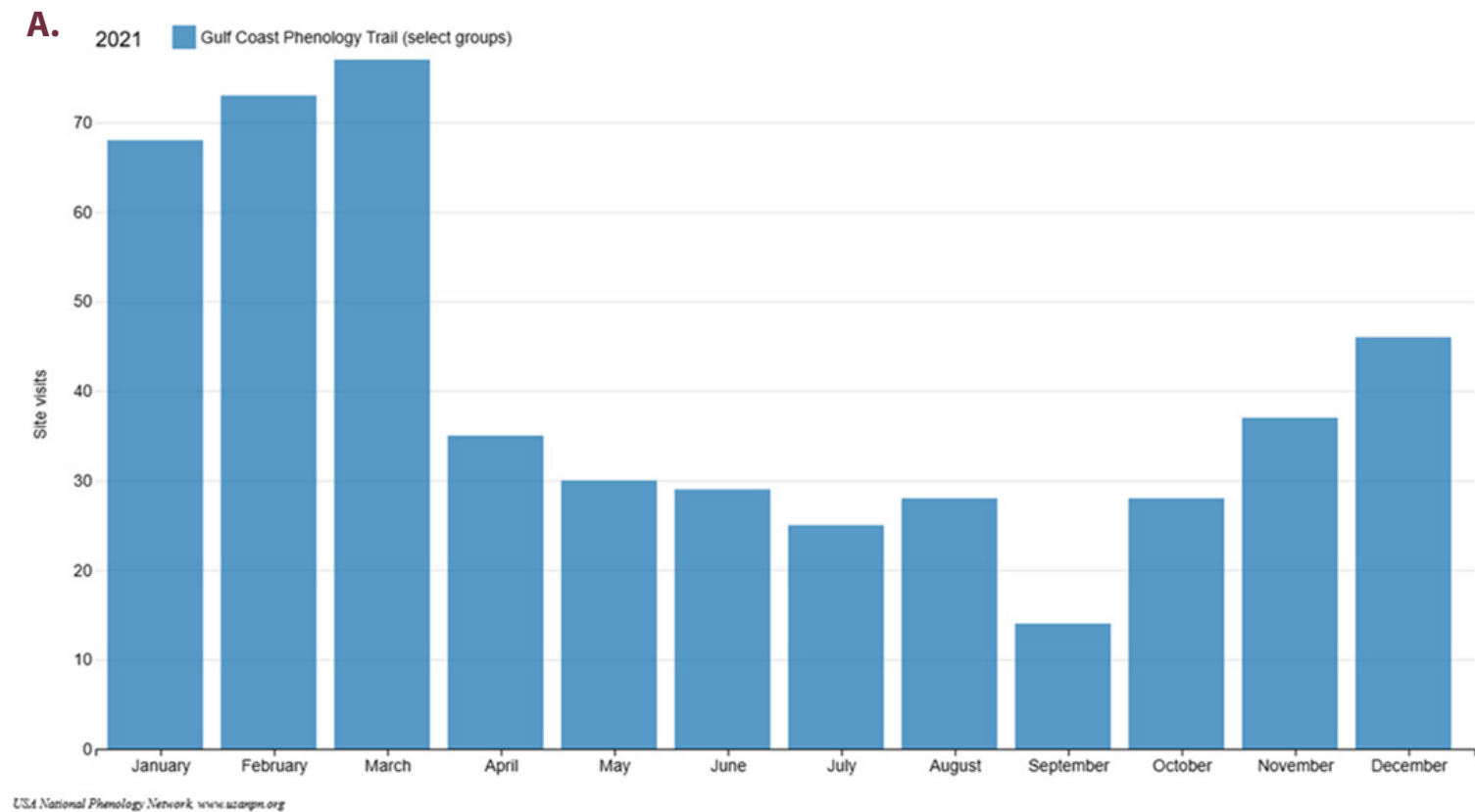
Dead nestlings or fledglings

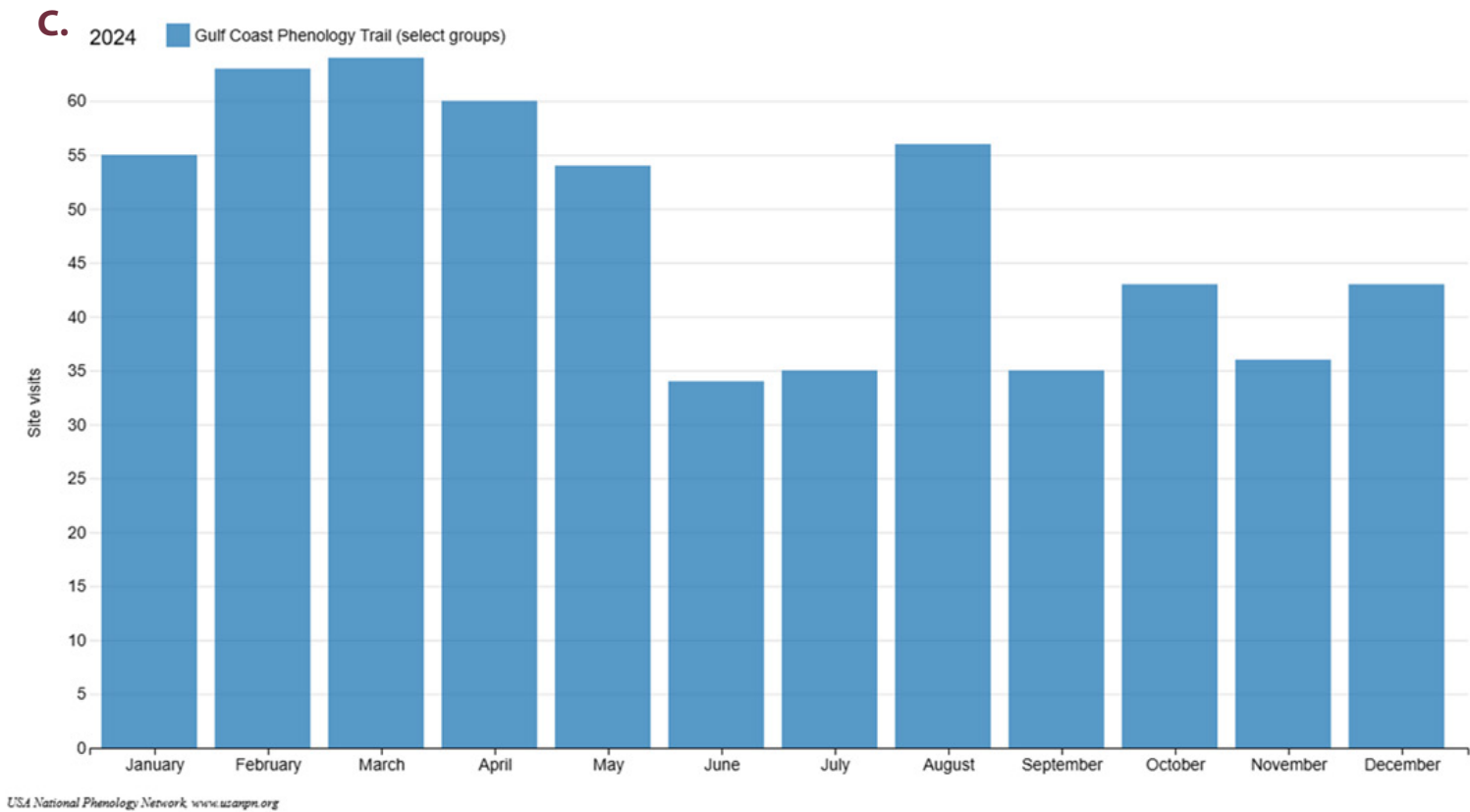
One or more dead nestlings or young are seen.

Method

Appendix D

Gulf Coast Phenology Trail site visits by month for 2021, 2023, and 2024.



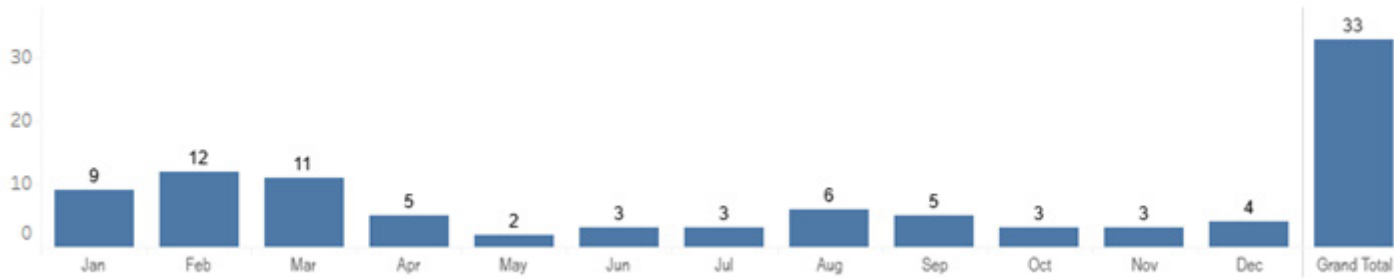


Appendix E

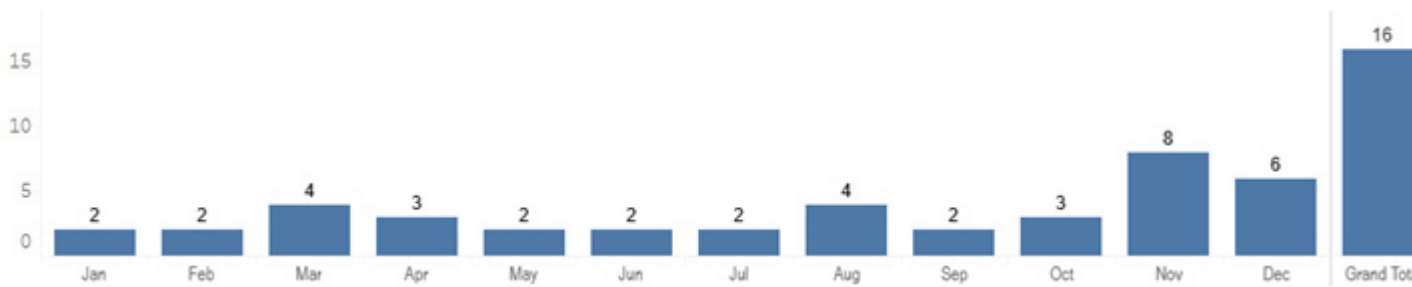
The number of active observers for the Gulf Coast Phenology Trail Local Phenology Programs by month for each participating state for 2023 and 2024.

Louisiana LPPs

Active observers by month, Barataria Phenology Trail, Bayou Lafourche Phenology Trail, Bayou Sauvage NWR and 2 more, 2023



Active observers by month, Barataria Phenology Trail, Bayou Lafourche Phenology Trail, Bayou Sauvage NWR and 2 more, 2024



Mississippi LPPs

Active observers by month, Crosby Arboretum, Grand Bay NWR/NERR, Gulf Islands National Seashore (Davis Bayou) and 5 more, 2023

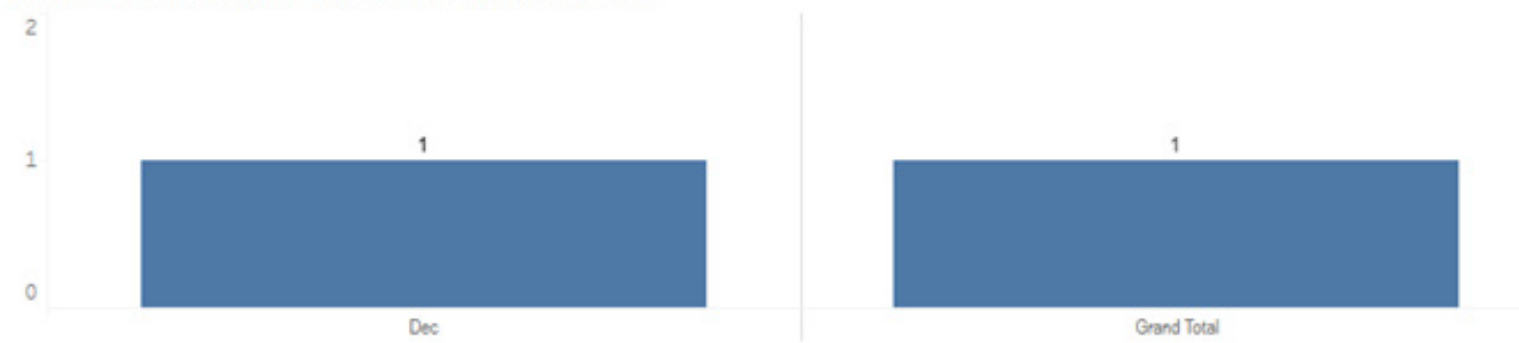


Active observers by month, Crosby Arboretum, Grand Bay NWR/NERR, Gulf Islands National Seashore (Davis Bayou) and 5 more, 2024

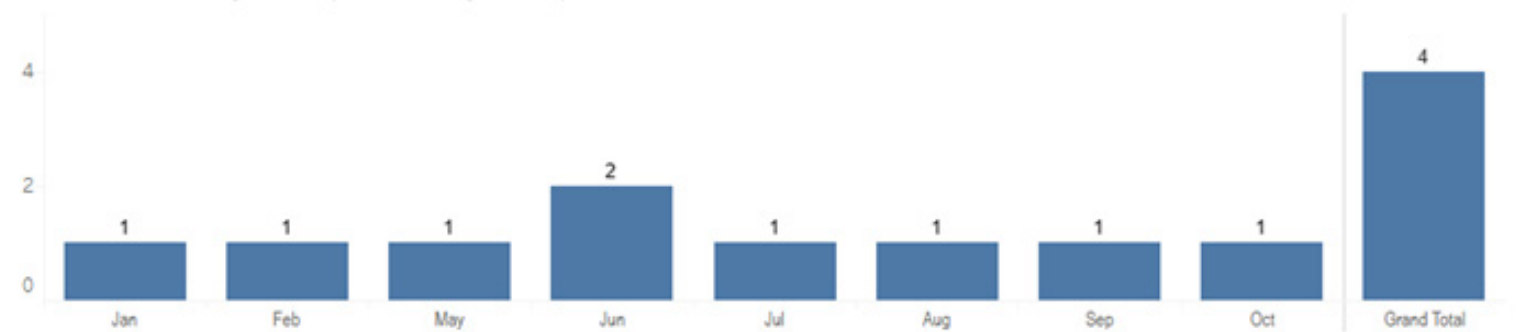


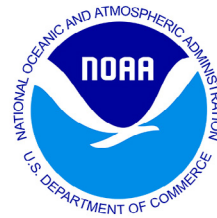
Alabama LLPs

Active observers by month, Weeks Bay NERR, 2023



Active observers by month, Weeks Bay NERR, 2024





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