

Seeing is Be-leaf-ing

Spring & Fall Phenological Patterns at Woodyard Conservation Area

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Phenology is the study of cyclic, seasonal behavior and the changes in biotic life (Schwartz et al., 2013). Our research focuses on tracking tree phenology; this means that we are recording the rate of leaf change in various tree species throughout the seasons. We decided to pursue this research because tree phenology is one of the most visible indicators of ecosystem change from climate change (Dragoni & Rahman, 2012). Our goal is to isolate and identify the climatic controls contributing to changing phenophase patterns and possibly discern how these phenophases will continue to change.

Observation Site

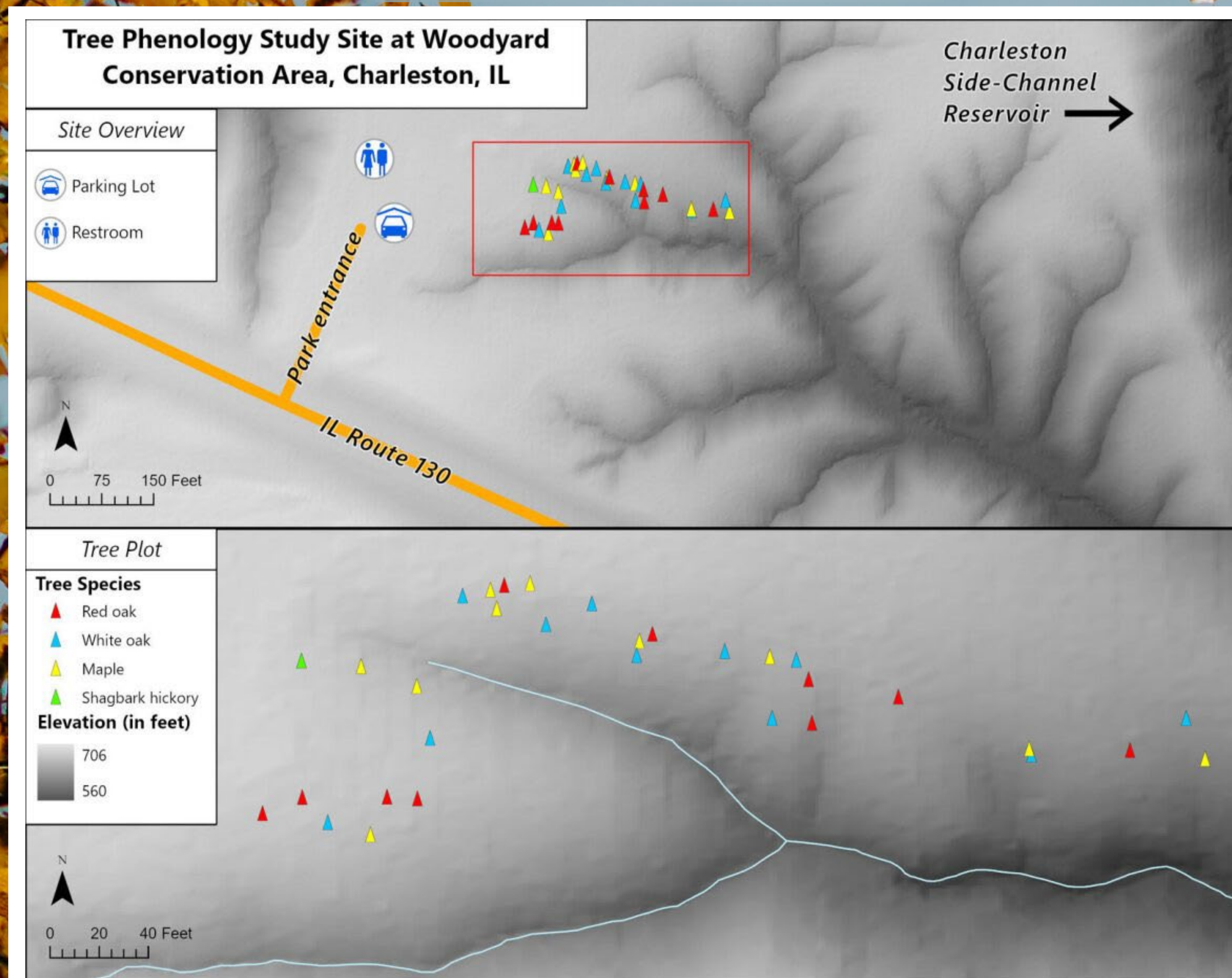


Figure 1: Woodyard study site map

Woodyard Conservation Area – Charleston, IL

The observation site includes 32 trees of different species: red oak, white oak, maple, and hickory. It is located on the upper and midslope portions of ravine ridgelines, moving down in elevation as they move east towards the Charleston Side-Channel Reservoir.

Results

Trees selected for study at our field site are grouped by species (maple, white oak, red & black oak, shagbark hickory) and mean phenophases were calculated to determine approximately when each species undergoes phenological change for the spring and fall seasons in 2021, 2022, and 2023 (Figure 4). Phenophase data are correlated with observations from the Charleston weather station. A variable that we hypothesized to have the greatest impact on phenophase change is freeze dates (days when the low air temperature is $\leq 32^{\circ}\text{F}$) – first frosts in fall are hypothesized to accelerate phenophase progression toward leaf fall and the last frost in spring brings warmer temperatures to encourage leaf out. First freeze dates seem to be effective at prompting leaf color change in fall, especially in 2022 and 2023, but they are less of an obvious factor impacting leaf out in spring. While freeze events might be one variable that controls phenophase change, we are investigating other factors such as precipitation, wind, and physical site characteristics. Seasonal patterns between species are also evident: 1) in fall, maples and shagbark hickory experience leaf color change and fall faster than the oaks, and 2) in spring, oaks are typically the first trees to leaf out and reach expansion while the maples take longer.

References

Dragoni, D. & Rahman, A.F., 2012. Trends in fall phenology across the deciduous forests of the Eastern USA. *Agricultural and Forest Meteorology*, 157(15). <https://doi.org/10.1016/j.agrformet.2012.01.019>

Puchałka, R., Koprowski, M., Gričar, J. & Przybylak, R., 2017. Does tree-ring formation follow leaf phenology in Pedunculate oak (*Quercus robur* L.)? *European Journal of Forest Research*, 136. <https://doi.org/10.1007/s10342-017-1026-7>

Schwartz, M.D. & Liang, L., 2013. High-resolution phenological data. In *Phenology: An integrative environmental science*. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-6925-0_19

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Observation Criteria

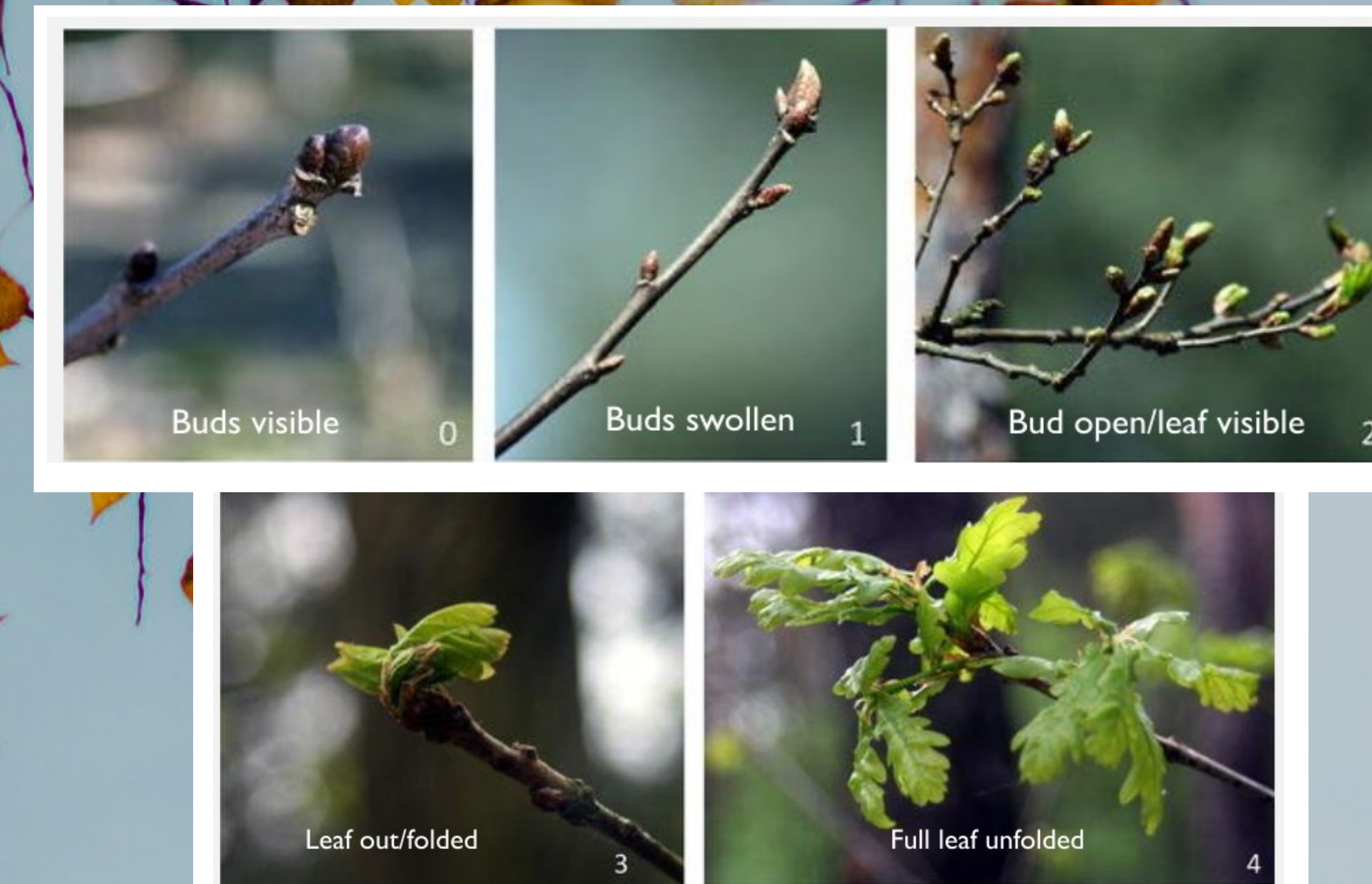


Figure 2b: Spring phenophase stage examples (Puchałka et al., 2017)

- 7 spring phenophase classes: (0) no buds visible, (100) buds visible, (200) buds swollen, (300) bud open and leaf visible, (400) leaf out, (500) full leaf unfolded, and (600) leaf expansion
- 2 fall phenophase classes: (800) leaf color change (senescence) and (900) leaf fall (abscission)
- Using binoculars, the observer inspects the entire leaf coverage for a tree, determines the furthest advanced phenophase present in that tree, and the total percentage it occupies

Phase #	Description	Percentage
0	No Buds Visible	0
100	Buds Visible	<10%
110		10-50%
150		50-90%
190		>90%
200	Buds Swollen	<10%
210		10-50%
250		50-90%
290		>90%
300	Buds Open (leaf visible)	<10%
310		10-50%
350		50-90%
390		>90%
400	Leaf Out (not fully unfolded)	<10%
410		10-50%
450		50-90%
490		>90%
500	Full Leaf Unfolded	<10%
510		10-50%
550		50-90%
590		>90%
600	Leaf Expansion	<25%
625		25-50%
650		50-75%
675		>75%

Figure 2a: Spring phenophase stages (Schwartz & Liang, 2013)

Phase #	Description	Percentage
800	Leaves Colored (including those on the ground)	<10%
810		10-50%
850		50-90%
890		>90%
900	Leaves Fallen	<10%
910		10-50%
950		50-90%
990		>90%

Figure 2c: Fall phenophase stages (Schwartz & Liang, 2013)



Figure 3: Repeat photography – Fall 2023 (Left to right: October 13, October 27, November 3, and November 10)

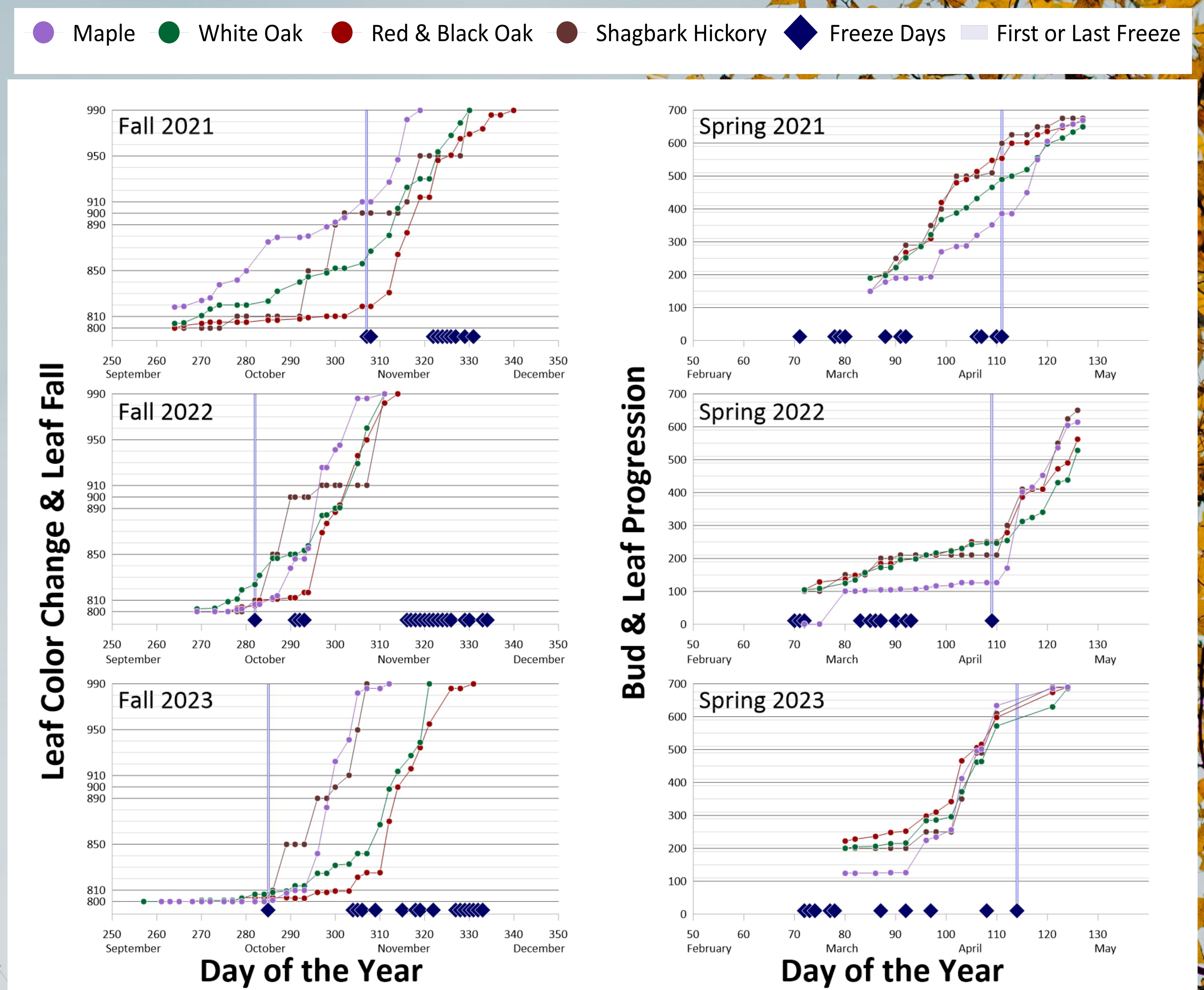


Figure 4: Spring and Fall phenophase plots grouped by species (2021, 2022, & 2023)