

More Than Beautiful Flowers:

Native Azaleas, Rhododendrons, and Their Pollinators

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Native azaleas are among the most widely recognized and visually striking flowering shrubs in eastern North America. Maryland has six native *Rhododendron* species: Smooth Azalea (*R. arborescens*), Dwarf Azalea (*R. atlanticum*), Great Rhododendron (*Rhododendron maximum*), Pinxter Flower (*R. periclymenoides*), Early Azalea (*R. prinophyllum*), and Swamp Azalea (*R. viscosum*). Another eleven native species occur in Virginia and North Carolina, including the rare Cumberland Rhododendron (*R. cumberlandense*). The Appalachian Mountains host a high diversity of *Rhododendron* species, and the region is known as one of two North American centers of *Rhododendron* diversification (the other is the Pacific Northwest). The primary center of diversification of the genus is southeastern Asia, where ninety percent of *Rhododendron* species occur.

Beyond their beauty, rhododendron and azalea flowers function as busy ecological hubs, providing a food resource for bees, butterflies, flies, and hummingbirds, who carry pollen between blossoms. This activity is important to the genetic diversity of the plants and the production of seed. Until our work, very little was known about the reproduction of North American *Rhododendron* species. Partly funded by a Maryland Native Plant Society grant (2022–2023), we have been studying who pollinates Maryland's native *Rhododendron* species and what floral features are associated with different visitors. Here, we report on some of our results.

For this study, we focused on a few native species: Sweet Azalea (*R. arborescens*), Flame Azalea (*R. calendulaceum*), Catawba Rosebay (*R. catawbiense*), Cumberland Azalea (*R. cumberlandense*),

Great Rhododendron (*R. maximum*), and Swamp Azalea (*R. viscosum*), which display remarkable floral diversity. For example, the spectacular orange and dark yellow flowering display of Flame Azalea makes it one of the most conspicuous native azaleas. Sweet Azalea and Swamp Azalea bear much paler white flowers and produce a lovely sweet fragrance. At slightly higher elevations, Catawba produces large clusters of pink-purple blossoms above its dark evergreen foliage. In contrast, Great Rhododendron has pale white and light pink flowers and thick evergreen leaves. To the human eye, these differences are visually striking. To pollinators, however, less obvious characteristics may be equally as important, such as the arrangement of the stamens, flower shape, how much nectar they produce, and even the concentration of sugar in that nectar.

Our Observations

During June and July 2022, our fieldwork took us to forests in Maryland and North Carolina. In Maryland, we studied sites at elevations ranging from 39 to 692 meters above sea level, including Patuxent Research Refuge (Laurel) and areas surrounding Swallow Falls (Oakland) and Big Run State Park (Swanton). The southern Appalachian sampling was conducted at higher elevation sites (1008–1820 meters above sea level) in North Carolina, in the Pisgah National Forest (Asheville) and the Nantahala National Forest (Otto).

At each locality, on clear sunny days, flowering branches were observed repeatedly during the morning and early afternoon. For each species, we observed 25–30 separate blossoms for roughly 10 to 15 hours. We recorded a pollinator visit when an animal came into contact with a flower's anthers or stigmas, providing an opportunity for pollen transfer.

Among the most noticeable visitors in our study were bumble bees, including *Bombus impatiens*, *B. vagans*, *B. sandersoni*, and *B. bimaculatus*. Bumble bees are comparatively large pollinators, ranging in size from ½ inch to 1½ inches long. When they quite literally bumble their way between stamens inside the flowers, they appear to collect large quantities of nectar, which they then transport to the next blossom. Their large hairy bodies provide ample surface on which pollen can be collected. We also recorded pollination by smaller native bees such as species from the genera *Andrena* and *Lasioglossum*. Great Rhododendron (*R. maximum*), Sweet Azalea (*R. arborescens*), and Catawba Rhododendron (*R. catawbiense*) received particularly high bee visitation.

Silver-spotted Skipper (*Epargyreus clarus*)
on Smooth Azalea (*R. arborescens*)
in Swallow Falls, MD.
Photo by B. Shweta.



We also measured the flowers' corolla length, nectar volume, and nectar concentration. Measuring nectar required preparing flowers the day before all measurements. We enclosed buds that were likely to open the following morning inside fine mesh bags. The bags allowed air circulation but prevented visitors from removing the nectar. The following morning, nectar was collected from newly opened flowers, then nectar volume (how much nectar was produced) and sugar concentration (how much saccharide the nectar had) were measured. These measurements revealed considerable differences among our North American Rhododendron species. Sweet Azalea, for example, produced relatively large nectar volumes, while Great Rhododendron produced nectar with the highest concentration of sugars.

Our analysis uncovered an intriguing connection between floral rewards and visitors. Among the North American species, higher bee visitation was positively associated with nectar concentration. Great Rhododendron illustrates this relationship particularly well. Its nectar contained about 35% sugar, the highest concentration among the North American species we sampled, and bee visitation greatly exceeded visitation by other visitors. This agrees with conceptual expectations based on floral biology and indicates that in the species studied, bees prefer to visit flowers with high sugar concentration.



R. prinophyllum species name is from the Latin for “prinos”, an old name for smooth-leaved hollies, and “phyllum” meaning leaves. Photo by L. McDowell.

Species	Number of Sites	Nectar %	Nectar volume	Corolla length	Average pollinator visits per flower			
					Bird	Bee	Fly	Butterfly
<i>R. catawbiense</i>	2	25%	8.3 µL	43 mm	0	3.6	0.02	0
<i>R. maximum</i>	3	35%	3.5 µL	34 mm	0	2.6	0.12	0
<i>R. arborescens</i>	4	25%	8.9 µL	41 mm	0.17	0.95	0.06	0.1
<i>R. calendulaceum</i>	2	16%	2.1 µL	32 mm	0	0.74	0.14	0.02
<i>R. cumberlandense</i>	2	13%	3.6 µL	37 mm	0	0.37	0.01	0.03
<i>R. viscosum</i>	4	16%	3.4 µL	33 mm	0.16	0.23	0.42	0.12

Table 1. Mid-Atlantic Rhododendron species studied, their floral characteristics, and average visitations by various pollinator groups based on observations of 25-30 blossoms per species. Species are listed in descending order of bee visitations. Nectar concentration is reported as the average percentage of nectar sugars, nectar volume as the average volume of nectar per blossom (microliters), and corolla length as the average corolla length (millimeters). Data are from Basnett et al. (2025).

Visitation numbers are not the whole story

One of the most memorable parts of our fieldwork was watching butterflies visit native azaleas. We recorded three butterfly species visiting the flowers: Eastern Tiger Swallowtail (*Papilio glaucus*), Silver-spotted Skipper (*Epargyreus clarus*), and Great Spangled Fritillary (*Speyeria cybele*). The Eastern Tiger Swallowtail is particularly striking beside an azalea. Its wings appear enormous compared to an individual flower. Large body size can be useful for pollen transfer. As a butterfly moves among flowers, its wings and body come into contact with the long, reflexed stamens and stigma. During our observations, butterflies would visit many flowers during a single encounter with a plant. Their wing movements also brought them

repeatedly into contact with floral reproductive structures allowing pollen to be transferred between the anthers and stigma during visits. Sweet Azalea and Swamp Azalea were among the species in which butterfly visitation was particularly noteworthy. Our study found that plants receiving more butterfly visitation tended to have less concentrated nectar than species dominated by bumblebee visitation, such as Catawba Rosebay and Great Rhododendron.

Bees and butterflies dominated many of our observations, but they were not the only flower visitors we saw. We also recorded the Ruby-throated Hummingbird (*Archilochus colubris*) visiting Sweet azalea, Flame Azalea, and Swamp azalea. This bird

continued



Five *Rhododendron* species studied (top to bottom) *R. arborescens*, *R. calendulaceum*, *R. catawbiense*, *R. maximum*, and *R. viscosum*. Photos 1-3 by S. Basnett, 4 by R. Simmons, and 5 by G. Dickel.

Azaleas continued



The elegant *R. periclymenoides* is native from Massachusetts to South Carolina. Photo by J. Swearingen.

visitation was uncommon compared to insect visitation, making the sudden appearance of a hummingbird especially memorable. The hummingbird would approach, hover at the flowers, feed, and disappear within moments. Frequency alone, however, does not determine the contribution of a pollinator. A relatively uncommon visitor can potentially transport pollen effectively between flowers or plants. Quantifying exactly how much pollen each visitor deposits is an important direction for our future research.

A hidden diversity of relationships

Our work found a particularly strong relationship between pollinators and nectar traits (volume and sugar concentration), whereas corolla length did not show a significant relationship with pollinator groups. This reminds us that some of the characteristics most important to pollinators are hidden inside the flower. Our research provides support for the importance of protecting native plant species and habitats in order to preserve ecological relationships.

The next time you encounter a flowering rhododendron or azalea in the woods, pause for a few minutes and watch for bumble bees, solitary bees, butterflies, or possibly a hummingbird. Rhododendrons and azaleas in flower are important meeting places and remind us that behind every blossom is an ecological partnership quietly keeping our native forests connected and thriving.

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REFERENCE

Basnett, S., J. Krpan & A. Espíndola. 2025. Floral traits and their connection with pollinators and climate. *Annals of Botany* 135:125-140.

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