

Month-By-Month Comments

July Comments:

Significant pollen types in the month of July included Clover, Tanoak, Plantain, Virginia Creeper, Chicory / Lettuce, Lambsquarters, Corn, Thoroughwort type, and Winged Sumac. The most universally significant July pollen types were Clover and Plantain. However when it came to quantity of pollen brought in, the maximum amount of Winged Sumac in a July sample was more than nine times that of clover. Usually, when Winged sumac was found in a sample, the volume of pollen brought in took a significant jump. The one exception to this was the Clarksburg samples in which the July 30 sample contained a high percentage of Winged Sumac, and yet the total pollen collected was very low.

Winged Sumac was not universally abundant. It was completely absent from the Raleigh County samples, insignificant in Quiet Dell, and also insignificant in the Clarksburg location in terms of quantity. However at the Salem location, where pollen was collected for three consecutive years, Winged Sumac turned out to be significant in all three years. This tells us that Winged Sumac can be a reliable and highly sought after by bees, and wider distribution of the plant could be useful. It was also very significant in the Jackson County samples.

English Plantain (*Plantago lanceolata*) appears to be a highly beneficial lawn plant for honey bees (and by field observation, for other wild pollinators as well).

Tanoak pollen grains closely resemble Chestnut, yet while Chestnut typically blooms in June, Tanoak blooms throughout the summer into August, so this would be the probable source of the pollen found in these samples. Tanoak is planted ornamentally.

The July 29 sample from Quiet Dell stands out as the only important occurrence of Lambsquarters / Amaranth type pollen, in which well over half of the sample came from this source. Very little total pollen was collected on this date. The project leader has observed and photographed honey bees working a patch of Lambsquarters (*Chenopodium album*) for pollen. However the pollen grains in this sample better matched the lower pore density of Amaranth, such as Redroot Pigweed (*Amaranthus retroflexus*). In the August 6 sample from Raleigh County, grains with both the lower and higher pore density were found, but only the grains with the higher density (matching *C. album*) were numerous enough to be found in the 400 grain count, while the Amaranthus type were extremely scarce. The difference between the two was not clear in the reference materials until the project leader had his own pollen pellet samples treated in December 2018, by which time it was too late to revise the tables and bar graphs to reflect this detail.

The most likely floral origin of the pollen that matched the Chicory / Lettuce references is still little bit mysterious. We know that bees will rarely be seen on Chicory. The pollen of this type showed up so often and sometimes in a high enough percentage that the project leader suspects another species with pollen grains very similar in appearance might be involved.

The appearance of a Rosaceae pollen type in a July sample and an August sample, long after most Rosaceae species have long finished blooming, could indicate the presence of the native Flowering

Raspberry (*Rubus odoratus*) which blooms through July and August. The project leader has watched honey bees gathering pollen from this plant at other locations in West Virginia. Another possibility would be domestic fall bearing / everybearing raspberries.

Corn pollen rarely appeared in the study, and Soybean pollen never did, reflecting the general absence of crop agriculture in most of West Virginia, due to its absence of flat ground. Only once did corn pollen appear in a significant percentage of a sample, at the Clarksburg location on July 22.

August Comments:

Significant pollen types in the month of August included Winged Sumac, Ragweed, Sunflower / Wingstem, Clematis, and Elephant's Foot.

The Sunflower / Wingstem type was an important source of pollen in every location except the Raleigh County site. Wingstem and Sunflower pollen are practically indistinguishable with light microscopy. Given the relative abundance of Wingstem in our region and the insignificance of most other wild and cultivated sunflowers, it might be safe to assume this pollen came from Wingstem.

Once again, Winged Sumac outshined the other pollen sources. The highest amount collected in a single day was from an August sample collected at the Salem location, and was three-and-a-half times more than the highest amount of Sunflower / Wingstem pollen seen in any sample.

Ragweed pollen, being a low protein food source that alone cannot sustain bee colony health, ranked surprisingly high for both percentage of a sample, and amount of pollen collected in a sample. Common Ragweed and Giant Ragweed are two prevalent species in the region. The project leader has observed honey bees foraging vigorously on Giant Ragweed, but has yet to find bees making use of Common Ragweed, and suspects Giant Ragweed to be the primary source of the Ragweed pollen found.

Clematis pollen was present in samples from all locations except the Clarksburg site, and was most prevalent in a small August sample from Quiet Dell where it comprised 30% of the sample. Overall, Clematis was less significant as a pollen source than the project leader expected, but is also a nectar producer and should be considered a good bee forage plant.

Elephant's Foot pollen was a type the project leader was interested in. Honey bees appeared to work it vigorously, but it was unfamiliar to beekeepers and absent from the beekeeping literature. It was years before he was even able to identify the plant. Comprising nearly 20% of an August sample, Elephant's Foot is a native plant that could be recommended for inclusion in seed mixes for added variety.

Red Clover made up 20% of an August sample. Red Clover pollen grains are practically indistinguishable from Crimson Clover pollen grains, and perhaps other *Fabaceae* types. While the honey bee proboscis is usually too short to reach the nectar in Red Clover flowers, honey bees have been observed working Red Clover for both nectar and pollen.

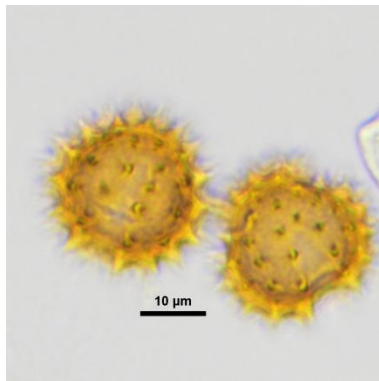
The sample containing the highest amount of Jewel Weed was an August sample from Raleigh County.

September Comments:

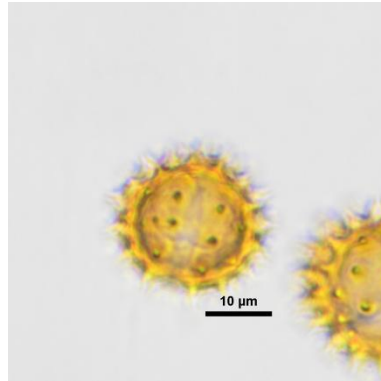
Significant pollen types in the month of September included the Goldenrod / Aster type, Ragweed, Wingstem, Virginia Creeper, and the Mistflower / Knapweed type.

One particularly unfortunate aspect of this study was the discovery that Snakeroot, Goldenrod, and Aster pollen grains are practically indistinguishable with light microscopy. The project leader strongly desired to be able to report distinct values for these pollen types. Slight differences were not consistent enough to differentiate them in polyfloral samples, considering the slight variations even within one type, as well as the presence of deformities. Furthermore the use of a single distinguishing factor such as a pore characteristic on otherwise identical grains cannot be used because, due to each grain's random position on the slide, the pore is usually not visible. Some slides contained a host of small Asteraceae type grains with every possible combination of variation in spine length, spine density, and grain size so that no lines of distinction could be drawn. On the bright side, in late-season samples after Snakeroot and Goldenrod had long faded, it could be safely assumed that the Asteraceae type present would be from Aster. Also, because Snakeroot pollen is white or light gray while Goldenrod is a deep golden color, a rough guess could be made based on the pollen pellet color of the frozen samples.

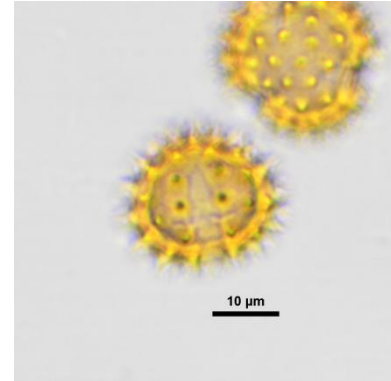
Below are some images of Snakeroot, Goldenrod, and Aster pollen grains showing their various features at different angles followed by photographs of bees on these flowers showing pollen pellet color.



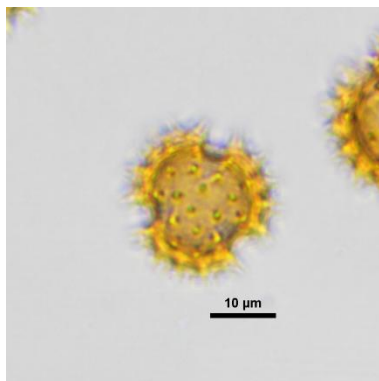
White Snakeroot (pore/furrow)



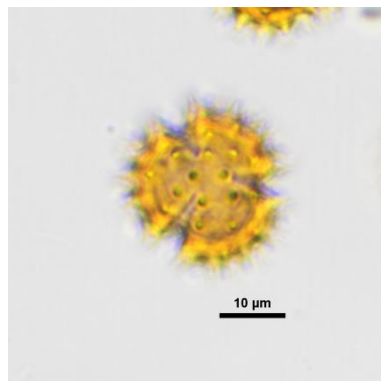
Tall Goldenrod (pore/furrow)



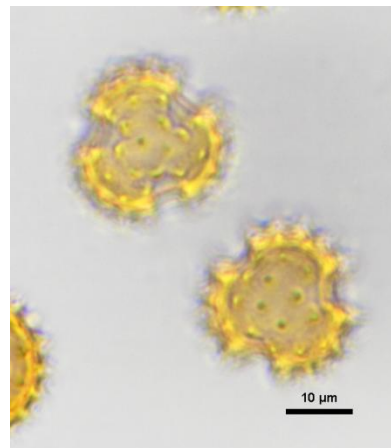
Late Aster (pore/furrow)



White Snakeroot (polar view)



Tall Goldenrod (polar view)



Late Aster (polar view)



Honey Bee on White Snakeroot



Honey Bee on Tall Goldenrod



Honey Bee on Fall Aster

It was striking to see the sudden change in pollen gathering when Goldenrod and Snakeroot began to come into bloom. The bees appear to have forgotten everything else in favor of one or more of these pollen types, and an increase in pollen gathering was seen almost universally. It could be argued that there is practically nothing else to be gathered at this time and that the bees might prefer other pollen types if they were as abundantly available, but the data we have suggest that honey bees find Fall Goldenrod and/or Snakeroot pollen attractive, or at least that it provides an abundant source of pollen.

The exception was the Raleigh County samples, in which the switch to the Goldenrod type was much less striking. The cause of this difference was not determined, whether it was a one-year incident due to something affecting the productivity of the Goldenrod plants overall, or a low quantity of the plants in the area, or some other factor. It is also very interesting to note that the “Goldenrod flow” in the Jackson County location appeared to begin unusually early and continued to the end of the season. This seems to indicate an additional plant type involved, with pollen of the same appearance, which began to bloom earlier than Goldenrod and Snakeroot.

As mentioned above, the two pollen types are very difficult to distinguish with light microscopy. However we can get a good lead based on the color of the pollen pellets in the sample, because Snakeroot pollen is whitish in color while Goldenrod pollen is a golden orange color (see pollen loads on the bees’ legs in the images above). Based on the color of the pellets in practically all the September samples, it is obvious that Goldenrod dominates significantly over Snakeroot.

Research indicates that the protein level in Canada Goldenrod pollen has dropped by a third from 18% to 12%, apparently due to the matching increase in atmospheric carbon dioxide¹. We do not know if other pollen types or Asteraceae types specifically have been affected the same way. 12% protein is about half the protein concentration required to sustain honey bee colonies. This carries significant implications if Goldenrod pollen accounts for nearly 100% of the bees pollen intake as they prepare for winter.

¹ Ziska LH, Pettis JS, Edwards J, Hancock JE, Tomecek MB, Clark A, Dukes JS, Loladze I, Polley HW. 2016 Rising Atmospheric CO₂ is reducing the protein concentration of a floral pollen source essential for North American bees. *Proc. R. Soc. B* **283**: 20160414. <http://dx.doi.org/10.1098/rspb.2016.0414>

Parthenocissus (Virginia Creeper type) pollen making up nearly 50% of the Raleigh County September 31 sample was a real shocker. The project leader is unaware of any other plant type with pollen grains matching those of Parthenocissus, and September 31 is well outside of the normal bloom period for this plant.

The appearance of "Magnolia" pollen in August and September was another anomaly of the Raleigh County site. The timing of these samples being way out of Magnolia bloom season suggests there is another plant the bees were visiting with pollen grains nearly identical to "Magnolia". The closest possibility the project leader could find in his references was Yucca, which still did not match what was found in the samples perfectly.

Wild Carrot ("Queen Anne's Lace") is one of the most abundant wildflowers throughout the state, with a long bloom season through the summer when pollen is likely to be in short supply and most desperately needed by bees. The fact that it never contributed any major amount or percentage to any sample indicates that honey bees have a very low preference for it as a pollen source.

October Comments:

The only significant October pollen types were the Goldenrod / Aster / Snakeroot group and a single incidence of Honeysuckle.

There were no October samples collected at the Quiet Dell location, and the October samples collected in Raleigh county were lost due to a mishap, so the October samples came only from Salem (2013-2015), Jackson County, and Clarksburg.

It was interesting to see the Asteraceae type pollen grains in the October samples becoming more uniform in appearance as the bloom season drew to a close for the year. This was no surprise as Goldenrod and Snakeroot and most other plants die off, leaving Asters as the only significant plant type in bloom, and which do not seem to be damaged by frost. Two of the common Aster species at the Salem location are the lavender colored "Crooked Stem Aster" (*Symphyotrichum prenanthoides*) and the small white "Calico Aster" (*S. lateriflorum*). Most abundant, however, is a large bushy white-flowered aster which could be "Frost Aster" (*S. pilosum*), and/or "Heath Aster" (*S. ericoides*), and/or "Panicked Aster" (*S. lanceolatum*) among others. The project leader did not take time to make definite identifications for the "White Bush Asters" common in the Salem sampling locality.

The high incidence of Honeysuckle pollen came from the Salem location in 2014. It was a small sample consisting of white pellets. This was so far outside the expected bloom period for Honeysuckle that a mistake might be suspected were it not that small amounts of Honeysuckle pollen were also collected from the same location in September and October of the previous year (but not in 2015). It is also interesting to note that in the Jackson County location, Honeysuckle was found in small amounts throughout the summer in the July and August samples. To date the most plausible explanation would be that the bees found and worked on Japanese Honeysuckle which has long bloom period and could potentially bloom or re-bloom throughout the summer and fall until frost.

One other plant known to bloom abundantly in the month of October is Smartweed (*Genus Persicaria*). The project leader has observed many bees working large patches of Smartweed and found it rare to see a honey bee collecting pollen from this plant. This study confirmed that what little pollen may end up in the hive from this plant could be accidental and incidental.

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