Pollinators Beyond the Bee

By Francis Drummond

Pollinators are referred to as keystone species. A keystone species is one that has a disproportionately large beneficial impact on an ecosystem. Their removal can result in a dramatic shift or even collapse of an ecosystem. Pollination is the movement of pollen (the male gamete of most plants) to the female reproductive organ, the pistil (three parts: the stigmata, the style, and the ovary). The process after pollination is fertilization, the fusion of the male gametes (pollen) with the female gametes (ovule) resulting in the embryo. Movement of pollen to pistil or pollination can be assisted by rain or other sources of water, wind (many tree species), and animals.

So, who are these animal pollinators that we often see in our gardens, meadows, wetlands and forests in Maine? Bees are the best known and receive much of our attention. We notice their presence on flowers, they are highly diverse (278 species in Maine) and visit a diverse community of flowering plants. Bees are very efficient at collecting pollen from floral anthers and distributing them to the stigmas of flowers (a sticky or hairy tissue at the tip of the pistil) usually belonging to plants of the same species which results in pollination and subsequently fertilization of floral ovules to form embryos and future seeds, nuts, and fruits.

However, there are thousands of species of non-bee pollinators, some that we are well aware of and others that we might not have observed visiting flowers. The non-bee insects are a significant group, but there are also mammals and birds that play a role pollinating numerous herbaceous wildflowers, woody shrubs, and trees comprising the different landscapes that surround us. Let's explore a few of these pollinators that we might see as we walk outdoors during the spring, summer, and fall.

First off when discussing pollinators, it is important to understand that there are co-evolved pollinators and incidental pollinators. Co-evolved pollinators are animals that have an intimate mutualistic relationship with certain flowering plants. This relationship has evolved over time and is generally thought to be of mutual benefit to both the pollinator (pollen and nectar as food obtained from the plant) and the flowering plant (pollination in return for food). These pollinators have to have anatomical modifications or specific behaviors that result in frequent and often repetitive pollen deposition upon stigmas such that plant reproduction is dependent upon these pollinators (one species or several simultaneously). Incidental pollinators are those animals that accidentally or infrequently come in contact with flowers and in doing so are contaminated by pollen. A subsequent contact with another flower of the same plant species might result in the transfer of pollen between the first and second contacted flowers. Incidental pollinators are not thought to provide a significant pollination service in an ecosystem.

In Maine, some small mammals are considered incidental pollinators. Shrews and little brown bats when hunting insects may contact blooming flowers and disperse pollen. Pollen has been anecdotally found on the bodies of little brown bats. White-footed deer mice are considered by some scientists as co-evolved pollinators transferring pollen as they feed on the flower petals, nectar, and anthers of some ephemeral wildflowers such as trout lily, bloodroot, and various Trillium species. White-tailed deer are also opportunistic feeders like mice and also feed on flowers (Figure 1). Because there is a lack of evidence of successful pollination by these mammals they are most often considered as incidental pollinators.

The ruby-throated hummingbird is the only co-evolved pollinator that occurs in Maine. It feeds on flowers that have a long tubular corolla with the nectary located toward the base of the

flower. In addition, many of the flowers that attract the ruby-throated hummingbird have red, orange, or pink petals and copious amounts of nectar such as wild columbine, honeysuckle, bee balm, and lowbush blueberry (Figure 2). Many other bird species are considered incidental pollinators such as the northern oriole, several species of warblers, and cedar waxwings.

The insects comprise thousands of both co-evolved and incidental pollinators. Examples of some of the non-bee co-evolved groups of insects that are numerically abundant throughout Maine are as follows: the Lepidoptera (moths and butterflies), the Coleoptera (beetles, specifically the soldier beetles, scarab beetles, sap beetles, checkered beetles, click beetles, and longhorn beetles), the Diptera (the true flies, specifically the bee flies, blow flies, tachinid flies, and the flower flies), the Hymenoptera (non-bee wasps such as yellow jackets, ichneumon wasps, spider wasps, and the digger and sand wasps).

The moths and butterflies are perhaps the largest group of co-evolved non-bee insect pollinators in Maine. They are represented by many hundreds of species, but by far the most common are the night flying hawkmoths and day flying hummingbird moths (family Sphingidae), the brush-footed butterflies (family Nymphalidae) such as the red admiral butterfly and the monarch butterfly, and the swallowtail butterflies (family Papillionidae) such as the Canadian tiger swallowtail (Figure 3). These pollinators have a long, coiled proboscis that they can uncoil and insert into a long tubular flower to imbibe nectar. It is when they are imbibing nectar that they come in contact with the floral anthers and pickup pollen, usually on their face/head. The butterflies are diurnal and the moths are mostly nocturnal. The dusk and night flying hawkmoths of the tomato and tobacco hornworm species often imbibe nectar from pitunias planted in the garden. The day flying hawkmoths called the hummingbird moths (Figure 4) resemble hummingbirds on the wing. The wing beat rate is exceedingly fast combined with dull colored wings make the wings almost impossible to see. They can hover, fly sideways and backwards, true aerial acrobatics, and with a long proboscis they are often observed feeding on the nectar of phlox and bee balm in June and July. The brush-footed butterflies can be recognized at rest as they hold the shorter front pair of legs up off the substrate, often a leaf or flower. The monarch butterflies migrate between Mexico and Maine each year and the butterfly can be seen feeding on the nectar from a diversity of garden flowers and the larvae feed on plants in the milkweed family. Because milkweed plants contain a cardiac toxin in the sap, the emerging late summer butterflies are avoided by mammalian and bird predators. The Canadian tiger swallowtail butterfly is a relatively early butterfly in Maine showing up during lilac bloom in late May and feeding on nectar from these flowers. The larvae feed on the leaves of birch, poplar, apples, and black cherry.

The beetles are mostly what are called mess and stain pollinators. They are attracted to fleshy petals such as magnolia or rose petals for food. As they eat petals, they also eat the floral anthers, pollen being rich in fats and amino acids, and the beetles become covered in pollen. As they move from flower to flower the pollen clinging to their body exterior falls off and lands on the stigmas resulting in pollination. This is thought to be the oldest form of pollination that evolved, dating back to the origin of the earliest angiosperm flowering plants in the Cretaceous Period more than 100 million years ago. Scarab beetles are the group of beetles that Japanese beetles belong. Here is an example of an insect being highly destructive and at the same time being beneficial. Japanese beetle adults will feed on leaves of over 300 different species of plants and often defoliate them. At the same time, they are highly attracted to certain flowers when they feed on these flowers, they pollinate the plants. Japanese beetle larvae feed underground on the root system of grasses, creating bare spots in lawns when high densities of larvae occur. Several other beetles that

bore into trees also are mess and stain flower feeders such as longhorn, jewel, checkered, and click beetles (Figure 5).

The flies are attracted to flowers with open corollas and easily accessible sticky pollen. Adult female flies utilize pollen rich in fats and amino acids for maturation of ovaries. Many flower visiting flies have sponging mouthparts to collect nectar and pollen, although some flies (such as female mosquitoes and black flies) have a sucking proboscis like bees. Many of the fly pollinated are early spring blooming wildflowers. One species, a member of the blowfly family, the cluster fly (Figure 6 top), overwinters in houses, barns, and sheds. They are active in the late winter when the sun shines through windows, providing a parade of walking flies interrupting many a fine view through the dinning room picture window. In spring, the females need high protein diets and so are often observed on dandelions growing in the lawn. Once the flies' ovaries are mature, they lay the eggs in soil. The hatched larvae search out earthworms which they parasitize. Three to four generations of cluster flies occur before sneaking into buildings and other protected structures for the winter. There is an entire group of flies called the hover flies or flower flies (Figure 6 bottom) that are associated with many types of open bowl-shaped flowers that have easily accessible pollen. It is estimated that there are more than 100 species of flower flies in Maine. Many are striped yellow and black and are thought to mimic hornets. Many of the flower flies feed on nectar and pollen as adults, but are predators as larvae of small soft-bodied insects such as aphids on plant leaves.

Another interesting fly pollination relationship occurs very early in the spring during March often when there is still snow on the ground. The skunk cabbage plant found in forested wetlands attracts flies (primarily carrion feeding flies and gnats) in early spring by mimicking a dead body. The skunk cabbage inflorescence (spathe) emits a volatile sulfur gaseous compound that has a putrid odor of decomposing flesh. The plant also exhibits thermogenesis by metabolically generating heat using a cyanide resistant cellular respiration. The flies being attracted to this warm (often 20º F above air temperature) smelly fake dead body crawl into the spathe pickup pollen and with sequential visits to other skunk cabbage plants in search of a real cadaver, pollinate the flowers (Figure 7).

The wasps are the last major group of non-bee pollinators. The wasps are closely related to the bees, but wasps are primarily carnivores (mostly other insects) while bees are vegetarians (only eating nectar and pollen). However, wasps like flies and beetles depend upon pollen for maturation of ovaries and nectar for flight energy needed for hunting prey. Wasps do not have the delicate sipping and lapping proboscis for drinking nectar. They, like the beetles have strong crushing and tearing mandibles. Their pollination type or syndrome is again one of eating the flower organs, not the petals as in many of the beetles, but the male and female sexual organs (anthers loaded with pollen and nectaries filled with nectar at the base of the pistil). In the spring it is common to see hornet (yellow jacket wasp) queens (Figure 8) feeding on wildflowers just prior to nest construction and egg laying to build a colony. Later in the summer if you look closely at flowers in your garden or in a nearby meadow you may witness several species of digger wasps (wasp predators of insects that live in tunnels in the soil) (Figure 9) and ichneumon wasps (wasp parasites of beetle larvae and caterpillars) feeding on floral parts (Figure 10,11).

So, there are many more pollinators in your garden and in surrounding landscapes than there are bees. While bees are highly efficient and abundant pollinators, there are many other pollinator species that are just as important to the reproduction of wildflowers, woody shrubs, and trees that are the building blocks in our ecosystems.

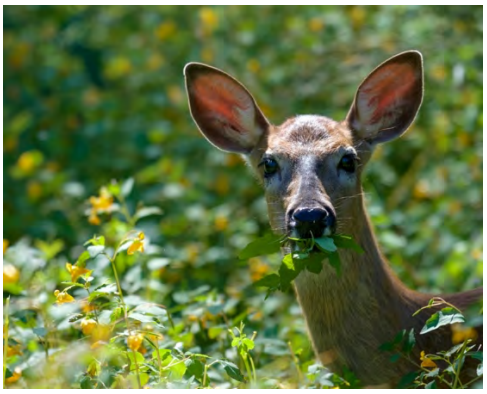


Figure 1. White-tailed deer eating a flowering Shrub. Photo credit: Andrew Patrick.

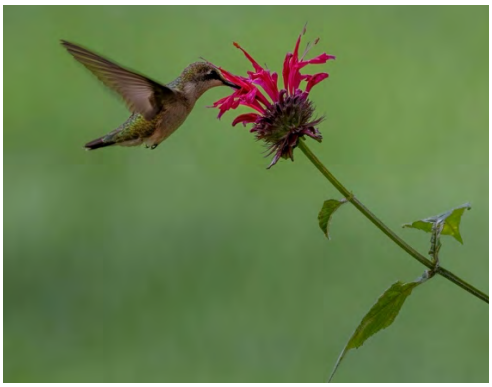


Figure 2. Ruby-throated hummingbird nectaring on bee balm. Photo credit: Mohan Nannapaneni.

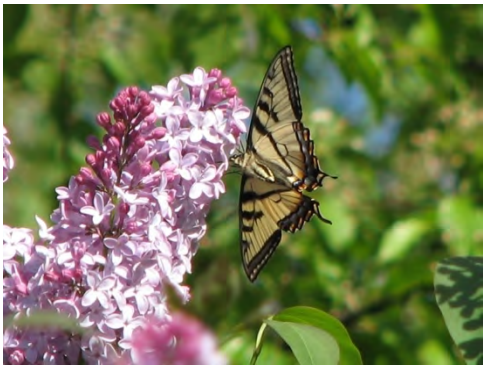


Figure 3. Canadian tiger swallowtail nectaring lilac. Photo credit: Gordon E. Robertson.

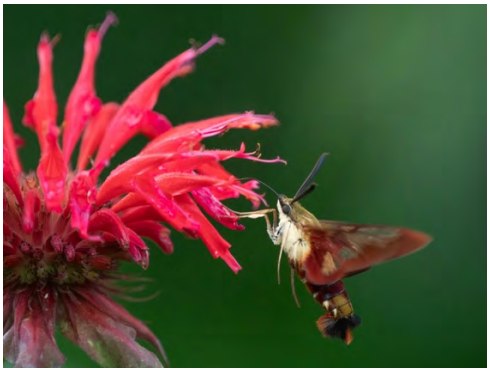
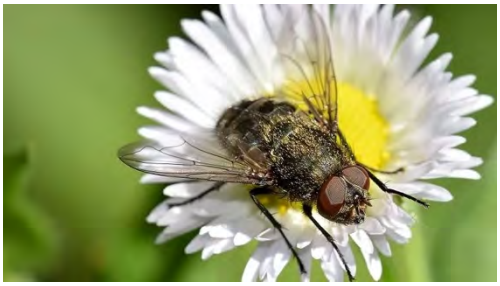


Figure 4. Hummingbird moth nectaring on bee balm. Photo credit: Chris F.

Figure 5. Checker beetle feeding on *Alium* sp. Photo credit: Diana Star.



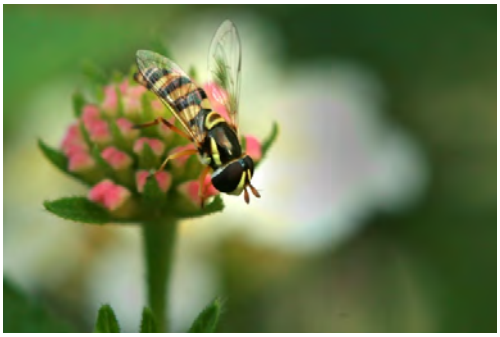


Figure 6. Cluster fly (top photo). Photo credit: Modern Pest Services. Flower fly (bottom photo). Photo credit: Jeffry Surianto.

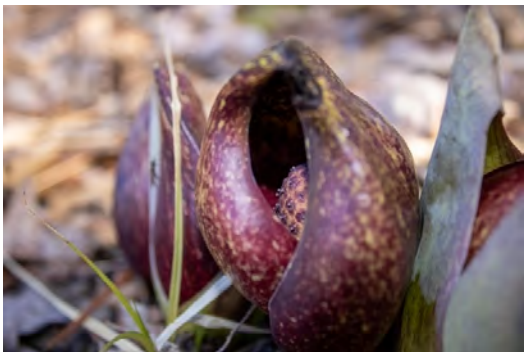


Figure 7. Earliest flowering plant in Maine, skunk cabbage. Photo credit: Gabriel Douglas.

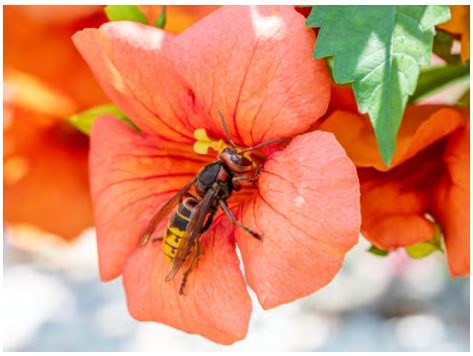


Figure 8. Yellow jacket queen feeding on Hibiscus flower. Photo credit: Erik Karits.

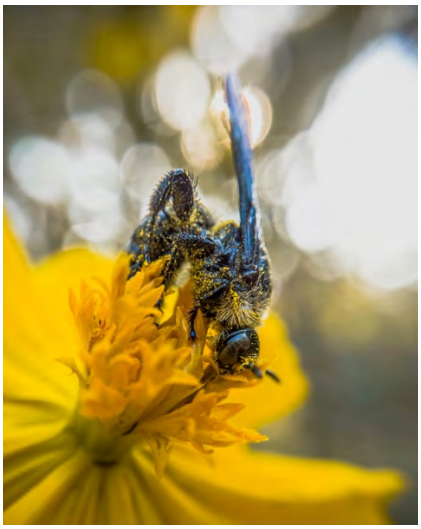


Figure 9. Predatory digger or sand wasp eating floral parts, covered with pollen. Photo credit: Arjun.

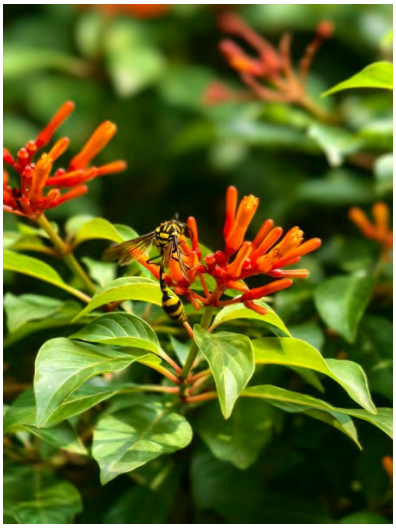


Figure 10. Ichneumon wasp feeding. Photo credit: Neeraj Anoop.

Figure 11. Ichneumon wasp feeding. Photo credit: Pixabay.