

Insect Pollinators of Central PA



Objectives

- Provide a brief overview of pollinating insects *in my garden* in Harrisburg, PA
- Show some species less commonly known as pollinators (flies, wasps)
- Visually demonstrate the beauty of pollinators



What is a Pollinator?

- A pollinator helps carry pollen from the male part of the flower (stamen) to the female part of the same or another flower (stigma).
- The movement of pollen must occur for the plant to become fertilized and produce fruits, seeds, and young plants.
- Some plants are self-pollinating, while others may be fertilized by pollen carried by wind or water.
- Others are pollinated by insects and other animals such as bees, wasps, moths, butterflies, flies, birds, and small mammals, including bats.¹



What is a Pollinator?

- Pollinators visit flowers in search of food, shelter, nest-building materials, and mates.
- Some pollinators, including many bee species, intentionally collect pollen.
- Others, such as many butterflies, birds, and bats, move pollen accidentally. Pollen sticks to their bodies while they feed on nectar and is then moved from flower to flower, which results in pollination.¹
- A pollinator is NOT a plant – it is an animal that pollinates a plant. Plants may be more or less pollinator-friendly, but they are not pollinators.



Bumble Bees

- Bumble bees and honey bees belong to the family Apidae.
- Apidae is the largest family of bees and includes more than 5,700 species.
- The family probably arose between 115 to 95 million years ago and includes the oldest known fossil bee.
- The genus *Bombus* includes 300 different species of bumble bee.





Bumble Bee Nests²

- A solitary queen hibernates over winter in leaf litter, the soil, holes in logs, or under stones and emerges in spring.
- She feeds, builds an initial nest, and lays eggs.
- Female workers emerge and take over foraging, and the queen creates more brood cells and lays more eggs.
- In late summer, if the bees have collected sufficient nectar and pollen, male bees emerge, and a new queen is produced.
- By fall the old queen dies along with the workers. Only the new queen survives and mates and then seeks out a sheltered spot to hibernate through the winter.
- Bumble bee nests can range from a few dozen bees to a few hundred.
- In the photo to the left, bumble bees made a nest in insulation. Photo by Debbie Roos for NC State Extension, used with permission.



On verbena bonariensis.

Green-eyed bumble bee on goldenrod.



*Green-eyed bumble bee on Russian sage
Taken at Fort Hunter.*





Bumble bee on raspberry.





On anise hyssop.

Bumble bee on dahlia: built for pollination!



Bumble bees on mint flowers.





Last bumble bee of 2023 on calendula, 11/19.

Carpenter Bees

- Carpenter bees are members of the subfamily Xylocopinae (family Apidae).
- These bees are mostly solitary, but they tend to be gregarious.
 - Groups of different sizes form under various conditions and may be referred to as aggregations, associations, clumps, or other terms.³
- Most members of this subfamily make nests in plant stems or wood.
- It can be difficult to differentiate species of carpenter bees from each other, but you can tell carpenter bees from bumble bees by looking at their abdomens: most carpenter bees have shiny abdomens, whereas bumble bees have abdomens that are completely covered with dense hair.





Compare abdomens.

Carpenter bee on dahlia.





Carpenter bee with grape hyacinth.



Carpenter bee on marigold.

Sweat Bees

- Halictidae is the second-largest family of bees with nearly 4,500 species.
- They are commonly called sweat bees because they are often attracted to perspiration.
- Halictid species are an extremely diverse group that can vary greatly in appearance.
- Most halictids nest underground. Species that are parasites of other bees do not build nests. Despite usually nesting in the ground, nesting behavior is otherwise highly variable among the species.



Green Sweat Bee, *Augochloropsis metallica*

- These bees feed on the nectar of flowers and the honeydew of aphid colonies.
- They nest colonially in soil:
 - Many bees use a single entrance in the ground but branch out to build their own nests. Females take turns sitting at the entrance to prevent intruders from entering.
- Members of this genus are unusual in that the pollen loaves they form for their developing larvae are cube-shaped instead of loaf-shaped.⁴



A close-up photograph of a green sweat bee (Halictus confusus) on a vibrant green leaf. The bee is covered in bright yellow pollen, particularly on its head, thorax, and legs. Its wings are dark and translucent. The background is a soft, out-of-focus green. In the bottom right corner, there is a white text caption.

A pollen-gathering machine: green sweat bee!





Green sweat bee on helenium.

Bicolored striped sweat bee (*Agapostemon virescens*) on echinacea.

- Females have white and black striped abdomens, while those of the male are yellow and black striped.





Bicolored striped sweat bee on New England aster.

Bicolored striped sweat bee on black-eyed Susan.



Megachilidae

Family of solitary bees with ~630 species in North America. Most are native, and a few were introduced accidentally and intentionally. Globally the number of species exceeds 4,000, and 81 species have been recorded in Pennsylvania.

They carry pollen in scopae* on their abdomens and provision their larvae with pollen and nectar, which means they are excellent pollinators.

The common names of the nonparasitic species come from the materials they use to build nests:

- **Carder bees** use plant fibers or animal hairs (carding is the process of combing cotton or wool fibers to weave them together).
- **Leaf-cutting bees** cut disks from leaves and petals (and sometimes plastic) to line the walls of their nurseries.
- **Mason bees** use mud to build their nests.
- **Resin bees** use plant resin in nest construction.

Other species are kleptoparasites often referred to as "cuckoo bees" that feed on pollen collected by other megachilid bees. Parasitic species do not possess scopae.





European Wool Carder Bee, *Anthidium manicatum*

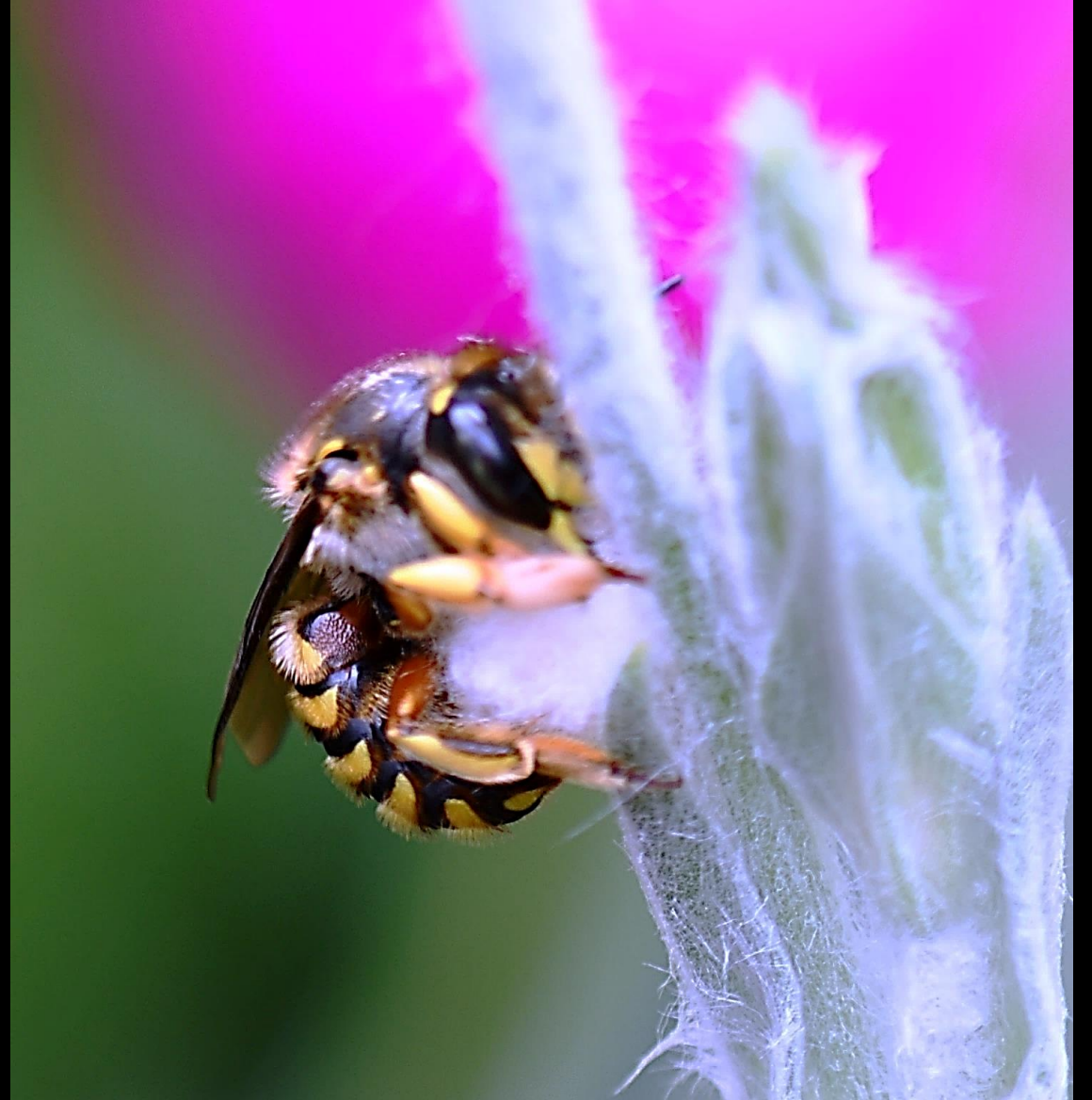
- The name "carder" is derived from behavior in which the female scrapes hair from leaves such as lamb's ear to use as nesting material -- males fiercely guard areas of these plants for potential mates.
- One of the few bee species in which the male is larger than the female.
- This species has been called the most widely distributed unmanaged bee in the world because of its expansive native and non-native range.⁵



European wool carder bee on pickerel leaf.



European wool carder bee feeding on pickerel weed.



Female wool carder bee on rose campion.

Leaf-Cutting Bees

Leaf-cutting bees vary in size, but on average, they're about the same size as a honey bee. Most bees carry pollen *on their legs* in one of two ways (broom vs. basket). However, the leaf cutter and other megachilid bees are different: the underside of the abdomen is particularly hairy and is used for this purpose. If you see a black bee about the size of a honeybee with a yellow belly, it is probably a leaf cutter.

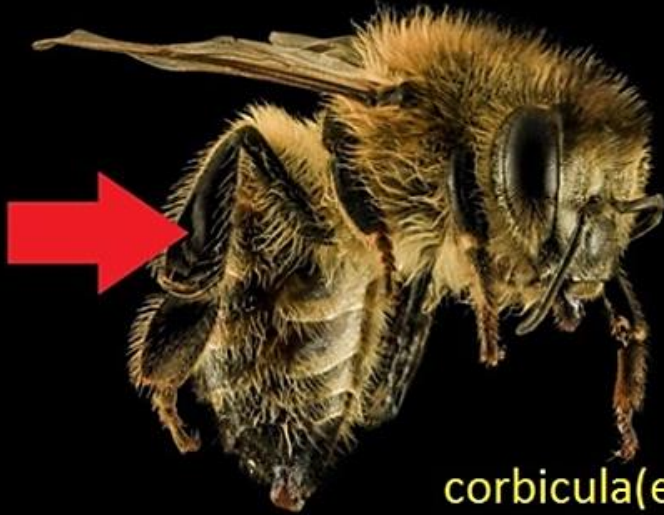


Leaf cutting bee -- Back and front.



How Bees Carry Pollen: Scopa vs. Corbicula

scopa(e) = pollen broom(s)



corbicula(e) = pollen basket(s)

Scopa (plural scopae, word origin "broom") is an area of branched hairs that is more dense than hair on other areas of the bee's body; bees push pollen in here for transport back to the nest after grooming it from other parts of their bodies. Spacing between the hairs and spacing of the branches on the hairs allow for pollen carrying. A scopa can be on the abdomen (as in the Family Megachilidae, upper left), but most other bees have scopae on their hind legs (upper right).

Corbicula (plural corbiculae, word origins "basket" and "very tiny") refers to the shape of this pollen-carrying area. Corbiculae are most typically found on the hind legs of social bees such as bumble bees and honey bees. They are relatively hairless, concave areas ringed with un-branched hairs (the hairs make the sides of the basket). After the bee combs/grooms pollen grains from her body, she packs the pollen tight in her pollen presses (the bee's knees, between tibia and tarsus), and often adds nectar to help the pollen stick together. She then places the compressed pollen in her basket (image bottom left and right: arrows point to pollen baskets on the tibiae of Apis and Bombus respectively).

The anatomy and behaviors associated with pollen collection in bees is more intricate and complex than described here. Bees can have special hairs on the front of their heads to aid in pollen collection. Some bees, for example, all species in the genus *Hylaeus* (Family Colletidae), carry pollen internally in a crop and do not have scopae or corbiculae.



Nonparasitic Megachilidae, including leaf-cutting and carder bees, typically divide their nests into cells:

- Each cell receives a supply of food (pollen or a pollen/nectar mix) and an egg.
- After finding a suitable spot (often near where she emerged), a female starts building a first cell, stocks it, and oviposits.
- She builds a wall with a leaf to separate the completed cell from the next one.
- The larva hatches from the egg and consumes the food supply. After moulting a few times, it spins a cocoon and pupates.

Leaf-cutting bee with pickerel weed.

From left to right: pupa, larva, and egg inside a nest cavity and adult female.

Note the pollen collecting hairs on the underside of the adult bee's abdomen.

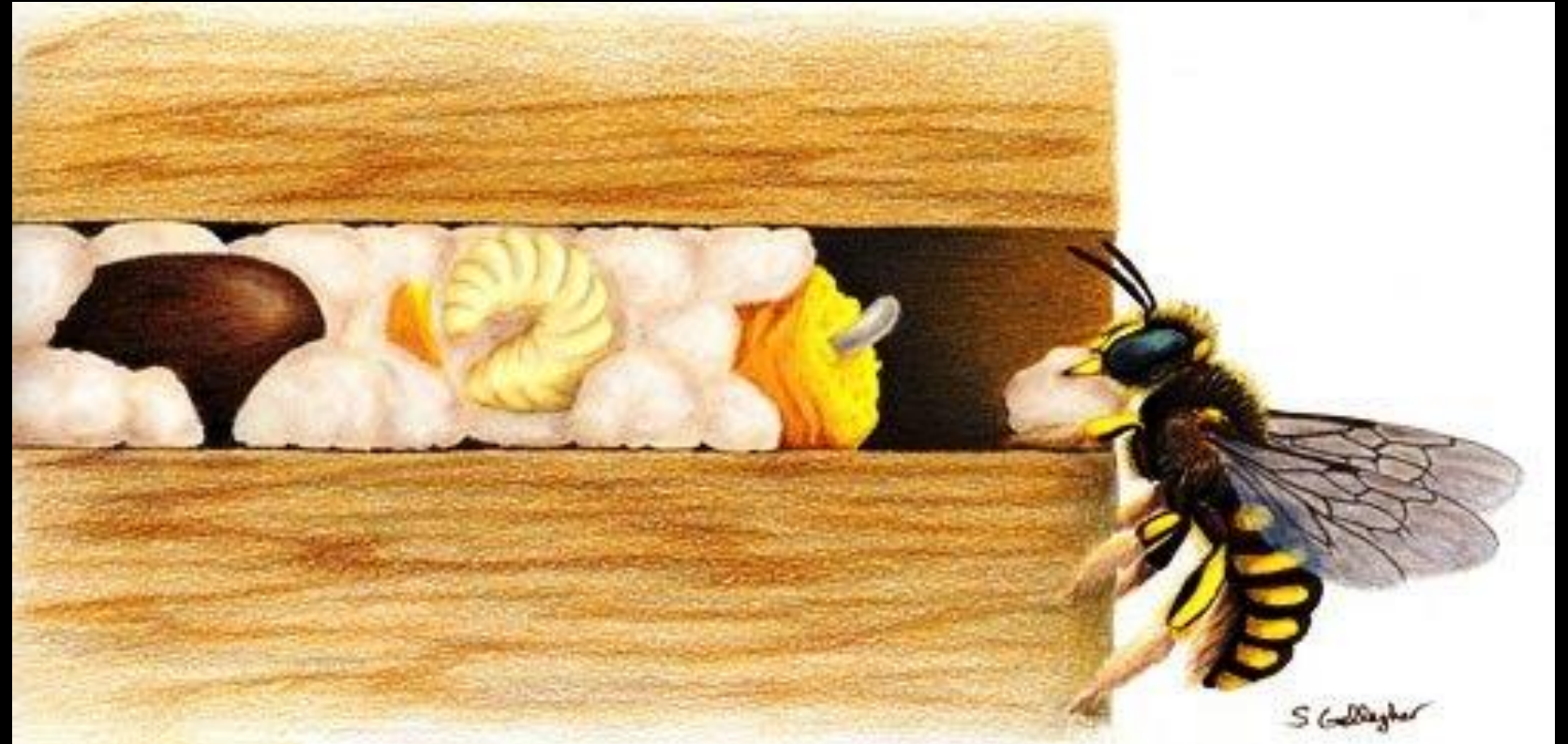


Illustration by Samantha Gallagher,
University of Florida. Used with
permission.
[https://entnemdept.ufl.edu/creatures/
MISC/BEES/Anthidium_manicatum.html](https://entnemdept.ufl.edu/creatures/MISC/BEES/Anthidium_manicatum.html)

Rendition of life stages of the European wool carder bee, *Anthidium manicatum*.



Corbicula of a bumble bee.

Anthophora

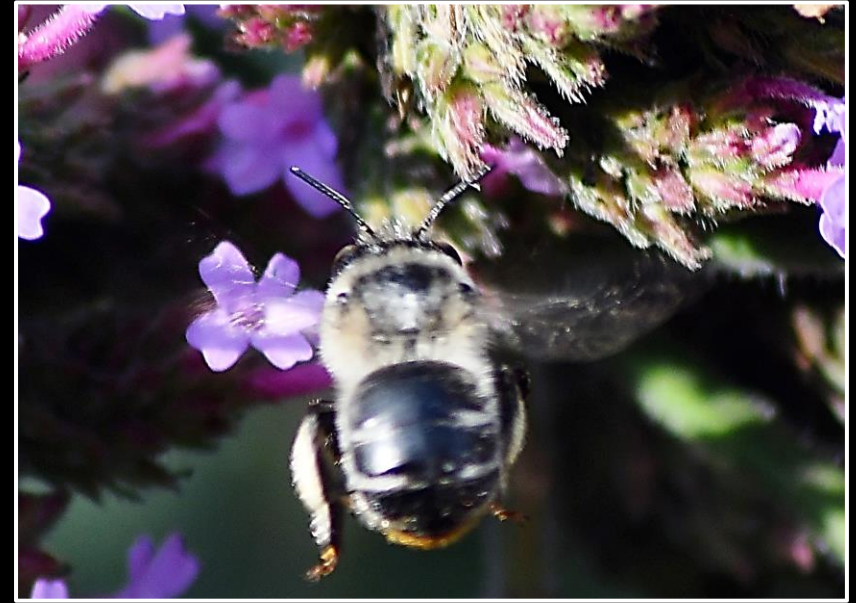
Another group of solitary bees, *Anthophora*, is one of the largest genera in the family Apidae, with more than 450 known species worldwide.

- They are most abundant and diverse in the northern temperate and African regions.
- Group of native bee species that are important pollinators of crops and wild plants.
- *Anthophora* bees are not aggressive but can sting for defense.
- All species are solitary, although many nest in large aggregations. Nearly all species make nests in the soil in banks or in flat ground; the larvae develop in cells with waterproof linings and do not spin cocoons.
- Individuals are large and often have yellow facial markings. Some species have distinctive bands. Males commonly have pale white or yellow facial markings and/or peculiarly modified leg armature and hairs.



Orange-tipped Wood Digger Bee, *Anthophora terminalis*

- The *Anthophora* bees in general are fast and noisy and forage on a wide variety of flowers.
- The wood digger prefers deep, tubular flowers such as the verbena bonariensis shown here, which they access with long tongues.
- Unlike most species in the genus that nest in the ground, they build their nests in hollowed out pithy stems or in rotting wood, which is why they are called “wood digger.”
- Females have a distinctive orange tip to their abdomens, while males have extensive yellow on the lower portion of their faces.



Flies

Members of the order Diptera, flies are the second most important pollinators in Pennsylvania after bees.⁶

- Flies have one pair of wings, which distinguishes them from other insects (two pair).
- Some flies mimic bees, but most do not have specialized pollen-carrying hairs like bees, so they are less efficient pollinators by comparison.



Hover Flies

- Hover flies make up the insect family Syrphidae.
- Adults of many species feed mainly on nectar and pollen.
- Larvae (maggots) eat a wide range of foods depending on species.

They may be

- Herbivores that eat plants,
- Detritivores that eat decaying plant and animal matter in the soil, ponds, and streams, or
- Insectivores that prey on aphids, thrips, and other plant-sucking insects.





Hover fly on zinnia.



Black-horned gem, *Microchrysa polita*

- Species of soldier fly found in Europe, Asia, and North America.
- Adults feed on flower nectar; larvae feed on decaying organic matter.



Mimic fly, *Mallota posticata*

- *Mallota* is a widely distributed genus of hover fly well known for a bee-like appearance.

Mimic fly.



Mimic fly.





Mydas Fly, *Mydas clavatus*

- Mydas flies are a small family of flies (Mydidae) with about 471 species.
- They are generally large.
- Many of the species mimic stinging wasps.
- Adults of several species are avid flower visitors and act as pollinating agents.
 - Rattlesnake master is a favorite nectar source. Seen here on mint.
- They are infrequently encountered since the adult lifespan can be quite short.

Mydas fly with photo bomb from Scoliid wasp.



Mydas fly on mint.

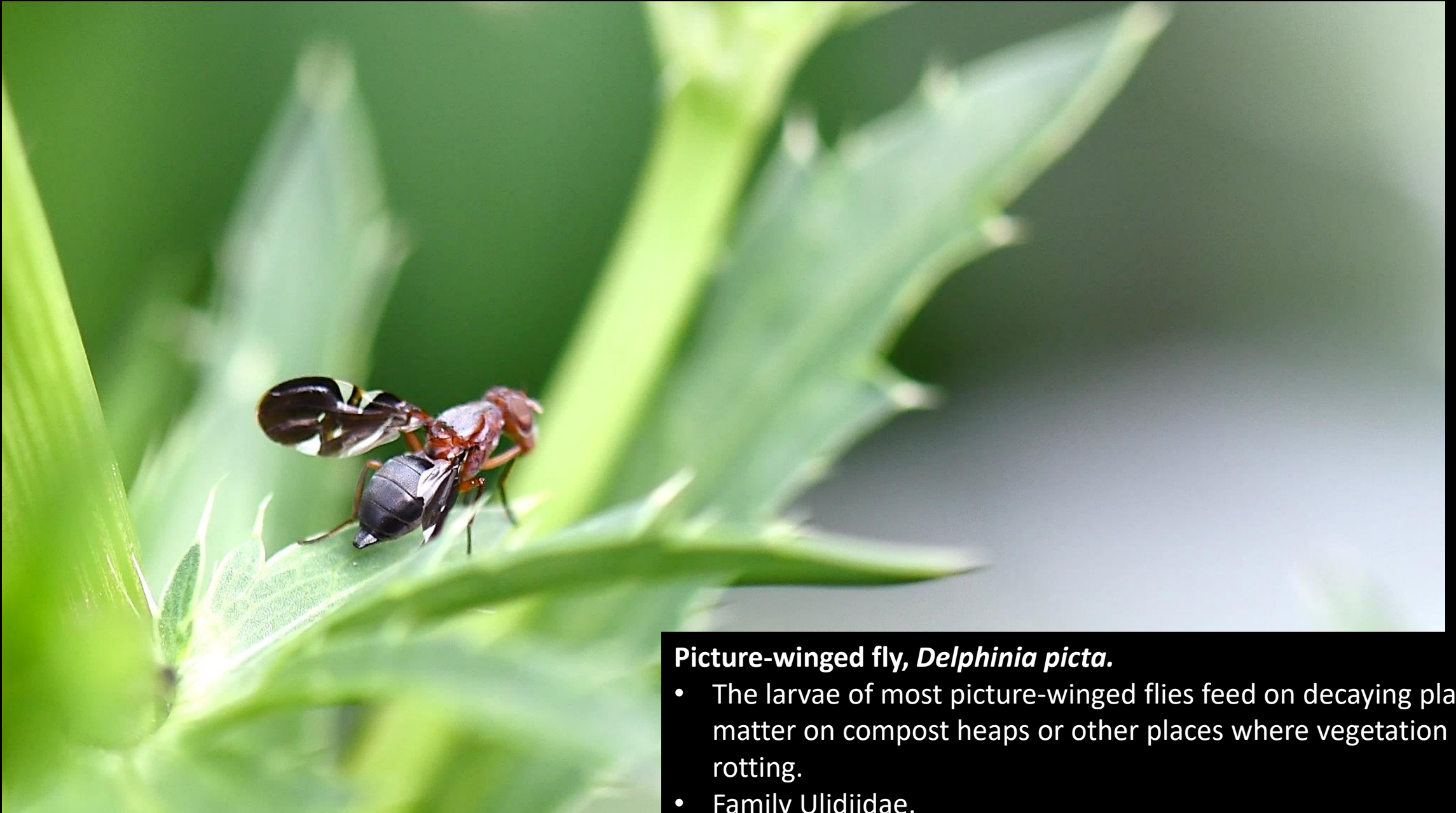




Hover fly on goldenrod.



Hover fly.



Picture-winged fly, *Delphinia picta*.

- The larvae of most picture-winged flies feed on decaying plant matter on compost heaps or other places where vegetation is rotting.
- Family Ulidiidae.

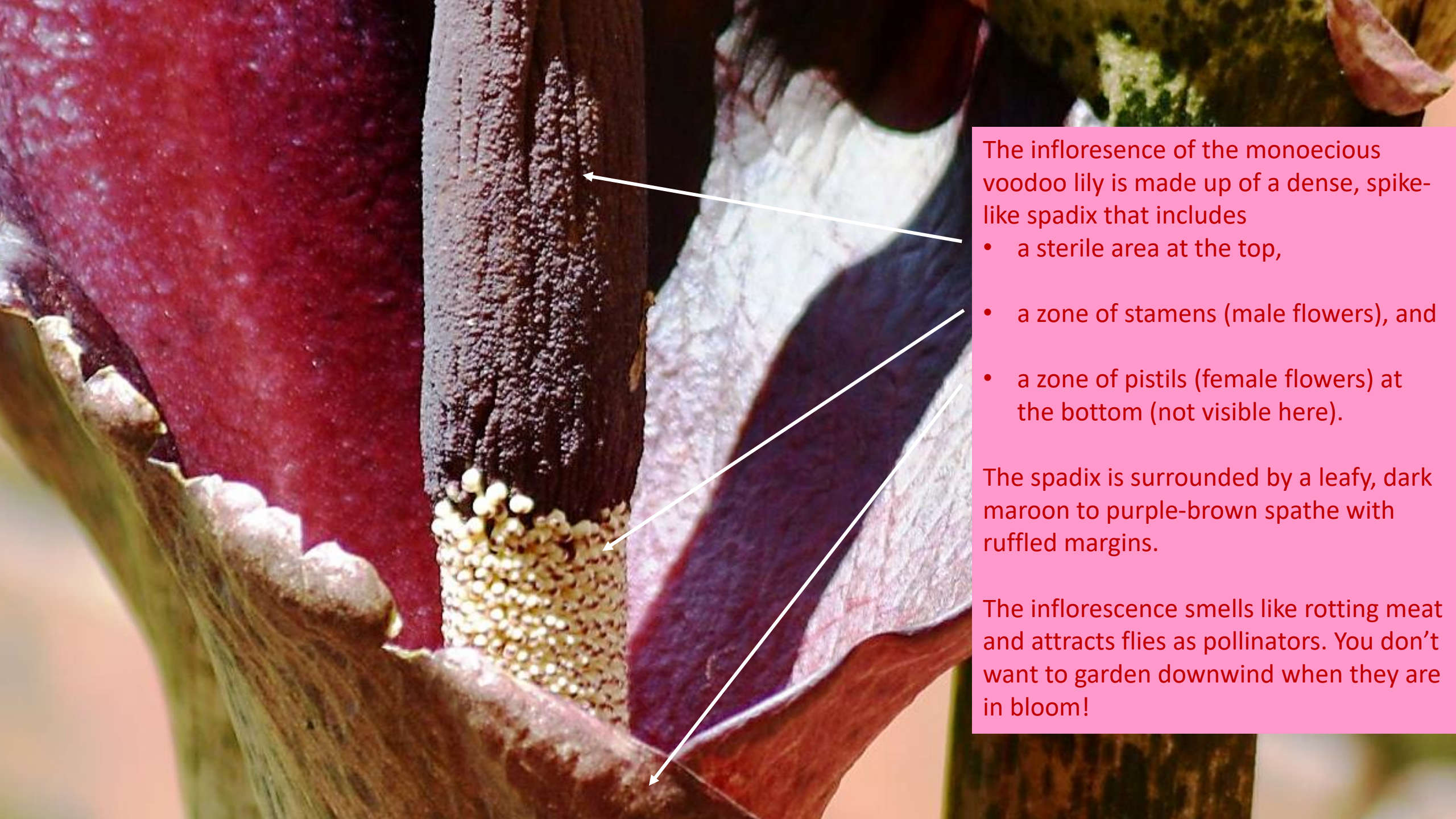
Some plants have evolved to be pollinated only by flies ...



Voodoo Lily,
Amorphophallus konjac



Inflorescence



The inflorescence of the monoecious voodoo lily is made up of a dense, spike-like spadix that includes

- a sterile area at the top,
- a zone of stamens (male flowers), and
- a zone of pistils (female flowers) at the bottom (not visible here).

The spadix is surrounded by a leafy, dark maroon to purple-brown spathe with ruffled margins.

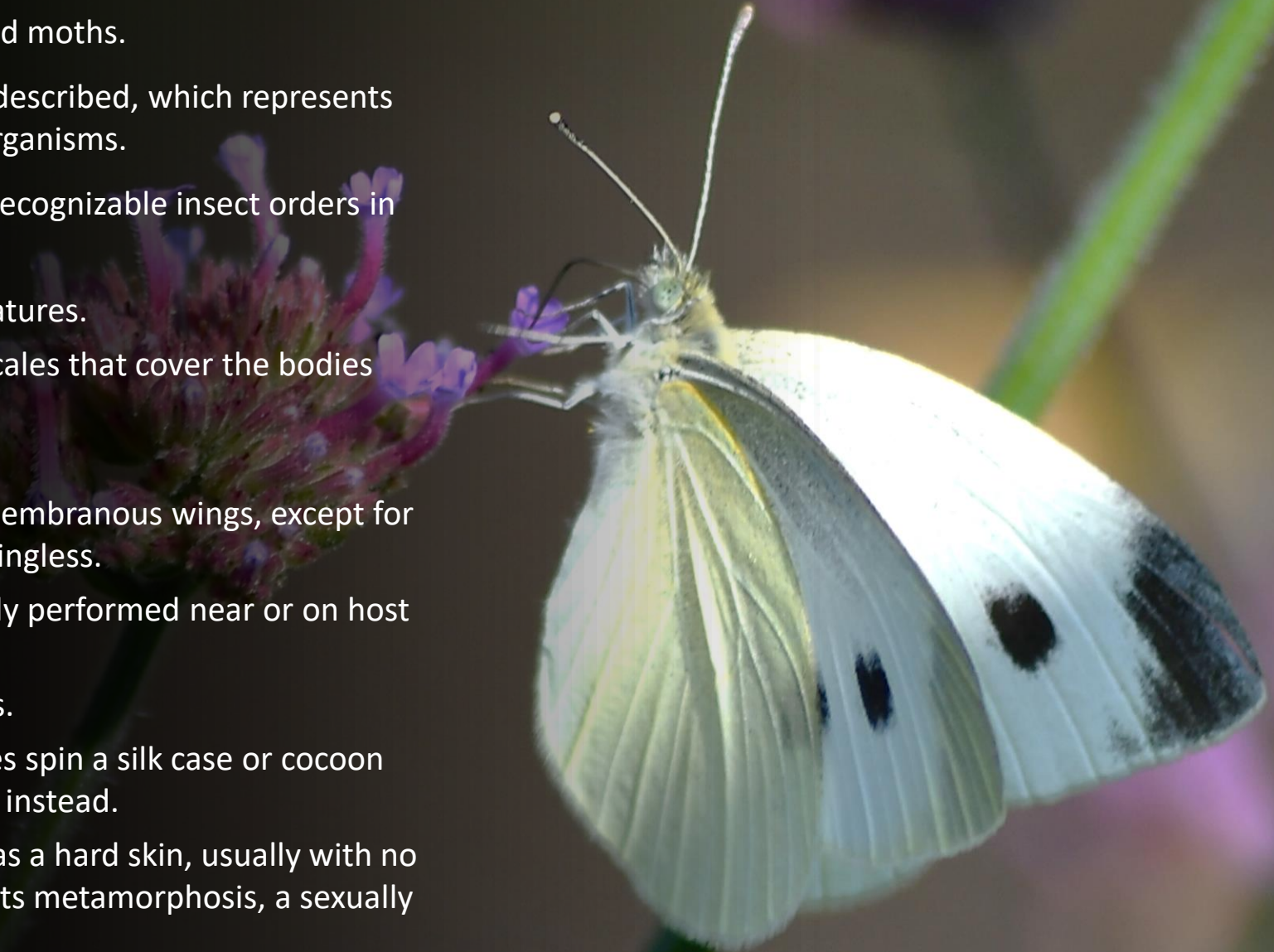
The inflorescence smells like rotting meat and attracts flies as pollinators. You don't want to garden downwind when they are in bloom!

The result of successful pollination!



Butterflies & Moths

- The order Lepidoptera includes butterflies and moths.
- ~180,000 species of Lepidoptera have been described, which represents 10% of the total described species of living organisms.
- It is one of the most widespread and widely recognizable insect orders in the world.
- Characterized by more than three derived features.
 - The most apparent is the presence of scales that cover the bodies and wings.
 - Presence of a proboscis.
 - Almost all species have some form of membranous wings, except for a few that have reduced wings or are wingless.
 - Mating and the laying of eggs is normally performed near or on host plants for the larvae.
 - They undergo complete metamorphosis.
 - A few butterflies and many moth species spin a silk case or cocoon before pupating; some go underground instead.
 - The butterfly pupa, called a chrysalis, has a hard skin, usually with no cocoon. Once the pupa has completed its metamorphosis, a sexually mature adult emerges.





Great Spangled Fritillary,
Speyeria cybele

- When the eggs hatch, the caterpillars crawl into the leaf litter and hibernate until the next spring.
- Caterpillar host plant: leaves of violet, *Viola*.



Great spangled fritillary on zinnia.

Great spangled fritillary on calendula.





Monarch, *Danaus plexippus*

- Monarch butterflies live in North, Central, and South America; Australia, some Pacific Islands; India; and Western Europe.
- Known for migration from North America to Mexico.
- Host plants of caterpillars are species of milkweed, which benefit their health and help defend them against predators.
- Migratory monarchs are classified as endangered.
 - During the last three decades, the population has decreased by more than 80%.
 - Main drivers are use of herbicides in the United States, resulting in a loss of milkweeds, and climate variations.⁷



Monarch on blue mist flower.



Monarch caterpillar on butterfly weed.



Ailanthus Webworm Moth, *Atteva aurea*

- Thought to be native to south Florida.
- Caterpillars eat the introduced, invasive tree of heaven (ailanthus tree) and possibly sumacs.
- Adult moths drink nectar from a variety of flowers.





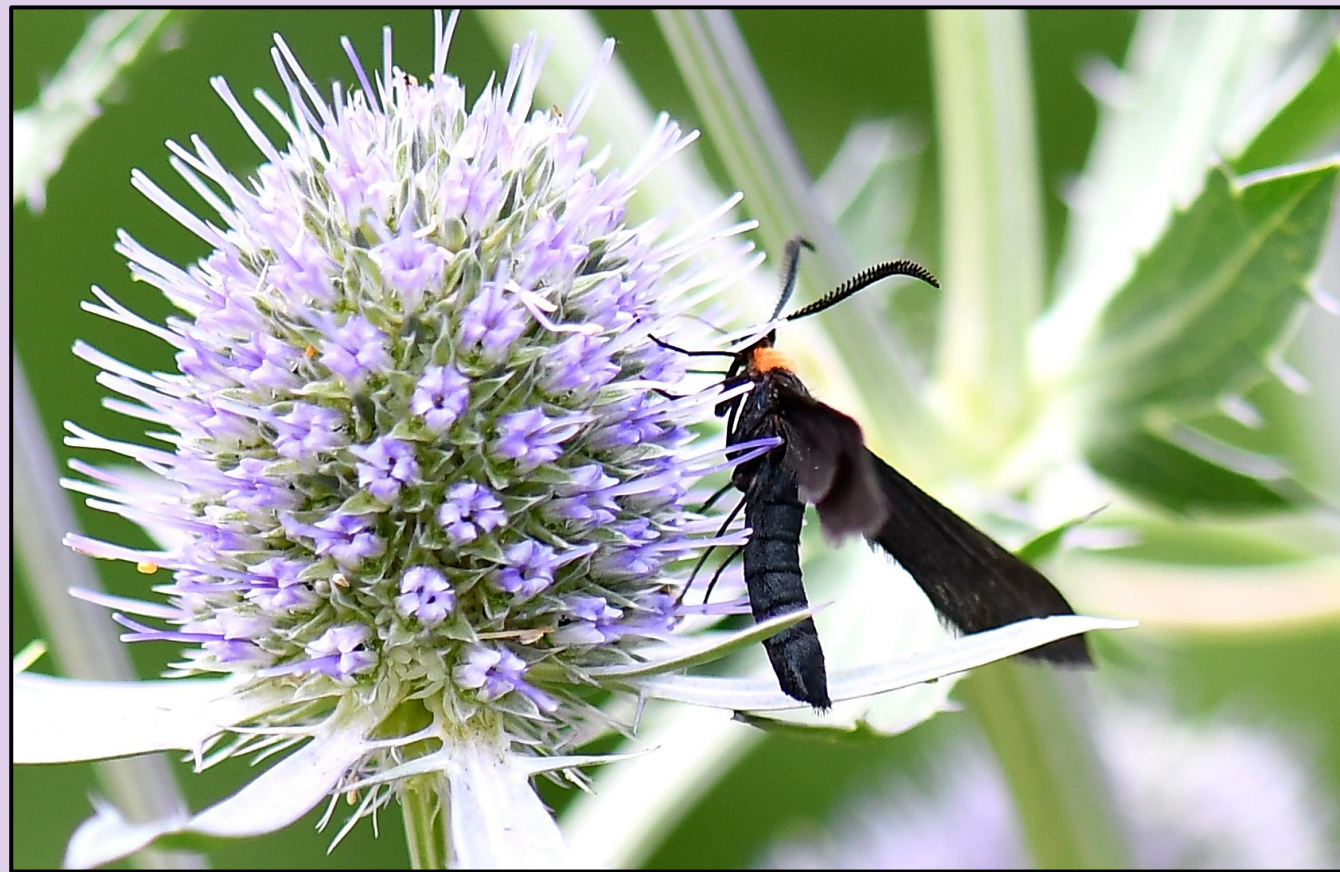
Ailanthus webworm moth on goldenrod.

Orange Sulfur, *Colias eurytheme*

- Also known as the alfalfa butterfly and in its larval stage as the alfalfa caterpillar.
- Member of family Pieridae, where it belongs to the lowland group of clouded yellows and sulfurs.
- Caterpillars tend to concentrate on pea family plants, such as vetch, alfalfa, and clover.
- Native to North America.



Grape Leaf Skeletonizer, *Harrisina americana*



- It is widespread in the eastern half of the United States and is commonly noticed defoliating grapes.
- This is the only moth species whose larvae feed gregariously on grape foliage.
- Adults are active visiting flowers during the day and night, and they live only a few days.



Eastern tiger swallowtail, *Papilio glaucus*,
on phlox.

Eastern black swallowtail, *Papilio polyxenes asterius*, on zinnia.



Eastern black swallowtail caterpillar on parsley.

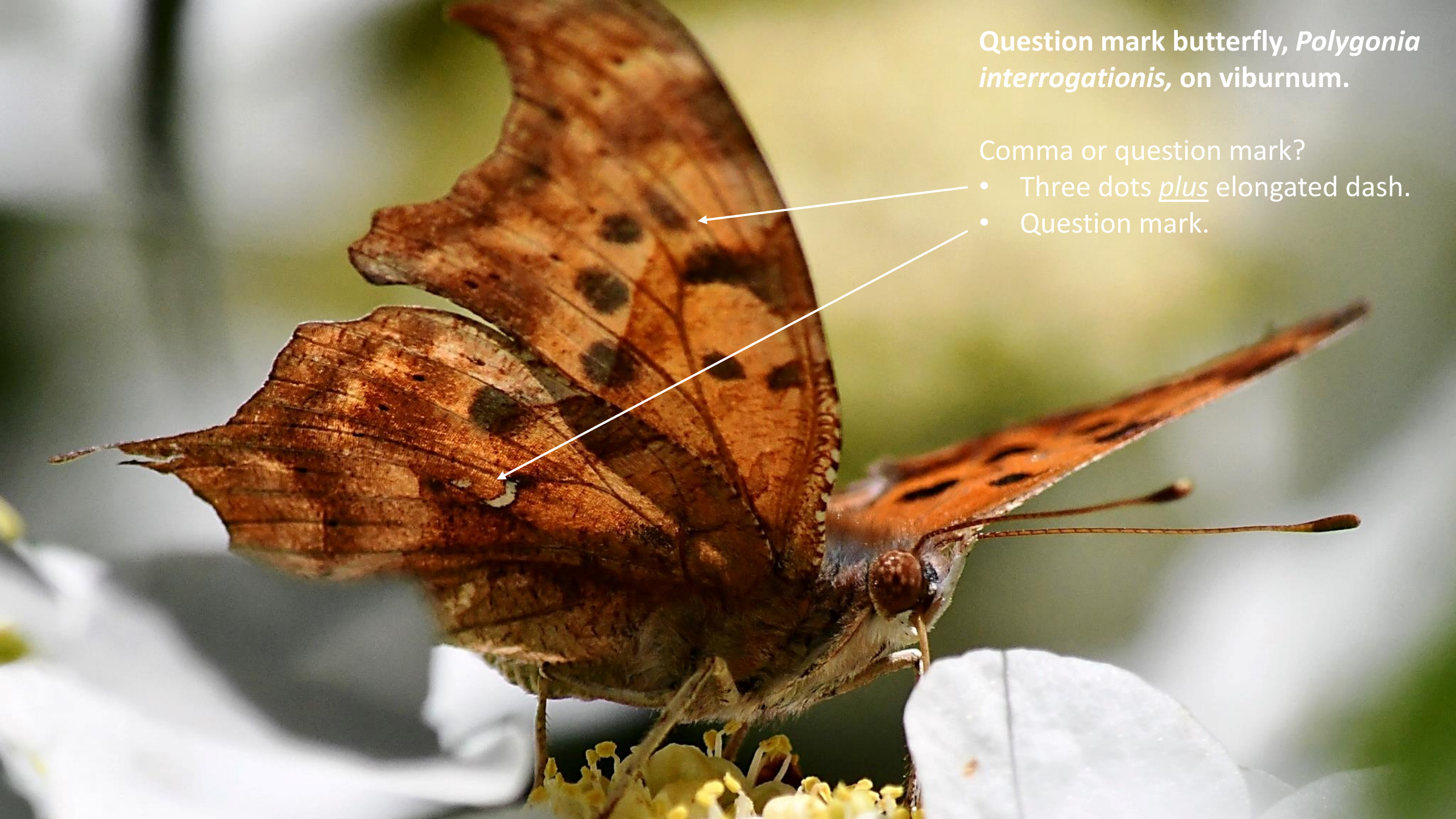




Question mark butterfly, *Polygonia interrogationis*, on viburnum.

Comma or question mark?

- Three dots plus elongated dash.
- Question mark.





Pearl Crescent(spot), *Phyciodes tharos*.

- Like the Spangled Fritillary, caterpillars winter in leaf litter on the ground.
- Host plant is aster.



Red Admiral, *Vanessa atalanta*.

Lycaenidae

- Second-largest family of butterflies, with more than 6,000 species worldwide.
- They constitute about 30% of the known butterfly species.
- Also called gossamer-winged butterflies.
- The family comprises seven subfamilies, including the blues, the coppers, the hairstreaks, and the harvesters.



Gray hairstreak.



Summer Azure, *Celastrina neglecta*.

- Host plants for caterpillars include New Jersey tea, dogwoods, and meadowsweet.



Red-Banded Hairstreak, *Calycopis cecrops*.

- Host plants for caterpillars include the fallen leaves of wax myrtle, dwarf sumac, staghorn sumac, and several oaks, including willow oak.

Eastern Tailed-Blue, *Cupido comyntas*.

- Distinguished by tails at the base of the hind wings.
- Caterpillar host plants include many plants in the pea family: yellow sweet clover, alfalfa, various species of vetch, wild pea, bush clover, and others.
- Native to Eastern United States.



Banded hairstreak.





Skippers



- Part of the family HesperIIDae. The most recent taxonomy places this family in the superfamily Papilionoidea, the butterflies.
- They are named for their quick, darting flight habits.
- Most have antenna tips modified into narrow, hook-like projections. More than 3,500 species of skippers are recognized, and they occur worldwide.
- Caterpillar host plants vary by species.



Dusky wing skipper on black-eyed Susan.



Dingy skipper on verbena bonariensis.

Silver spotted skipper on zinnia.





Skipper on China aster.

Wasps & Hornets

- All hornets are wasps, but not all wasps are hornets. Hornet is the name for 22 specific, social wasps.
- A wasp is any insect of the narrow-waisted suborder *Apocrita* of the order Hymenoptera, which is neither a bee nor an ant. Most wasp species are solitary, and each adult female lives and breeds independently.
- Hornet
 - Name commonly misused for wasps that nest above ground, including bald-faced hornets.
 - Construct paper nests.
 - Sting is more painful than other wasps.
 - More aggressive than other wasps.
 - Members of the family Vespidae and are eusocial, ie, live together in a nest with an egg-laying queen and non-reproducing workers.





Great Golden (Sand) Digger Wasp, *SpheX ichneumoneus*

- Native to Western hemisphere.
- Provisions young with paralyzed grasshoppers, locusts, crickets, etc.
- Pulls prey into the burrow by the antennae.



European Hornet, *Vespa crabro*

- Introduced from central Europe into North America, first detected in the 1840s, have since become widespread and well established in the eastern United States, including all of Pennsylvania.
- Only true hornet found in North America.
- Require high levels of protein, which they obtain from the nectar of flowers and fruiting trees.



European hornet.



European hornet.



Four-Toothed Mason Wasp, Monobia quadridens.

Paper wasp on black-eyed Susan.



Paper wasp on tropical milkweed.



Four-banded stink bug hunter wasp,
Bicyrtes quadrifasciatus.

- Large sand wasp common in the United States.





Adult wasps only feed on sugars but hunt other invertebrates to feed to their offspring. Social species capture insects, chop them up, and carry parts back to the nest.⁸



— Miscellaneous

Various other pollinators from the garden.







Locust borer on goldenrod.





Hummingbird and cardinal flower.



Honey bee on sea holly.





Mystery insect. Who can guess?

Hummingbird with hosta flower.





*Opportunistic behavior: wasp slices base of hosta flower to obtain nectar.
Later, other species benefit, including hairstreaks, bumble bees, honey bees, and carpenter bees.*





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