Extension

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Beneficial Insects in New Hampshire Farms & Gardens

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Although there are plenty of references on insect pests, there are relatively few references that feature beneficial insects. I wrote this publication to illustrate and describe some of the common New Hampshire beneficial insects that might be found in your yard, garden, or farm. I'll concentrate on predaceous insects, parasites, and pollinators. I will not cover insects that are beneficial in other ways, such as breaking down leaf litter, feeding on carrion, or serving as an important food sources for birds, bats, fish, and other animals. I won't include beneficial species that are mostly encountered if you purchased them for release in greenhouses or other situations. You can find photos of them in catalogs and greenhouse references. I will not include species that are strictly aquatic. Since people learn from photographs, I've included as many photos as I could, to help you recognize beneficial insects by sight. I've listed size in millimeters, because it is more accurate than inches. There are 25.4 mm to the inch, so 1 mm is pretty small. Rather than organize the information taxonomically (by insect orders, then families in each order), **I have arranged them by "profession", starting with parasitic insects, then predators, then pollinators.** At the end, I've described how to preserve and encourage beneficial insects on your farm or in your garden.

Beneficial insects are all around us. By reading the descriptions and looking at the photographs, you can spot them in your yard.

Insect Parasites

An observant person can find insects that have been attacked by parasites. Adult female parasites are the ones that do the attacking (laying eggs). Parasites usually attack multiple individual hosts, usually by laying their eggs on or in the body of the host insect. Many parasites have a very narrow host range; they'll attack just one or a few species. Some parasites attack a wide range of species.

Photo 1. A tachinid fly that attacks squash bug.

Tachinid flies (pronounced ta-kin-id, family Tachinidae) lay their oval, whitish eggs on the surface of their prey. This means the eggs are easily visible. When the egg hatches, the parasite larva burrows directly into the body of the host and starts feeding, leaving the empty egg shell attached to the surface. Once fully grown, the

maggot emerges from the now dead host, and pupates. Eventually the adult fly emerges from the pupa, and the cycle begins again. Tachinids commonly attack caterpillars or sawflies, and a few species attack true bugs (stinkbugs for example) or beetles. The red, gold and black fly on page 1 is a tachinid that attacks squash bug and stinkbugs. Some attacked insects have several eggs on their bodies, showing that they were attacked multiple times, like the **cutworm** in photo 2. If you look closely at Japanese beetles in early July, you can find tachinid eggs on some. On this host species, the eggs are most common on the thorax, the shiny green section behind the head. Those beetles with tachinid eggs on them are doomed. The fly that parasitizes Japanese beetle was introduced from Korea many years ago, in an effort to control the pest. It kills some, but doesn't seem to lower Japanese beetle numbers very much. Most tachinid flies look a lot like house flies. The only way to identify the adult flies for certain is to use a microscope and a technical key. There are at least 276 species of **Tachinids** in New Hampshire. They are highly variable. Some species are long and narrow, while others are stout, like a house fly. Most are gray or black, but a few have some bright colors. They are as large as 16mm (2/3 inch).

Photo 2. Cutworm with tachinid eggs.

Photo 3. A very large tachinid fly.

Photo 4. Aphid mummy.

Photo 5. A braconid wasp.

Aphids that have been attacked and killed by parasites typically turn tan and rigid, and are called **mummies**. Sometimes mummies have a large circular hole in the body. That shows that the parasite (usually a tiny wasp) has already emerged to attack other aphids. Most of the parasites that attack aphids here are very tiny **braconid wasps**. If you find an aphid mummy with a ragged hole in it, that is probably evidence of a hyperparasite.

A hyperparasite parasitizes (kills) parasites, so is detrimental to the parasite population. Braconid wasps lay their eggs inside the hosts they attack, so there is no egg shell sitting on the host insect, to give a clue that it has been attacked.

If you examine insect eggs enough, eventually you'll find one or more that has a tiny hole in the top or side --- too small for the hatching larva to have left. These have been parasitized by tiny Chalcid [kal-sid] or Trichogramma [trick-o-gramma] wasps. You really need good magnification (usually a microscope) to find these holes. Some of these adult wasps are only a millimeter long. They have elbowed antennae, and very few wing veins. Photo 6 shows one examining caterpillar eggs in my garden.

Photo 6. Chalcid wasp.

Photo 7. Hornworm with wasp cocoons.

Photo 8. Braconid cocoons on cabbage leaves.

In some species of parasites, when the parasite larva is fully grown, it emerges from the body of the host it attacked, and spins a cocoon on the outside of the host. The parasite then transforms into an adult inside that cocoon. The most common garden examples are tiny white cocoons on the backs of hornworm caterpillars or the single white cocoons on cabbage leaves (the parasite killed imported cabbageworms). In these cases, the parasites are tiny braconid wasps. Some braconids are polyembryonic. That means that many wasp larvae develop from just one parasite egg laid in the host (photo 9). Adults of most braconids are relatively small, 7-9 mm or so (roughly 3/8 inch). They have relatively long, curved antennae. Braconids are common here. We have at least 140 species of them in New Hampshire.

Photo 9. Caterpillar, with dozens of parasitic wasp larvae inside.

Other common insect parasites include wasps in the families Ichneumonidae, [ik-new-mon-id-ay] Chalcidae, and Trichogrammatidae. Ichneumonds (photos 10 & 11) include some large species. Two of them are particularly impressive, with bodies up to 1.5 inches long, and ovipositors (egg-layer) up to 3 inches long. They are adapted to attack the larvae of horntails boring in wood. They use the long ovipositor to bore precisely through the wood, find and pierce the body of a borer an inch or two inside the wood! Occasionally you will find where a bird or other predator interrupted the egg-laying and ate the wasp, leaving the ovipositor stuck in the tree. Ichneumonds are recognizable by a meat-cleaver-shaped cell in the forewing. In photo 11 that cell is just below the thickened spot along the leading edge of the forewing. We have over 300 species of ichneumonds in New Hampshire.

Photo 10. Ichneumond wasp.

Photo 11. Ichneumond wasp.

Big-headed flies (family Pipunculidae) are not very abundant, but are very odd-looking. They are small flies, with heads almost entirely covered by their huge eyes (photo 12). They are parasites of leafhoppers and planthoppers. These specimens I captured in a net trap in August of 1997.

There is one relatively common parasite of white grubs in New Hampshire. It is a black wasp with a very long abdomen (photo 13). You may see it in late August or September. The abdomen is so long, it doesn't fly very well. With the long abdomen, it can reach into the soil where white grubs live, to lay its eggs. It is in the family Pelecinidae [pel-a-sin-i-dee]. There are many more species of parasites, in other families.

Photo 12. Big-headed flies.

Before leaving the subject of parasitism, I'll contrast two terms used by entomologists. The term "parasitoid" is used to mean what I've here called a parasite. A parasitoid is a macro-organism (meaning not microscopic, like a bacterium) that lives by attacking another organism, and consuming it. It kills the host it attacks, and as it grows, it kills only one individual host. Usually a parasitoid and its host are taxonomically close (both being insects for example). So the families of "parasites" I've discussed in this publication are actually parasitoids.

Photo 13. Pelecinid wasp.

Most entomologists use the word "parasite" to mean a macro-organism that lives at the expense of another organism. Usually parasites do not kill their hosts, and one host can support many (sometimes thousands) of parasites. Often the host and parasite are taxonomically far apart, like ticks feeding on a moose. Occasionally, an observant person will notice insects that have parasites on them. One example is in photo 14. The tiny orange dots on this firefly larva are mites. Other examples of true parasites are tracheal mites and varroa mites on/in honeybees, and intestinal worms in many animals.

Photo 14. Firefly larva with parasitic mites.

Predators

Predaceous insects use various methods to find their prey. In some cases, the adults locate prey by smell, and lay their eggs close to prey colonies, so their larvae will have a good food supply. Lacewings, syrphid flies, and cecidomyid flies are examples of these. If you find a tiny orange maggot among a group of aphids, it is the larva of a cecidomyid fly. Most cecidomyids are actually plant feeders, but the aphid predator *Aphidoletes aphidimyza* (photo 15) is very common. The orange color of the larva proves that it is this species. Adults are very tiny (1mm long) delicate flies. You are not very likely to spot one, because they sit in cover during the day, and fly on calm nights. Photo 16 on the next page shows a pinned adult.

Photo 15. Larva of a cecidomyid fly.

A bright yellow maggot among a group of aphids could be a less common aphid predator, a Chamaemyiid [kam-ee-my-ee-id] fly. Syrphid larvae could be among aphids. Usually syrphid larvae (photo 17) have mottled colors, never all orange. Since I've described the larvae, I should mention eggs. The eggs of Syrphid flies are found next to aphid colonies on plants (photo 18). They are oval, cream colored eggs. If you find one, look at it with a magnifying glass, and you'll probably see a distinctive bumpy surface. Cecidomyid eggs are also among aphids, but are elongate, minute, and orange.

Photo 16. Adult Aphidaletes aphidimzea.

Photo 17. Syrphid larva with aphid prey.

Photo 18. Syrphid egg.

The adults of all of these flies I just mentioned are not predaceous…just the larvae. Syrphid adults are quite common on flowers. They have a distinctive spurious vein in the wing: one that fades out at both ends. It is located between the radius & medius veins (photo 19). Not all of the syrphids are predators.

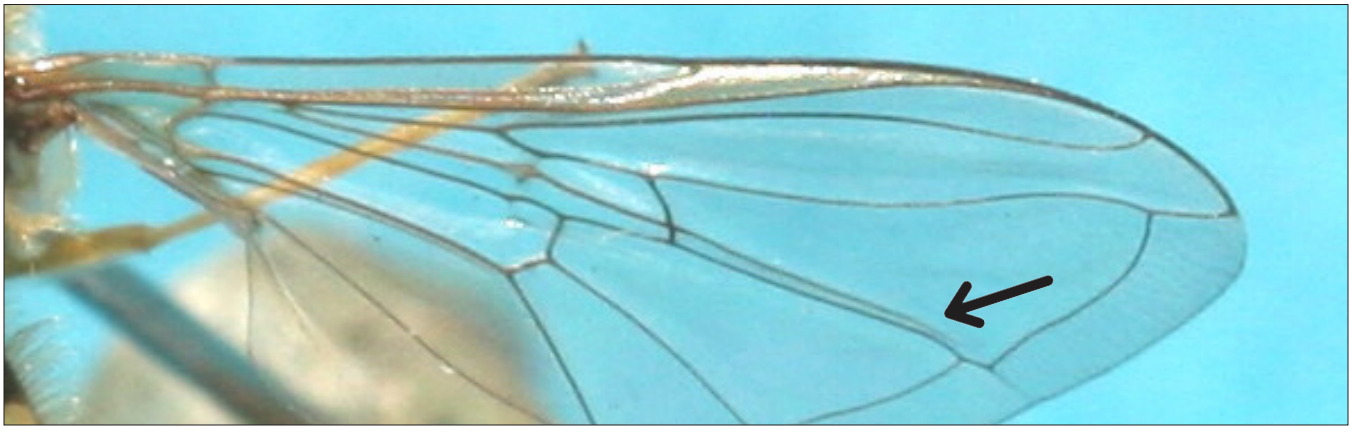

Photo 19. Wing of Syrphid fly.

Photo 20. Syrphid fly.

Photo 21. Lacewing.

The eggs of green lacewings are so distinctive, that you can identify them on sight (photo 24). Each whitish, oval egg is laid at the tip of a long, slender stalk. Usually the adult lays them singly or in small groups, close to a group of aphids. The adults locate aphid colonies by smell. Green lacewing larvae (photo 23) are elongated, with long curved jaws. The adults (photo 21) are small, delicate light green insects. Their wings have so many tiny veins that they resemble lace.

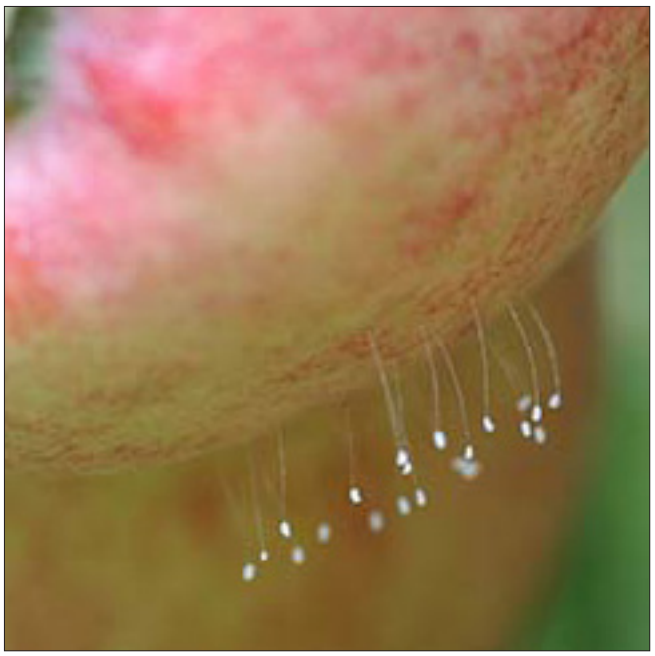

Photo 22. Lacewing eggs.

Photo 23. Lacewing larva.

Many ladybugs (they're actually beetles) are aphid predators, both in the adult and larval stages. Ladybug larvae are elongated, often reminding people of tiny six-legged alligators (photo 23). Some ladybugs feed on a wide range of prey, including tiny caterpillars, insect eggs, and other soft-bodied insects. We have over 60 species of ladybugs in New Hampshire. One of them (Mexican bean beetle) is a plant feeder, but the rest are predators. The smallest species are only 1mm long, but the largest are about 12mm long. Our most common ladybug now is multi-colored Asian ladybug (photo 25). It eats a wide variety of prey. It shows a wide range of colors and patterns. Some adults of this species have no spots at all, while others have as many as 20. Our next most common species is spotted ladybug, a native species which is bright pink, with black spots. It has a

Photo 24. Ladybug larva.

Photo 25. A multi-colored Asian ladybug.

Photo 26. Spotted Ladybug.

Photo 27. 14-spotted ladybug.

more oval shape than most of our other ladybugs. *Propylea quatuordecimpunctata* is sometimes called the 14-spotted ladybug. This species is a "tiny dude" (3-4mm) but it is easy to find in alfalfa and clover fields.

Some predators lay traps and wait for insects to come by. The larvae of ant lions are one example. They wait at the bottom of a tiny pit of dry sand or soil, and are common in dry spots, where buildings prevent rainfall from reaching the soil (photo 28). The larva is grayish, and completely buried, except for its jaws. When an ant or other small insect falls into the pit, the ant lion grabs it and sucks out its body fluids. Adult ant lions (photo 29) look somewhat like dragonflies, but unlike them, have large, obvious antennae. They are much slower fliers than dragonflies, and this is another clue to their identity. The fine lace-like veins in their wings are similar to their close relatives, lacewings.

Photo 28. Ant lion trap.

Ambush hunters

Some predators wait in spots where insects are likely to come by. The larvae of tiger beetles wait in their burrows for an insect to walk close by. When prey does come near, the predator grabs it and pulls it into the burrow to eat. Have you heard the kid's song doodle-bug? The name refers to larvae of tiger beetles. Ambush bugs (family Phymatidae) are especially common on flowers in mid and late summer (photo 30). They wait there for insects to visit, grab them, and suck out their body fluids.

Photo 29. Adult ant lion.

Photo 30. Ambush bug.

Active Searchers

Some predators actively search for prey visually, like preying mantids. Mantids do some walking, and a lot of waiting. They are distinctive insects, easy to identify, even when small. Motion triggers their attention, so they usually feed on insects that move, including other mantids. Our one species of mantid in New Hampshire is usually green (photo 31). The young nymphs are very pale, and occur in late spring and early summer. Both immature and adult mantids are predaceous. Adults are found in August and September. The females lay eggs in the fall, in masses of foam that turns hard and light brown. You may find them on buildings or low vegetation. If you find one, and want to have the young emerge in your garden, do not store it indoors! The warmth will cause the eggs to hatch much earlier than they are supposed to, dooming the young to starvation.

Photo 31. Praying mantid.

Photo 32. Praying mantid egg mass.

Store it outside, in the garden.

Mantispids (also called mantis flies) look similar to mantids, but are smaller. We have two species of mantispids here. The more common one is dark brown, and about one inch long (photo 33). It is an active predator, like mantids. It somewhat resembles a brown paper wasp, so it might gain some protection from being eaten by birds or other predators. Mantispids are not very common. They are closely related to lacewings and ant lions. Mantids are closely related to crickets & grasshoppers.

Adult tiger beetles (photos 34 & 35) also hunt visually, and are very active. Pick one up the wrong way, and you'll find out why they are called tiger beetles. They are common on sunny, relatively bare soil, and many have bright metallic green or blue colors. If you catch one, a magnifying glass could help you see the impressive jaws. Many species respond to your approach by flying away, then landing a short distance away and turning to face you.

Photo 33. A mantispid.

Photo 34. Tiger beetle.

Many Carabids (ground beetles) are active hunters, both as larvae and as adults. They are usually black, and most of them are predators both as larvae and as adults. A few have metallic colors on part of the body, especially the group called "caterpillar hunters". One caterpillar hunter (*Carabus auratus L.*) was imported from Europe, to help control gypsy moth. Some "caterpillar hunters" have metallic coloring. Some of those climb trees, but most ground beetles are active on or near the ground. Ground beetle larvae are also active predators, but bear little resemblance to the adults. The one in photo 38 was in my garden. The ground beetle family is huge, with over 400 species in New Hampshire. The adults range in size from about 2mm to 25mm long.

Photo 35. A tiger beetle.

Photo 36. Ground beetle.

Photo 37. Caterpillar hunter.

Photo 38. Ground beetle larva.

Rove beetles (family Staphylinidae [staf-i-lin-id-ee]) are very long and thin. Most beetles have wing covers that cover most or all of the abdomen. Rove beetles have wing covers that are very short, and their wings are completely folded up underneath them. With such short wing covers, their segmented abdomens are fully exposed to view. Most rove beetles are black, and fairly small. This species is one of the largest – almost an inch long. When captured, the two specimens in photo 39 were attacking fly pupae at a dairy farm. We have over 200 species of rove beetles in New Hampshire.

Photo 39. Rove beetle.

Photo 41. Soldier beetle.

Soldier beetles (family Cantharidae), photo 41, are relatively soft-bodied, elongate beetles, often with black and yellow markings. They are often found on flowers, since the adults feed on pollen. Their larvae are general predators of soft-bodied insects, like aphids or young caterpillars. Our common soldier beetles are 8-12mm long. The larvae are elongated and often look velvety under a hand lens.

Photo 40. Firefly.

Fireflies are actually beetles, and they are easy to see on a July night. Some species are predaceous as adults, eating other fireflies. The timing and pattern of their flashing are signals intended to attract a mate of their particular species. The predaceous species mimic the flashes of other species, luring them close, so they can be eaten. If you see a firefly during the daytime, you can confirm its identity by looking at the last few segments of the abdomen, from the underside. They should be whitish. New Hampshire fireflies range from 5 to 14mm long. Larval fireflies are somewhat flattened, and obviously segmented.

Checkered beetles (family Cleridae) are common on and under bark and logs. Most are predators, both as larvae and as adults. Many have somewhat checkered markings. They range from 3 to 10 mm long, and some have bright colors.

True Bugs that are Active Searchers

Photo 42. Assassin bug.

True bugs (order Hemiptera) have piercing-sucking mouthparts rather than chewing mandibles. Assassin bugs (family Reduviidae) wander in vegetation, and attack prey that comes close by. They can't successfully attack tough-shelled things (most beetles for example) but otherwise consume a wide variety of prey. We have eleven species of them in the state, and they have a variety of shapes and colors, from gray to brown, green and yellow & black. With such a range of shapes, it is difficult to give a combination of characters that identify this family. I'll try: they have piercing-sucking mouthparts. Their front legs are often adapted to grab prey, not just for walking. Entomologists look at the underside of the thorax ("chest"), to see if there is a groove into which the mouthparts fit, when at rest. If so, it is an assassin bug. You'll need magnification to see this groove. Some of these might bite if you try to handle them. One especially colorful one is *Pselliopus cincta.*

Photo 43. Assassin bug.

Photo 44. *Pselliopus cincta,* an assassin bug.

Photo 45. Assassin bug.

Most stinkbugs are plant feeders, but we have at least three common species of stinkbugs that are predators. The spined soldier bug is the most common of these, and it usually feeds on soft-bodied insects like caterpillars, sawflies, and larvae of Colorado potato beetle and Mexican bean beetle. The nymphs have a different, more colorful pattern than the

Photo 46. Adult spined soldier bug.

Photo 47. Nymph of spined soldier bug.

Photo 48. Spined soldier bug eggs.

Photo 49. Anchor bug.

adults. Adults of spined soldier bug are recognized by the spines on either side of the thorax, the faint light line down the center of the back, and the black lengthwise line in the clear wing tips (photo 46). Stinkbugs lay eggs shaped like barrels, laid in groups. Spined soldier bug eggs are distinctive with a row of long spines encircling the top, and a slightly metallic sheen.

The "Anchor bug" is a less common predaceous stinkbug with an anchor pattern on its back. Most individuals here are black & tan, while a few are black and pink. In photo 49, the anchor is tan with a very slight pinkish hue. *Perillus bioculatus* (F.) (photo 50) doesn't have a common name. It is a black and orange-red predaceous stinkbug, and it feeds (among other things) on Colorado potato beetle larvae.

Minute pirate bug is a species in the family Anthocoridae. The name fits; it is about 1 mm long. It attacks small soft-bodied insects and insect eggs. The one on my fingertip in photo 51 was in a greenhouse, but it could be found in your garden, lawn, corn field, or alfalfa.

Photo 51. Minute pirate bug.

Photo 50. *Perillus bioculatus* (F.)

New Hampshire alfalfa and clover fields are also a likely spot to find Nabids (damsel bugs). They have a somewhat oval shape, with slightly swollen front legs (used for catching prey).

Photo 52. Nabid.

Photo 53. Robber fly.

Some active-searching predaceous flies are predators in the adult stage, not as larvae. They include robber flies, which are very hairy, and have large eyes. Many robber flies have a stabbing hair at the tip of each leg, but you'd need a microscope to see that. The flies sit on perches and wait for prey (usually flying insects) to pass close by. Then they pounce on them, and eat them (photo 53 & 54).

Photo 54. Robber fly.

Photo 55. Long-legged fly.

Dolichopodids [doll-ik-o-po-dids] are tiny, metallic colored flies that are very active predators while they are adults. They prey on insects that are smaller than themselves. The common name for the family is long-legged flies.

Photo 56. A digger wasp.

Photo 57. Provisioning wasp.

Photo 58. A potter wasp and nests.

Many wasps, ants and hornets are valuable insect predators. Some actively search for prey, and bring it back to their burrows. Digger wasps and sand wasps are examples. Some species specialize in certain types of prey --- stinkbugs, flies, leafhoppers, or small caterpillars (photo 57). Others take a range of insects as prey. In some species, the female may have difficulty flying with heavy prey, and sometimes resorts to dragging the prey to the burrow. Mud-daubers and potter wasps create nests of clay or mud, which they stuff with prey. They lay an egg on the prey and seal the chamber. The wasp larva hatches from the egg, eats the prey, transforms into a pupa, and then an adult wasp, and emerges from the nest (usually next year). Potter wasps usually make round mud pots,

Photo 59. Mud-dauber nest.

Photo 60. Common brown paper wasp.

while mud daubers make elongated mud tubes for nests. Both types usually select nest spots out of reach of rain, like under eaves of buildings.

Our vespid wasps are valuable caterpillar and sawfly predators. They include the brown paper wasps, bald faced hornet, yellow jackets and giant European hornet. The common brown paper wasps are the least aggressive of these, with respect to stinging people. They place their open paper nests under eaves and in other protected locations. Bald-faced hornets are common here. They aggressively attack people who threaten them or their nests. Their paper nests are usually pear-shaped, with paper combs hidden inside. If they nest out of the way of my activity, I leave them alone, so they'll hunt caterpillars in my yard.

Photo 61. Bald faced hornet.

The larvae of most of our butterflies and moths (caterpillars) feed on plants. But we have one species that has a surprise: the larvae of the "harvester" butterfly feed on aphids! They are not very common. The caterpillars are easiest to find on alders that have lots of woolly aphids on them.

Photo 62. Harvester butterfly.

Photo 63. This dragonfly is named black spinyleg.

Photo 64. Immature dragonfly.

One common insect group composed entirely of predators is the dragonflies. Both the adults and the immatures are predators. The immature stages live in water; some in fast flowing streams & rivers, others in ponds, pools and marshes. We have over 100 species of them in New Hampshire, and some of the adults have beautiful colors. Dragonflies have excellent vision, and most are quick-reacting, fast fliers, so they catch prey on the wing. All are daytime hunters, although several species are crepuscular --- active at twilight. One of the largest species (dragonhunter) largely feeds on other dragonflies. People who collect and pin a beautifully colored dragonfly for the first time soon have a disappointment: the beautiful colors quickly fade, and the insect turns grayish-brown. If you want to preserve the beautiful greens, yellows, reds and blues, do it by taking a photo.

Immature stages of dragonflies have an unusual adaptation for predation, the "labial mask". This is the lower section of mouthparts that can suddenly be thrust forward and grab prey that is close by. In this photo, the mask is the elongated structure on the head. The immatures wait for prey to come close enough to get caught, or walk slowly to within range. In some dragonfly families (darners for example), the immatures are elongate. In one family (cruisers), the immatures are broad, very flat, and have very long legs, reminding some people of spiders.

Pollinators

The honey bee is a European species that is our most important and best known pollinator. There are about 200 species of native bees in New Hampshire that pollinate too. Most of them are smaller than honey bee, and very few have common names. The squash bee is one that does have a common name. It specializes in pollinating flowers in the squash family. Note that it has very long antennae, and is darker color than honeybee. Some Megachilid bees carry pollen

Photo 65. A native bee in the family Andrenidae.

Photo 66. Squash bee.

Photo 67. Megachilid bee.

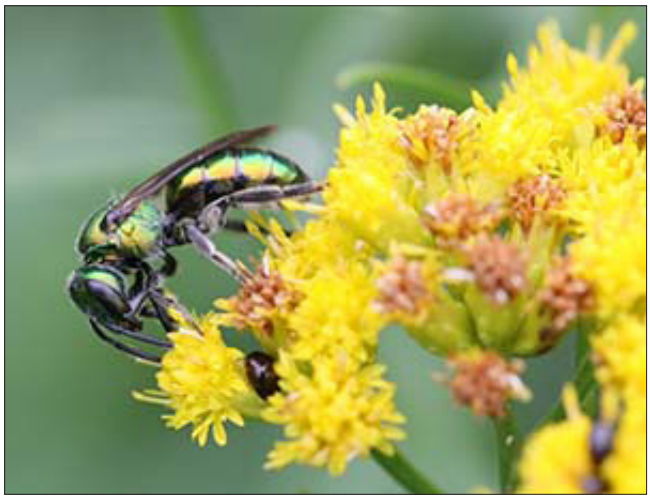

Photo 68. Megachilid bee.

Photo 69. Megachilid bee.

Photo 70. A parasitic bee in the genus Nomada.

on their bellies, making them easy to identify when they are gathering pollen. That family is called leaf cutter bees, because many species line their nest cells with pieces they cut from leaves. Bees in the family Halictidae are usually small, often with beautiful metalic green colors. Some small halictids are attracted to sweat, so the family is called sweat bees.

Most of the native bees are solitary. That means each female bee makes her own home, for herself and her young. Frequently she stores pollen for the larvae to eat. Many make burrows in bare soil (like species in the families Colletidae and Andrenidae. Others (Megachilids, some Anthophorids & Colletids) make or use holes they find in wood or plant stems. All bees have hairs that are branched. You need a microscope to see this adaptation, which makes them efficient pollen collectors. At least two of our species of bumble bees that were formerly abundant in this state have almost disappeared: Bombus terriciola and Bombus affinis. A protozoan pathogen from Europe might be responsible.

A few of our bee species are relatively poor pollinators (few body hairs) and make their living as freeloaders in the nests of other bees. The example in the photo above is in the genus Nomada, and is recognizable by the small size and bright color.

Although bees are the best of our pollinators, some wasps, flies, beetles, butterflies, skippers and moths help in some flower pollination. In some areas where bees are few (the cold alpine gardens on Mt. Washington, for example) these serve as the main insect pollinators.

Other Natural Enemies of New Hampshire Insects

There are many other insect relatives that prey on insects, including spiders, centipedes, predaceous mites, pseudoscorpions, and more, but I won't cover them here. There are also insect attacking nematodes, bacteria, fungi, protozoans and viruses. Then, of course, there are birds, mammals, amphibians, reptiles, and fish that eat insects.

Preserving, Protecting and Encouraging Beneficial Insects

Consider your use of pesticides:

One of the most effective steps to protect beneficial insects is to minimize your use of chemical insecticides. Remember that most insecticides are like double-edged swords… they can kill pests, but can kill beneficial insects as well. In general, the ones that are most detrimental to beneficial insects are the broad-spectrum insecticides that have long residual action. "Broad-spectrum" means that they kill a very wide range of insect species. You can get an idea of this by reading the pesticide label. "Long residual" materials means the residue still kills insects that walk over the sprayed surface for many days after it is sprayed. Synthetic pyrethroids

Photo 71. Branched bee hairs. Photo by Cheryl Smith.

(Asana, Baythroid, Warrior, permethrin) are good examples that are both broad-spectrum and long residual materials.

Research on beneficial orchard mites (predators) in Quebec demonstrated that some pyrethroids were still killing predator mites that walked over the treated foliage six weeks after a single treatment! Carbamates (Sevin, Lannate, Vydate etc.) and organo-phosphates (such as Guthion, Imidan, Diazinon, Malathion) are also broad-spectrum insecticides, but many have shorter residual action than most synthetic pyrethroids. Some plant-derived insecticides (Neem and Pyganic for example) are broad spectrum materials, but have very short residual action. These products are often sold in greatly diluted form, so they may be detrimental to beneficial insects for a relatively short period of time --- hours to perhaps a day.

Some modern insecticides are very narrow-spectrum materials, and are not likely to harm many beneficials. Examples include *Bacillus thuringiensis* - based insecticides, like Dipel, Biobit and Xentari. Another type of insecticide is the soil-applied, systemic, soil-applied material. These are absorbed by the plant's roots, and get incorporated into the plant tissues. These can harm insects that feed on the plant, but not those that simply walk on the leaves. Therefor these can be harmless to many beneficial insects. Systemic insecticides, however, can be harmful to soil-dwelling beneficial insects, like ground and rove beetles. Systemic insecticides are rarely legal to use on food crops, due to concerns that they might end up inside the plants or fruits we eat.

Pesticide risk to bees is an important consideration in any insecticide program and is affected by formulation. Bees have many tiny, branched hairs on their bodies, to help collect pollen. Pesticides that are in dust or wettable powder form are often in a particle size comparable to pollen grains, so are easily picked up (by electrostatic attraction) by bee hairs. For managing risk to bees, dusts are the most problematic, followed by wettable powders and flowable formulations. Emulsifiable concentrate formulations generally pose the lowest risk to bees.

There are concerns that some newer insecticides may concentrate in pollen or nectar of flowers, and thus be harmful to bees (they eat both). In summary: keep in mind the impact to pollinators and other beneficial organisms in your insecticide program, and use insecticides only if you really need them. Try to favor the narrower-spectrum, shorter-residual products if you do need to treat a crop. Some of the neonicitinoid insecticides (imidacloprid, thiamethoxam, clothianidin for example) may pose significant risks to bees, depending on how they are used.

Think about the value of plant diversity

We see higher numbers of beneficial insects in habitats that have many plant species, compared to those with few plant species. When I studied beneficial insects in soybean fields, I found that insect predators were most common along the edges bordered by woods, shrubs, or fallow fields. We see this pattern in other crops too.

Photo 72. This colletid bee is guarding her nest.

You can put this information to use on your farm by de-emphasizing large blocks of the same crop, by strip cropping, companion-planting or interplanting. To a degree, cover-cropping helps as well. Many of the photos in this publication I took at the edges of fields, or in strip-cropped sites.

High diversity in flowering plants can ensure availability of pollen and nectar. This is important to many beneficial insects. Nectar is especially important to many tiny parasites, like the trichogramma, chalcid and braconid wasps. The smallest ones can't travel very far without nectar to eat, so maintaining nectar sources on the farm is important to help them. Our bees vary greatly in the length of their tongues. Those with short tongues can't reach the nectar in deep flowers (like red clover), so having a variety of flowering species is especially helpful to benefit a wide range of bee species. Think of spatial distribution as well as time of year in providing nectar sources. The ideal site has nectar sources throughout the farm, with something in bloom at all times during the growing season.

Provide cover for beneficial insects:

Many insects require nesting and protective resting sites. Providing this will encourage predators, parasites and pollinators. Many of our native bees require undisturbed nesting sites. Most of them are solitary nesters. Some construct a nest burrow in twigs, the pith of stems or decaying wood. Others (like the colletid bee in the photo above) nest in the ground, so they need relatively bare soil that is not plowed regularly.

Purchasing beneficial insects:

I am regularly asked about buying predators or parasites and releasing them in the garden, to control insects or establish new populations. Generally, I don't recommend this outdoors (there are a couple of exceptions) because most of the released organisms disperse, rather than stay. Some, like most commercial ladybugs, are collected in the wild in winter. When removed from cold storage and released, their natural behavior is to fly away. This makes it hard to keep them in your garden. Also, many predators are general feeders, rather than specialists that concentrate on pest species. My suggestion is to think of predators as tools that assist in keeping pest numbers down, rather than controls. Parasites, on the other hand, are more species-specific, and might have a greater effect on pest populations.

Gardening with beneficial insects can be fun. In addition to the end goal of reducing pest populations by encouraging the healthy beneficial insect populations, there are additional benefits. One is a more judicious use of targeted insecticides. Another is creating a garden area with a complex structure and season-long flowering plants, both of which can be aesthetically pleasing. A third is that you may begin to recognize the beneficial species and distinguish them from pests. This can lead to greater enjoyment of insects in your garden. It is interesting to watch them and appreciate their diversity. Good luck to you in the next growing season!

For Further Reading

Pollinator Conservation Handbook. Matthew Shepard, Stephen Buchmann, Mace Vaughn and Scott Hoffman Black. 2003. The Xerces Society. ISBN 0-9744475-0-1

Bee Nest Box Guidelines. 2016. Amy Papineau, UNH Extension. https://extension.unh.edu/resources/files/Resource005503_Rep7670.pdf

Flowering Calendar for Wildflower Species in Southern New Hampshire. 2015. Dr. Cathy Neal, UNH Extension. https://extension.unh.edu/resources/files/Resource005602_Rep7825.pdf

Native Wildflowers for New England Meadows. 2014. Dr Cathy Neal and Amy Papineau, UNH Extension https://extension.unh.edu/resources/files/Resource004206_Rep6043.pdf

Photographs

Unless otherwise indicated, all photos were taken by Alan Eaton. Many were taken with a digital camera, but a few are old slides that were recently scanned into digital format. The older technology (film) images tend to be less sharp, and the scanning process can result in additional loss of resolution. Cheryl Smith took the microscope photo of branched bee hairs.

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