



Predators, Parasites and Parasitoids

According to the Food and Agriculture Organization of the United Nations (FAO), herbivorous insects such as aphids, caterpillars and weevils destroy about one fifth of the world's total crop production each year. However, under reduced or low use of chemical pesticides in agroecosystems, pest populations can be effectively controlled by a number of natural enemy organisms in a process known as biological control. The most important functional groups of organisms providing biocontrol services are:

Predators	Parasites	Parasitoids	Pathogens
<ul style="list-style-type: none">• Consume many prey during development.• Generally larger than prey• All stages may be predators.• Are often generalists rather than specialists on any one prey type and eat both adults and immature stages.	<ul style="list-style-type: none">• Smaller than host and don't generally kill it (e.g., mites)	<ul style="list-style-type: none">• Immature stages feed only on a single host and almost always kill it.• Are smaller than the host.• Are often specialized in their choice of host species and life stages thereof.• Only the female attacks the host and lays eggs or larvae on or in the host.• Immature stages remain on or in the host, adults are free living and mobile and may be predaceous, feed on nectar, or not feed at all.	<ul style="list-style-type: none">• Diseases caused by fungi, bacteria, and viruses that kill the host.• Some are naturally occurring and some have been commercially developed.• <i>Bacillus thuringiensis</i> (Bt) toxins and spores-- Dipel, etc.• Fermentation products from fungi are precursors to making abamectin and spinosad.• Codling moth polyhedrosis virus available commercially for control.• Naturally occurring <i>Beauveria</i> and <i>Hirsutella</i> fungal pathogens.

Identification

Accurate species identification often requires the help of trained taxonomic professionals. However several traits can nonetheless help distinguish natural enemies as a functional group. Yellow and black colour patterns are common in many insect natural enemies like wasps and hoverflies (right), but also for beneficial insects like bumblebee pollinators. Other distinctive natural enemy traits include large biting or piercing mouth parts used for feeding on prey (e.g. ladybird larvae, ground beetles, and assassin and pirate bugs; see images below).



Fig.1 Hoverflies

Important Predators, Parasites and Parasitoids

Antlion

- Immature stages are voracious feeders. Adult stage feeds on nectar and pollen
- Larvae feed primarily on ants but will also feed on other small insects that enter into pit in addition to small spiders

Ladybird Beetles (Coccinellidae)

- Worldwide, nearly 6,000 species of ladybirds are known
- Ladybirds beetle adults are oval, often brightly colored with yellow, pink, orange, red, or black and usually marked with distinct spot, and vary in size from 1.5 mm to 6 mm.
- Adult females usually lay clusters of eggs on plants close to aphid, scale, or mealybug colonies. The alligator-like larvae which are spiny and black with bright spots are also predators.
- Natural enemies of many insects, especially aphids and other sap feeders.
- A number of species require pollen as adults to reproduce and some can be important predators of moth eggs.



Fig.2 Ladybird beetle

Ground beetle (Carabidae)

- Ground beetles comprise one of the largest insect families, with approximately 40,000 species worldwide also known as Carabids.
- Three essential structures that distinguish Carabidae from other beetle families:
 - The first visible ventrite (abdominal segment) is not continuous; instead it is divided by fixed hind coxae;

- Front tibia has a prominent notch (antenna cleaner) on the inside near distal end;
- Hind trochanter is elongate (at least 1/3 femur)
- Carabids have 6-segmented legs and often 2 claws
- Ground beetles are known for their long legs and powerful mandibles which enable them to be voracious predators, important for the biological control of insect pests on farms
- Adults beetle being beneficial predators, the burrowing larvae of these beetles seek out and feed on pests in the soil.
- The egg, larval, and pupal stages are spent primarily underground while the adult life-stage is spent primarily aboveground.



Fig.3 Ground beetle

Rove beetle (Staphylinidae)

- Staphylinidae is the largest family of beetles, with over 63,000 species known worldwide and probably over 75% of tropical species still undescribed.
- Some typical characteristics are as follows
 - body shape typically elongated, with parallel sides
 - elytra short (about same length as pronotum, or only slightly longer; wings are functional in most), typically exposing 3-6 (usually 5-6) abdominal segments, though abdomen concealed in a few
 - coloration usually dark but some brightly colored
 - antennae thread-like or clubbed
- Beetle have only 5-segmented legs and always only 1 claw
- Some large species are a brightly coloured black and yellow, thus resembling [wasps](#); other rove beetles mimic soldier [ants](#) in both appearance and behaviour.
- They suppress populations of pest insects and mites in numerous crops, and of biting flies (including mosquitoes) and fleas.
- Rove beetles are usually found around decaying [animal](#) and vegetable matter, preying on carrion-feeding insects.
- Staphylinids (rove beetles) are usually predatory, both as larvae and as adults.



Fig.4 Rove beetle



Fig.5 Rove beetles

- Beetles are a soil-dwelling general predator that feeds on the larvae of [fungus gnats](#), shore fly, moth fly and pupae of [thrips](#) and springtails.

Lacewings

- The adult green lacewing is about 3/4 inch long, light green and has a delicate appearance with lacy wings.
- The larvae (called aphid lions) prey mostly on aphids, but also attack scale insects, mealybugs, leafhoppers, thrips, psyllids, whiteflies, caterpillars, moth eggs, many other small insects as well as mites. .
- They are voracious aphid predators, eating 100 to 600 aphids during a 1 to 2 week development period and can be important predators of moth eggs and larvae as well.
- Larvae may consume more than 20 aphids per day or 30 to 40 mites per day.

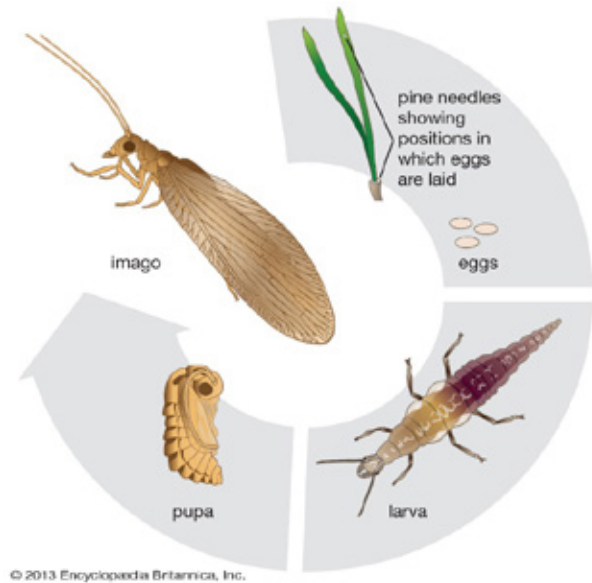


Fig.6 Lacewing lifecycle

Dragon fly

- Around [7,000 species](#) of true dragonflies are alive today, and, together with the closely related [damselflies](#).
- In their [larval stage](#), which can last up to two years, dragonflies are aquatic and eat just about anything—tadpoles, mosquitoes, fish, other insect larvae and even each other.
- Dragonflies catch their insect prey by grabbing it with their feet.
- The dragonflies caught 90 to 95 percent of the prey released into their enclosure.
- Dragonflies are actually carnivorous having strong jaws with sharp teeth that they use for catching and eating bugs, mosquitos, moths, aphids, midge and butterflies.



Fig.7 Dragon fly

Praying mantis

- There are about 1,800 species of praying mantids around the world.
- Praying mantis is named for its prominent front legs, which are bent and held together at an angle that suggests the position of prayer.
- It takes the mantis only 50-70 milliseconds to strike out with its forelegs and snare its prey

- They have triangular heads poised on a long "neck," or elongated thorax. Mantids can turn their heads 180 degrees to scan their surroundings with two large compound eyes and three other simple eyes located between them, have amazing body shapes that make them look like leaves or branches.
- Praying mantids are carnivores, eating mainly [insects](#) and other small animals like moths, crickets, grasshoppers, flies, and other insects.
- Young mantids feed on fruit flies (*Drosophila* sp.), aphids or other small insects.

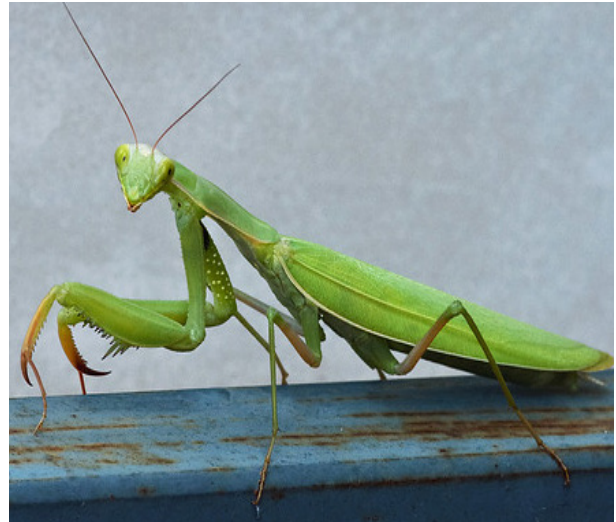


Fig.8 Preying mantid

Spider

- Spiders are one of the largest groups of predatory organisms in the animal kingdom with more than 45,000 identified species distributed over the world.
- Spiders are important predators of pests such as thrips, caterpillars, aphids, plant bugs, leafhoppers, flies, and other arthropod pests in home gardens and crop fields.
- only about 50 percent of the species catch their prey with webs; the rest hunt on plants, on the ground or below it, using a variety of tactics such as stalking, stabbing, crushing - even seduction
- By one estimate, the spiders on one acre of woodland alone consume more than 80 pounds (36 kg) of insects a year
- Spider may kill as many as 50 times the number of prey it consumes.
- Spider generally eat prey that is 50 % to 80 % of their size, with web weavers more adapt at catching larger prey; smaller prey are typically



Fig.9 Spider

Hoverfly

- Hoverflies also known as flower flies or syrphid flies, are made up of approximately 6,000 species in around 200 genera and occur on every continent except Antarctica and remote oceanic islands
- Hoverflies are beneficial, predatory insects. Adults are small (3/8 to 3/4 inch long) and resemble small bees or



wasps with short antennae and large eyes. Unlike bees or wasps they only have two wings.

- adults usually feed on nectar and pollen from flowers, the larvae have a range of dietary traits, such as saprophagy, phytopy, mycophagy or entomophagy
- The larvae are the predators of aphids and soft body insects such as thrips, psyllids, whiteflies, mealybugs, springtails and lepidopteran larvae.
- A single larva may be able to consume between 400 and 1,000 aphids during its larval development stages in about 3 weeks.
- They are considered the second most important pollinator next to bees



Fig.10 Hover fly

Predatory bugs (Assassin bug)

- Assassin bugs are important predators, since both adults and nymphs feed on a variety of insect pests.
- Assassin bugs often wait in hiding and ambush their prey.
- Generalist predators of aphids, spider mites, thrips, psyllids, whiteflies and small caterpillars.
- Assassin bugs, like all true bugs, have piercing, sucking mouthparts (collectively called a beak) that are used to remove body fluids from the prey.
- Once prey is captured and punctured, salivary secretions are pumped through a canal inside the piercing/sucking mouthpart.



Fig.11 Assassin bug

Pirate bug

- Pirate bugs are true generalist predators feeding on many different prey.
- Both adults and nymphs feed by sucking juices from their prey through a sharp needle-like beak.
- Both immature stages (nymphs) and adults feed on including thrips, aphids, spider mites and many insect eggs.
- They can consume as many as 30 mites per day.



Fig.12 Pirate bug

Tachinid Flies

- Tachinids are potential biocontrol agents of several insect pests and contain about 10,000 species worldwide.
- Adult tachinid flies resemble small houseflies and may be covered in dark bristly hairs.

- All species are parasitic in the larval stage and many are important natural enemies of major pests.
- Female tachinid flies lay their eggs on the bodies of host insects, after which the eggs hatch and the larvae tunnel inside and excavate the host's body
- Tachinid eggs laid on the caterpillar will hatch and, as larvae, bore into the host. Some tachinids lay eggs on plants and enter their insect hosts by being eaten.
- These flies are important parasitoids of leaf roller.
- Tachinid larvae do not kill their hosts immediately but feed first on non-essential tissues, growing within the host, which continues to live normally.



Fig.13 Tachinid fly

Aphidius sp.

- Aphidius are parasitoid wasps that will attack many common species of aphids.
- Female wasps will sting and inject a single egg inside of an aphid.
- One female can sting 300 hundreds of aphids in her two-week lifetime, although most of this parasitism occurs in the first couple days after her emergence
- Adults are extremely strong flyers and females will cover large distances in search of aphids.



Fig.14 Aphidius sp

Aphelinus sp.

- Aphelinus is a parasitoid wasp which attacks over 200 species of aphids.
- Aphelinus has a relatively long life and oviposition period of several weeks and can lay 5-10 eggs/day.
- These adult wasps are very small and they insert their eggs singly into the body of aphids, where they will develop internally to kill the host.
- These very small wasps are able to attack only the aphids on the periphery of the colony and cannot successfully penetrate the wax and mass of aphid bodies to attack the center of the aphid colony



Fig.15 Aphelinus sp

Parasitic wasp

- Parasitic wasps are more accurately called "parasitoid" wasps because the wasp itself is not a parasite, it's a beneficial predator.
- These wasps find insect pests, such as aphids and cutworms, and hijack them as incubators for the wasp's own eggs.

- **Braconid Wasps**

- Braconid wasps are often black or dark-colored, with long antennae and almost transparent wings.
- The wasps seek out aphids, tent caterpillars, and hornworms, and lay their eggs in the soft bodies of these pests.
- The female braconid wasp uses her ovipositor, an insect-specific organ, to insert her eggs into the host.
- As the wasp larvae develop, they consume the pest insect. When these little beneficial wasps hatch, they fly off to find nectar for food and insect pests to host their eggs.



Fig.16 Braconid wasp

- **Ichneumon Wasp**

- Ichneumons are slender, medium- to large-sized wasps, comprising more than 60,000 (possibly up to 100,000) species worldwide.
- This wasp control pest populations of crop-damaging beetles, butterflies, codling moths, and other hymenopterans
- Female use the ovipositor to deposit eggs into or onto a host, usually while the immature insect host is a larva or pupa. The eggs then hatch and develop into ichneumon larvae that slowly consume their host.

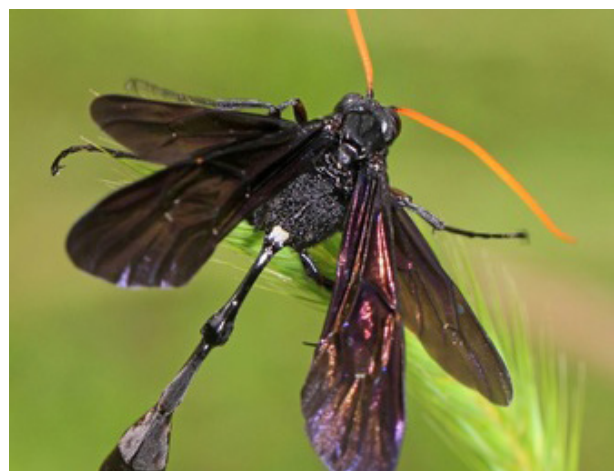


Fig.17 Ichneumon wasp

Trichogramma sp.

- Trichogramma wasps are tiny parasites that attack the eggs of over 200 species of moths and caterpillars.
- Females may then live up to 2 weeks and lay over 80 eggs
- Trichogramma lays its eggs inside the eggs of moths preventing the moth egg from hatching into a caterpillar.
- Trichogramma control cabbageworm, tomato Hornworm, corn Earworm, codling Moth, cutworm, armyworm, webworm, cabbage Looper, corn Borer, fruitworms, diamondback moth, tent caterpillar.



Fig.17 Trichogramma sp



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