That's an old photo
Recognizing and Working with Natural Enemies of Insect Pests
Cabbage looper is a common insect that chews on many kinds of plants. An example of why natural controls are so important.
On average one cabbage looper female moth **may lay 100 eggs**. When the egg hatches the insect feeds and grows, ultimately becoming a new adult......if everything goes well.
On average 98 of those 100 eggs will not produce a new adult. Something gets them along the way.
Natural Controls

Natural Enemies

Abiotic (Weather) Controls

Topographic Limitations
Abiotic (Weather-related) Controls of Insects
Natural Enemies

- Predators
- Parasitoids
- Pathogens
Recognize so you can work with (and avoid working against) existing natural controls
Characteristics of Insect Predators

- Immature stages actively hunt prey
- Several prey are consumed in the course of development
- Adults may or may not have similar food needs as immature form
Some Common Arthropod Predators

- Lady beetles
- Ground beetles
- Lacewings
- Flower flies
- Robber flies
- Mantids

- Assassin bugs
- Predatory stink bugs
- Minute pirate bugs
- Predatory thrips
- Predatory mites
- All spiders
LADY BEETLE
There is a Colorado State University Fact Sheet on the Lady Beetles found in the State

Colorado State University Extension

Lady Beetles
Fact Sheet No. 5.594 Insect Series | Home and Garden

by W.S. Cranshaw*

Lady beetles, also known as “ladybugs” or “ladybird beetles,” are familiar insects. Some 70 species are native to Colorado and about 10 to 12 additional species have established during the past century.

Overwhelmingly, habits of lady beetles are highly beneficial to human interests. Both the adult lady beetles and the grub-stage larvae have chewing mouthparts and are voracious predators of other insects. Although each type of lady beetle has preferences for what they will eat (e.g., aphids, scales, spider mites, mealybugs, etc.), they tend to have fairly broad tastes and feed on almost any small scales (Coccidophilus, Scymnus) usually are uniformly black or dark brown. A few lady beetle species are even striped.

Lady beetles, as all beetles, develop in a pattern known as ‘complete metamorphosis.’ This involves eggs, mobile feeding-stage larvae that molt four times as they develop, transition-stage pupae that undergo changes to the final form, and ultimately the familiar adults.

Most lady beetle eggs typically are spindle-shaped and yellowish or orange-red in color. They are laid in clusters on leaves or other surfaces near aphids and

Quick Facts

- About 80 different species of lady beetles (a.k.a., “ladybugs” and “ladybirds”) are present in Colorado.
- Adults and larvae feed on a variety of pest insects and mites, notably aphids and scales.
- Lady beetles can be invited into a garden by providing plants that adults use as nectar/pollen sources, sustaining levels of...
Most lady beetle adults are brightly colored
Upper left: *Coccidophilus*, a scale predator

Lower left: *Olla* sp., a grey colored lady beetle of forests

Below: *Chilochorus* sp., a predator of various scales
The “bad apple” of the lady beetle clan
Mexican bean beetle
- a plant feeding lady beetle
Lady Beetle Life Stages

- **Adults**
- **Eggs**
- **Larvae**
- **Pupae**
Lady beetles with egg masses
Lady beetle larvae at egg hatch
Lady beetle larvae

Predators of small soft-bodied arthropods (aphids, caterpillars...)
Lady beetle prepupae (stage just before they molt to a pupa)
Lady beetle pupae
Stages of a newly molted convergent lady beetle
Purchasing lady beetles?

Ladybirds Do The Work...
No More Poison Sprays
Use the safe biological method used by government and large growers to destroy aphids, inchworms, Japanese beetles, fruit scales, leafhoppers, boll worms, corn ear worms, mites, etc. Ladybugs (ladybird beetles) live on larvae, eggs and insect pests. About 9000 Ladybugs to the pint. Instructions.

A000455E...Ladybugs (1/2 pint)..................$9.95
A000463E...Ladybugs (1 pint)..................$15.95
A list of commercially available biological controls. It includes 36 insect predators, 21 parasitoids of insects, and 17 insect pathogens. There are 36 suppliers.

**Predators of Insects/Mites**

**Convergent Lady Beetle/Lady Beetles.** When sold as “lady beetles” or “ladybugs” the species involved is the convergent lady beetle, *Hippodamia convergens*, a native lady beetle found throughout North America. Purchased lady beetles are all field collected insects, captured in high elevation areas of California where they periodically migrate to and mass aggregate, allowing easy collection. Ability of the collected lady beetles to reproduce is suspended (they are in "reproductive diapause") so eggs are not produced for several weeks after release. (Pre-feeding lady beetles prior to release can allow some egg maturation to start and a few companies provide such "pre-conditioned" lady beetles). Lady beetles tend to readily disperse from the area of release. Since they store well, lady beetles are available most of the year, although supplies often are limited by midsummer.

Sources: 1, 2, 4, 5, 10, 11, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24, 25, 27, 29, 30, 31
Convergent lady beetle

*Hippodamia convergens*

– the lady beetle of commerce
Unlike most lady beetles, the convergent lady beetle often masses during the dormant period.
Massed lady beetles in the Sierra Nevada Mountains

Photograph courtesy of James Solomon USDA-FS
After arriving in the mountains, the beetles feed on pollen and nectar and store fat. Then they aggregate in canyons and remain relatively inactive, taking in only water. When fall rains begin, beetles at higher elevations (up to 8000 ft) may move down canyons to foothills and aggregations become larger.

In the early spring, after temperatures reach 65°F, adults mate and migrate to the valley floor, feed and lay eggs. Both larvae and adults feed voraciously on aphids. In early summer when aphid numbers decline, beetles become starved and migrate to higher elevations.
Massed lady beetles in the Sierra Nevada Mountains

Photograph courtesy of James Solomon USDA-FS
Purchasing lady beetles?
Lady Beetle Releases for Aphid Control: How to Help Them Work

Many retail stores sell lady beetles (commonly called ladybugs) for controlling aphids in gardens and landscapes. Your customers might wonder: Does releasing lady beetles really work? University of California research has demonstrated lady beetle releases can effectively control aphids in a limited area if properly handled and applied in sufficient numbers. However, because of inadequate release rates or poor handling at the store, in shipping, or after purchase, it is likely most lady beetles purchased at stores fail to provide satisfactory control. Here are some things to consider if you sell lady beetles:

**Keep lady beetles refrigerated.**
Live lady beetles on display are attractive to customers, but beetles left out at room temperature will rapidly deteriorate. Perhaps leave out one container with an attractive display advising customers to take a container of fresh beetles from the cooler and refrigerate them at home until they release them.

**Lady beetles need water.**
When you receive a shipment of lady beetles, mist them with a little water directly from collectors) and avoid suppliers who regularly ship dead beetles. Generally, retailers shouldn’t store beetles for more than two months.

**Suggest adequate release rates.**
University research shows high numbers of lady beetles are required to control aphids. One large, heavily infested rose bush in the landscape required two applications of about 1,500 lady beetles each, spaced a week apart. Most packages sold in stores contain only enough lady beetles to treat one aphid-infested shrub or a few small plants.

**Release lady beetles at dusk or early evening.**
Lady beetles will fly away almost immediately if released during the heat of the day or when the sun is shining. Spray a fine mist of water on the plants, as giving beetles a drink can keep them around longer. Place beetles at the base of plants or in the crotches of low branches. Lady beetles will crawl higher into the plant in search of aphids. Don’t release lady beetles on plants that have been sprayed with insecticides.

The convergent lady beetle, *Hippodamia convergens*, named for the converging white marks on its thorax, is the species sold in stores for aphid control. Suppliers collect beetles from large overwintering aggregations in California’s foothills and mountains. Many other species of lady beetles occur naturally in California landscapes but aren’t sold.

In research studies flew away within 48 hours. Lady beetles are unlikely to lay eggs on the plants they are released on. If aphids return a week or two later, customers will need to release more lady beetles, hose aphids off with water, use insecticidal soap sprays, or wait for other native beneficial insects to fly in. Instead of releasing lady beetles, some customers might get better results by hosing aphids off with water or using insecticidal soap or horticultural oil sprays. However, these beneficial insects can be fun and educational!
Lady beetle releases *are* fun
Conserve and enhance existing lady beetles
Conserving and Enhancing Natural Enemies

• Don’t kill them
  – Limit use of broad spectrum insecticides
• Provide foods that the adults need
  – Often need nectar, pollen
• Provide foods that the immature stages need
  – Allow there to be some hosts, prey available
Principles of Gardening for Natural Enemies of Insect Pests

- Learn to recognize them – and don’t kill them
  - Provide for food needs of adults
  - Provide for food needs of immature stages
  - Provide nest sites, if required
Lady Beetle Larvae
Adults of many predators use flowers (nectar, pollen) for sustenance.
Small, accessible flowers are most commonly used by natural enemies of garden pest insects.
Some plants useful for providing food for adult stages of insect predators and parasitoids

- Most Apiaceae - (dill, fennel, cilantro, ammi, etc.)
- Yarrow
- Many sedums
- Spurges
- Sweet alyssum
- Basket-of-gold
- Thyme, several herbs
Two personal favorites for good natural enemy insect action

Ammi (white cultivars)

Mooncarrot
Principles of Gardening for Insect Natural Enemies

• Learn to recognize them – and don’t kill them
• Provide for food needs of adults

• Provide for food needs of immature stages
• Provide nest sites, if required
Spirea aphids on my bridal wreath spirea shrub – A pest??
Perennial plants that consistently provide predator food sources in my garden.
Promote habitat diversity to optimize natural enemies
An excellent publication by the Xerces Society on improving habitat for natural enemies of insect pests.
Green Lacewings
Neuroptera: Chrysopidae
Adult green lacewings maintain themselves on nectar and pollen.
Green lacewings, like beetles have **complete metamorphosis**

**Lacewing Adult**
- Feeds on honeydews, nectars, and pollens.
- Lives 20-40 days.
- Each female 10-30 eggs per day.

**Cocoon**
- 10 days

**Lacewing Larvae**
- General predator: Aphids, psyllids, mealy bugs, moth eggs and larvae, etc.
- 12 days

**Eggs**
- 5 days

**GREEN LACEWING LIFE CYCLE**
- Eggs (x5)
- Lacewing larvae (x7)
- Cocoon (x3)
- Lacewing Adult (x3)
Green lacewing eggs are uniquely stalked.
Green lacewing eggs often are laid in groups.

Egg hatch has occurred in the lower picture.
Left: Green lacewing larva eating aphid

Right: Green lacewing larva eating leaf beetle larva
Green lacewing eggs are available from many suppliers that rear/distribute insects.
Flower (Syrphid) Flies

Photograph courtesy of David Shetlar

Photograph courtesy of Brian Valentine
CAUTION

Insect Mimicry in Action!
Syrphid flies are excellent mimics of bees and wasps

Honey Bees

Flower (Syrphid) Flies
Honey Bee …or Flower Fly?
Honey bee

Flower Fly

Honey bee
Syrphid egg in aphid colony
Flower fly larvae

Brian Valentine

Ken Gray
Syrphid “smear’
Characteristics of Insect Parasitoids

• Larvae develop in, rarely on, their hosts
  – One or more larvae develop in a single host
• They are invariably lethal to the host
  – “parasitoids”
• Adults often have different food needs
  – Nectar, honeydew
  – Pollen
  – Insect blood feeding may occur
Common Insect Parasitoids

- Parasitic Hymenoptera
  - Braconid wasps
  - Ichneumonid wasps
  - Chalcid wasps
  - Eulophid wasp
  - Trichogrammatid wasps

- Parasitic Diptera
  - Tachinid flies
Parasitoid Wasps

Ichneumonidae, Braconidae, Eulophidae, Trichogrammatidae, Encrytidae, Chalcidae and other families
Some parasitoid wasps

Females possess an ovipositor – a “stinger” - but they cannot sting
Male and female house cricket

Ovipositor
Bees, some wasps, and some ants have a stinger used for defense. The stinger is a modified ovipositor.
Parasitic Wasps – Male (left) and Female (right)
Ectoparasitic wasp larvae on fall webworm caterpillar host
Parasitoid larvae emerging from caterpillar host
Parasitoid larvae (*Cotesia glomeratus*) emerging from cabbageworm host and spinning pupal cocoons
Cocoons of cabbageworm parasitoid
Some parasitoids pupate on the insect host.

Left: Buck moth caterpillar
Below: Tobacco hornworm
Giant Ichneumon Wasp, parasitoid of the Pigeon Tremex Horntail
A photo from a Denver MG, Linda Coyle, I got last year

A photo from an Arapahoe County MG, Mark Overland, received this year
Two large and bizarre looking insects are commonly associated with dying branches and trunks of several commonly grown hardwood trees. One of these is an insect that develops as a borer within the tree – the **pigeon tremex horntail** (*Tremex columba*). The other is the most common natural enemy of this insect, the **giant ichneumon wasp** (*Megarhyssa macrurus*).
Pigeon tremex – a wood boring wasp of deciduous trees in decline
Giant ichneumon wasp – the most spectacular natural enemy of the pigeon tremex
Egg parasitoids

University of California
IPM Program

Jim Kalisch, University of Nebraska
Trichogramma wasps - a type of egg parasitoid

Photos courtesy of University of California IPM Program
What’s wrong with this picture?

"WONDER WASPS"

(Trichogramma)

The Wonder Wasp seeks and destroys the eggs of over 200 pest insects—bollworms, gypsy moths, tomato hornworms, to name a few. She drills into and lays her eggs within the eggs of destructive pest insects, then the newly hatched wasp larvae feed on and destroy the host eggs. These wasps will not sting people or pets or harm plants, and they coexist with praying mantis and other beneficial insects. Each container provides enough wasps to protect one-half acre of garden or field crop.

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(Delivery March thru June)
Aphid parasitoids
Host evaluation

Oviposition

Photographs courtesy of Brian Valentine
Aphid Mummies
Parasitized psyllids (above) and oystershell scales (below)

Parasitized aphids (above) and whiteflies (black forms, below)
Tachinid Flies
Tachinid fly eggs on body of whitelined sphinx caterpillar. Some are indicated with arrows.
Tachinid fly eggs on caterpillar (above) and squash bugs (upper right) and Japanese beetle (lower right)
Cabbage looper supporting six developing tachinid fly larvae

Tachinid fly pupae within killed cabbage looper larva
Caterpillars killed by tachinid flies

Photograph courtesy of Ken Gray/Oregon State University
Some large CO caterpillars

Cecropia moth

Twotailed swallowtail

Achemon sphinx
What Should We Cover?

- Aphids
- Hummingbird Moths
- Yellowjackets and Hornets
- Slugs
- Earwigs
- Wood borers (incl. emerald ash borer)
- Bark beetles/Ipso
- Japanese beetle/White grubs
- Scale insects
- Spider mites
- Gall insects
- Nuisance invaders
- Grasshoppers
- Codling Moth
- Flea beetles
Cluster Flies

*Pollenia* spp.

The most common indoor flies during the cool months
Curly golden hairs mark cluster flies
Cluster flies are parasites of earthworms – they are not ‘filth flies’
Cluster fly searching for a site to lay eggs
Cluster fly larvae and worm host
There are three common species of cluster flies found within homes in Colorado:

- *Pollenia pediculata*
- *Pollenia rudis*
- *Pollenia angustigena*
Scenario for Cluster Fly Invasion of a Building

• Flies move to sunlit vertical surfaces during period when seeking winter shelter
• Flies move upward as sun sets
• Flies enter upper areas of building, cluster behind walls
Cluster Flies and other “Winter Flies”

Fact Sheet No. No. 5.618
Insect Series | Home & Garden

W. Cranshaw

During the cool months some insects have the habit of moving into buildings as a temporary winter shelter. Common examples of such cool season “nuisance invaders” are box elder bugs, western conifer seed bug, and elm leaf beetles. Cluster flies (Pollenia species) are the most common of the flies that often use buildings as a temporary shelter through winter.

Cluster flies tend to be particularly common in higher elevation communities, but problems with cluster flies within buildings can occur statewide. Most often they are a problem where there are nearby areas of irrigated turfgrass, near streams or rivers, and other sites where soils are moist.

Cluster flies are dull grayish-brown flies about 3/8-1/2-inch long, slightly larger than a house fly. They may be noticed within buildings from early autumn through early spring. Adults frequently move indoors through openings around foundation cracks, gaps under doors and windows and can also fly indoors directly from outdoors.

There are some other kinds of flies that will be found indoors and these are reviewed in Fact Sheet 5.502 Flies in the Home. Among these are some other “winter flies” that use homes for winter shelter, particularly the “blue bottle flies” (Calliphora species) and the black blow fly (Phormia regina). The habits of these differ in some important ways from those of cluster flies and are discussed below.

Life History and Habits of Cluster Flies

Cluster flies are not a type of “filth fly” that develops in carrion, decaying plant matter or garbage. Instead the young stages are predators of other small animals and most, if not all, cluster flies in North America feed on certain earthworms (e.g., Aporrochocerca rosea, Allobophora chlorotica).
Management of Cluster Flies

- Prevention
  - Seal all openings prior to time when cluster flies enter buildings
  - Pyrethroid insecticides can be applied to exterior around openings
  - Insecticide dusts can be blown into wall voids to kill flies behind walls.
Management of Cluster Flies

• **Coping**
  – Explain nature of problem
  • Transient nuisance invader
  • Self-limiting; no breeding occurs indoors
  • Not a filth fly
  – Vacuum individuals as they are observed