Working with Biological Controls of Insects

Garfield County AgExpo

February 1, 2020

Whitney Cranshaw
Colorado State University

An example of why natural controls are so important

Cabbage looper **is a common insect that chews on many kinds of plants**

Cabbage looper life cycle

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

- **Predators**
- **Parasitoids**
- **Pathogens**

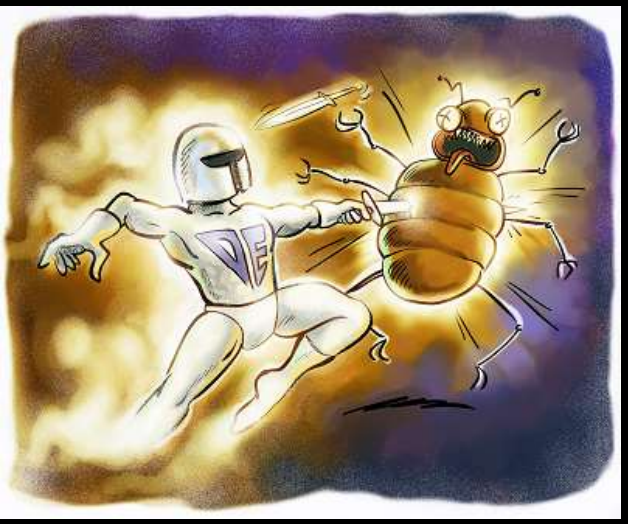
Tent caterpillar killed by virus

Parasitoid wasp laying egg in an aphid

Predatory stink bug feeding on a caterpillar

Working with 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**



Recognize so you can work with (and avoid working against) existing natural controls

Life Styles of the Swift and Vicious

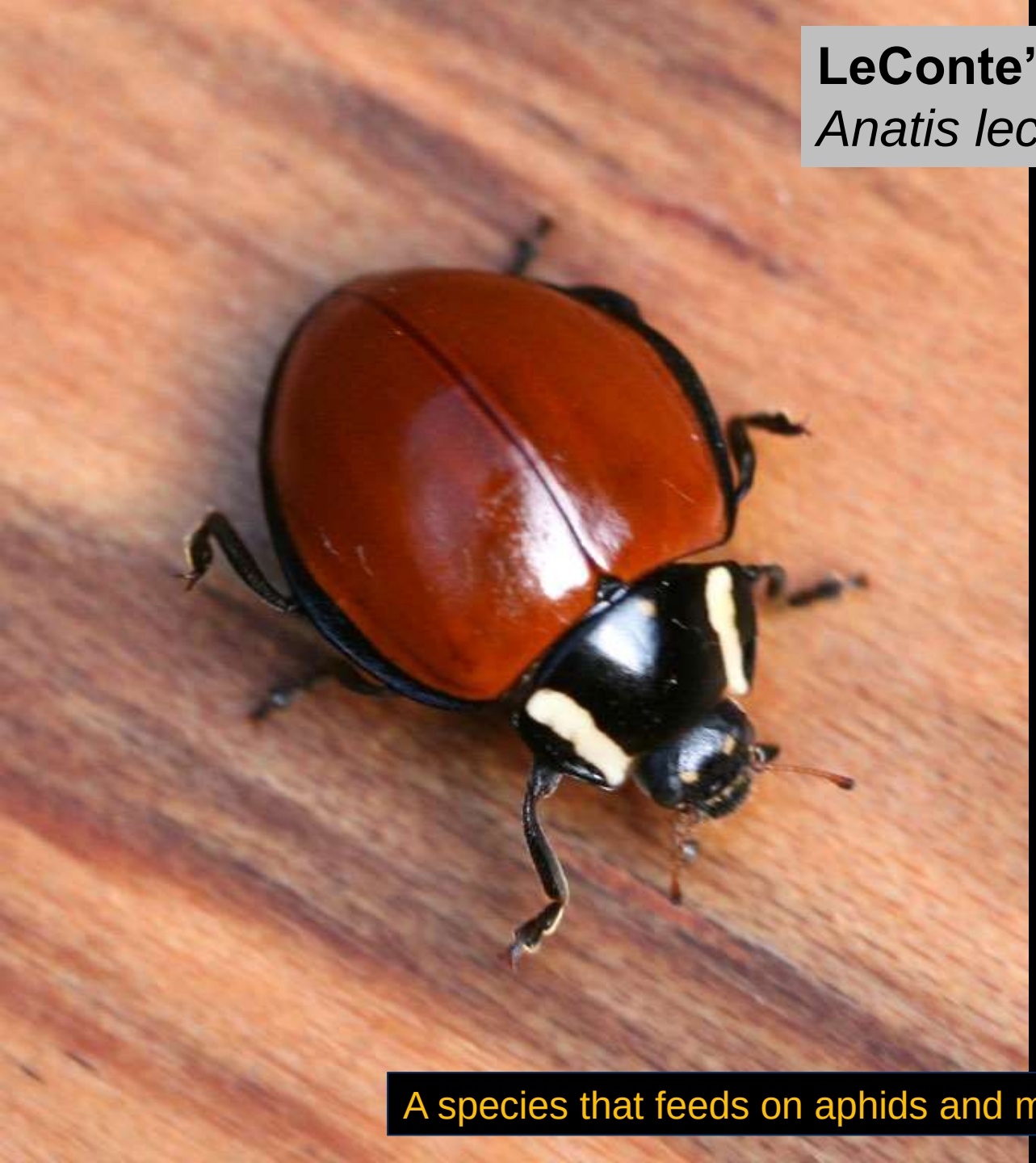
Characteristics of Predators of Insects

- 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
  - Many switch to nectar, pollen

LADY BEETLE

Most lady beetle adults are brightly colored


Pinkspotted lady beetle
Coleomegilla maculata
A species that feeds mostly on eggs and larvae of beetles



LeConte's giant lady beetle
Anatis lecontei

A species that feeds on aphids and mealybugs on trees

Upper left: ***Coccidophilus*, a scale predator**

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

Below: ***Chilochorus* sp., a predator of various scales**

Lady Beetle Life Stages

Lady beetle egg masses

Eggs of lady beetles are usually laid where prey are nearby that can feed their young, such as aphids


Lady beetle larvae
at hatch from eggs
Lady beetle egg mass

Lady beetle larvae at egg hatch

Lady beetle larvae

Predators of small soft-bodied arthropods (aphids etc…)

Lady beetle prepupae

Lady Beetle Pupae

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

Green Lacewings

Neuroptera: Chrysopidae

Adult green lacewings sustain themselves on nectar and pollen

Green lacewing eggs are uniquely stalked

Green lacewing eggs often are laid in groups.

Egg hatch has occurred in the lower picture.

Photograph courtesy of Brian Valentine

Green Lacewing Larvae

Photograph courtesy of David Shetlar

Left: Green lacewing larva eating aphid

Right: Green lacewing larva eating leaf beetle larva

Photograph courtesy of Ken Gray/Oregon State University

Flower (Syrphid) Flies

Photograph courtesy Brian Valentine

CAUTION

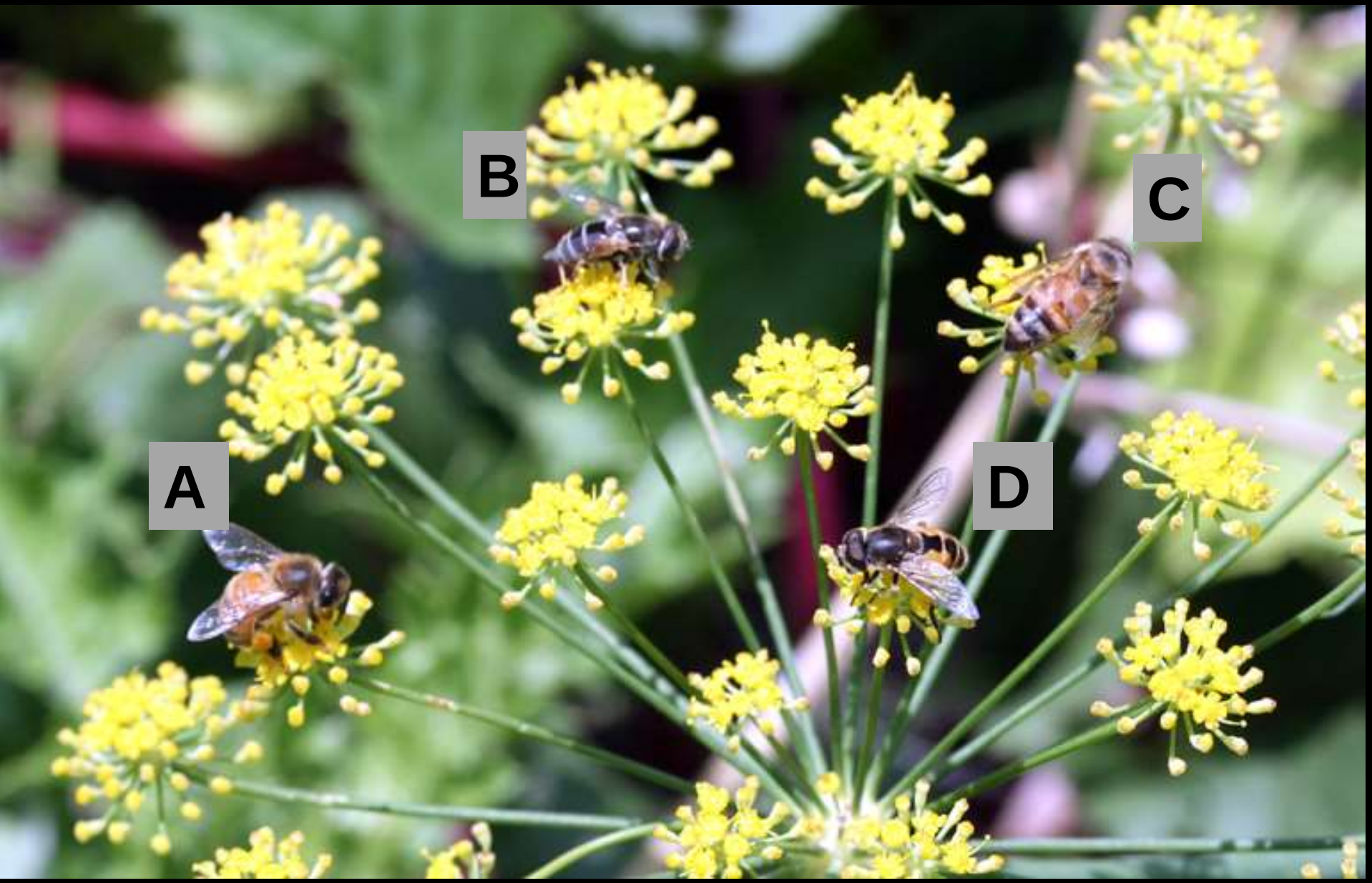
Insect Mimicry in Action!

Syrphid flies are excellent mimics of bees and wasps

Flower (Syrphid) Flies

Honey Bees

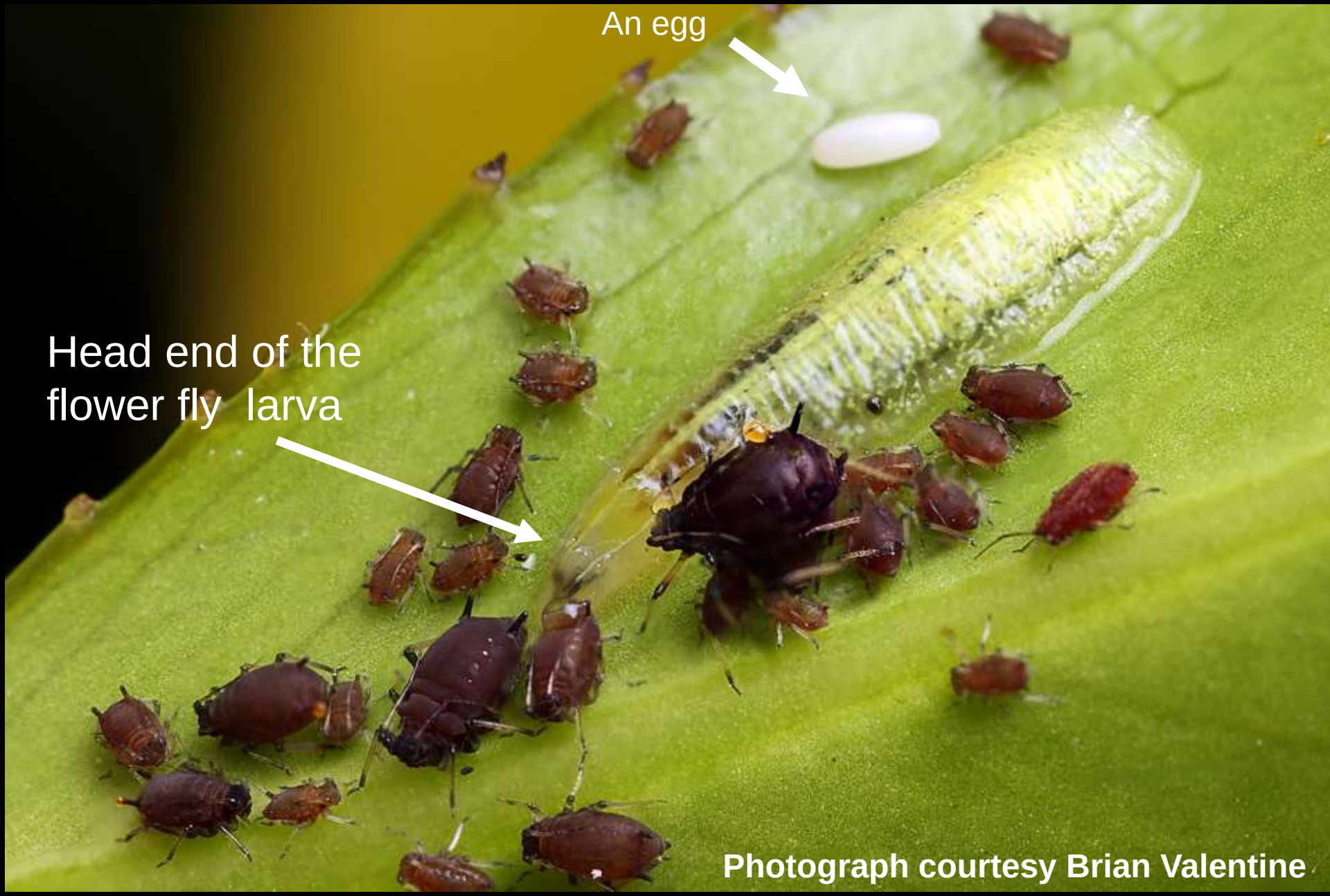
Honey Bee …or Flower Fly?



Flower Fly

Honey bee

Syrphid/flower fly eggs **are typically** laid near a colony of aphids


An egg
Head end of the flower fly larva
Photograph courtesy Brian Valentine

Flower fly larvae

Mantids

Mantids are generalist predators that hunt by ambush

European Mantid

Mantis religiosa

This is an introduced species to North America and is probably the species most common in Garfield County. **There are 4 native species of mantids in Colorado.**

Mantid Egg Laying

Mantid Egg Cases (Oothecae)

Adults

European mantid life stages

Nymph (immature form) – a predator

Eggs – laid in a mass (oothecal). The overwintering stage.


European mantid egg cases

There is a Colorado State University Fact Sheet about the Mantids that are found in the State

COLORADO STATE UNIVERSITY
EXTENSION

Mantids of Colorado

Fact Sheet No. **5.510** Insect Series | **Home and Garden**

by W. Cranshaw*

Mantids are some of the most distinctive and well-recognized of all the insect groups. All mantids are predators that feed on various insects, including some pest species. Seven species of mantids are found in Colorado (Table 1), five of which are native to the state.

Mantids are very distinctive insects. All have front legs which are large and well-designed for grasping prey. The segment of the body containing these legs (prothorax) is very elongated as is the overall body form.

Quick Facts

- Mantids are large, distinctive insects that feed on other insects, including some pests.
- All mantids survive winter in the egg stage, within a large egg case (ootheca).
- There are seven kinds

Some Common Kinds of Predators that Feed on Insects

- Lady beetles
- Ground beetles
- Lacewings
- Flower flies
- Robber flies
- Hunting wasps
- Mantids
- Assassin bugs
- Predatory stink bugs
- Minute pirate bugs
- Predatory thrips
- Predatory mites
- All spiders

Characteristics of Insect Parasitoids

- The mother hunts, inserting eggs in or on a host insect
- The immature stage develops in the host insect, ultimately killing it
  - Many may develop in one host
- Adults mostly feed on nectar and honeydew

Parasitoid Wasps

Ichneumonidae, Braconidae, Eulophidae, Trichogrammatidae, Encrytidae, Chalcidae and other families

Parasitoid wasps sustain themselves on nectar and pollen

Parasitoid Wasps

Females possess an ovipositor (‘stinger’).

This is used to lay eggs in a host insect.

They do not sting.

Photograph courtesy Brian Valentine

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 the cabbageworm parasitoid (*Cotesia glomeratus*)

Aphid parasitoids

Host evaluation

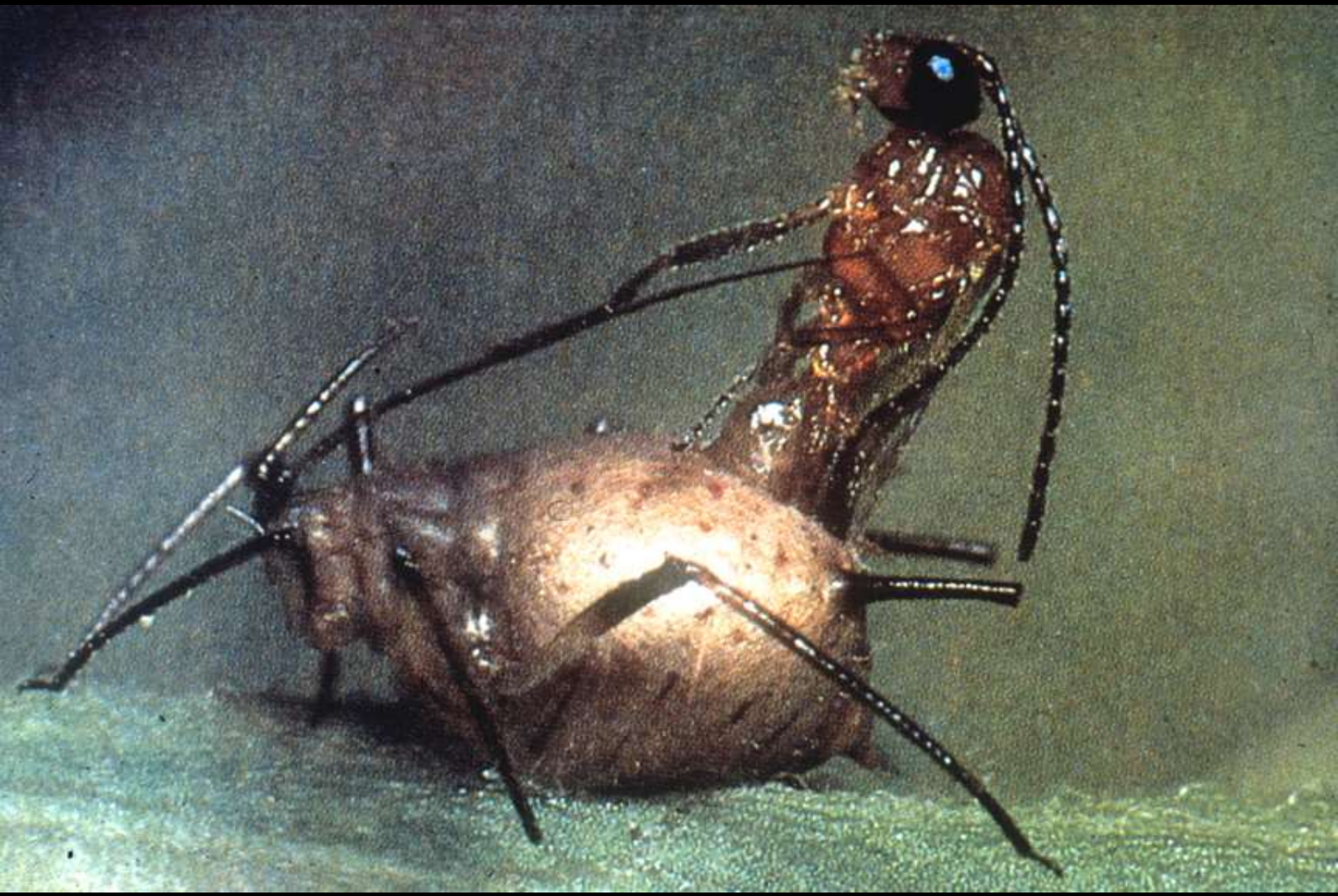
Oviposition

Photographs courtesy of Brian Valentine

Aphid Mummies

Aphid showing early symptoms of parasitism

Aphid mummies



Parasitized psyllids (above) and soft scale (below)

Parasitized aphids (above) and whiteflies (black forms, below)

Tachinid Flies

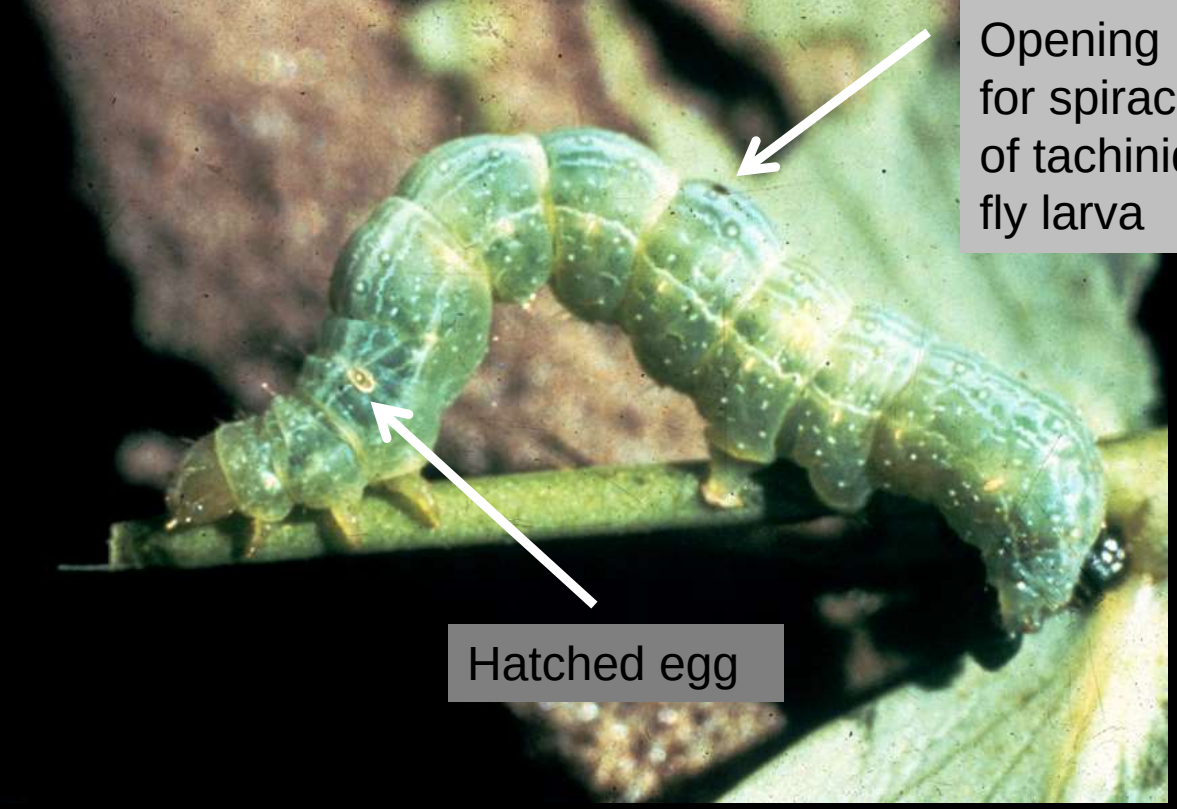
Tachinid fly eggs on body of whitelined sphinx caterpillar. Some are indicated with arrows.

Photograph courtesy of Jim Kalisch

Photograph courtesy of Jim Kalisch

Photograph courtesy of David Shetlar

Tachinid fly eggs on caterpillar (above), squash bugs (upper right) and Japanese beetle (right)


Opening
for spiracle
of tachinid
fly larva
Hatched egg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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

Landscaping for Biological Control Agents

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

Lady beetles

(“Lady bugs”, “Lady birds”….)

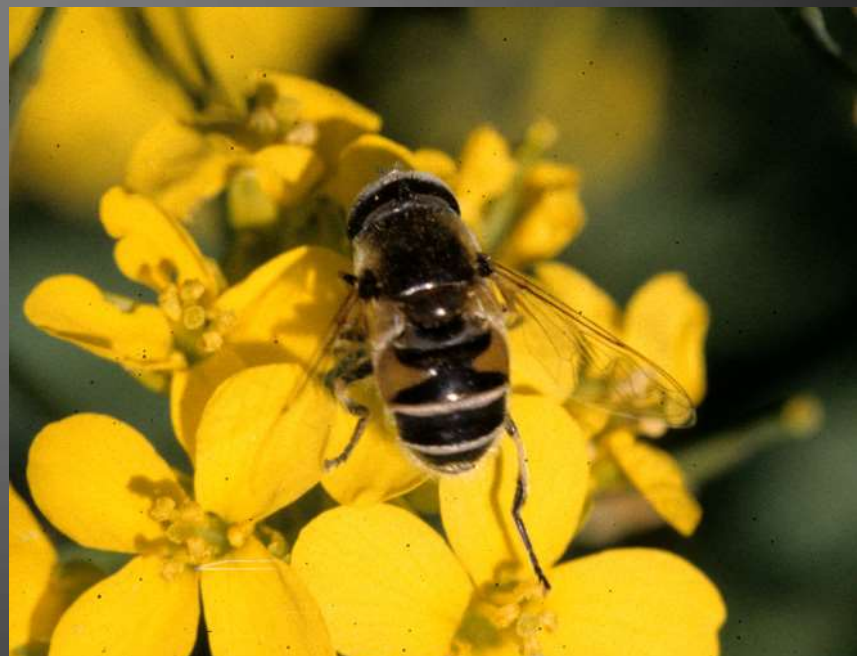
Lady beetle adults feed on nectar and pollen

Green Lacewings

Neuroptera: Chrysopidae

Most adult green lacewings maintain themselves on nectar and pollen

Flower (Syrphid) Flies



Adult flower flies sustain themselves on nectar

Adults of many natural enemiesuse flowers (nectar, pollen) for sustenance

Parasitoid wasps maintain themselves on nectar and pollen

Tachinid fly adults sustain themselves on nectar and pollen

Larvae develop within and kill other insects

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 natural enemies

- Most Apiaceae - (dill, fennel, coriander, Ammi, Queen Anne's lace, etc.)
- Yarrow (some)
- Many sedums
- Spurges
- Sweet alyssum
- Basket-of-gold
- Thyme, several herbs

Mooncarrot

Two personal favorites for good natural enemy insect action

Ammi (white cultivars)


Farm Planning for Conservation Biocontrol
Xerces habitat planting, California almond orchard
Photo: Jessa

Principles of Gardening for Insect Natural Enemies

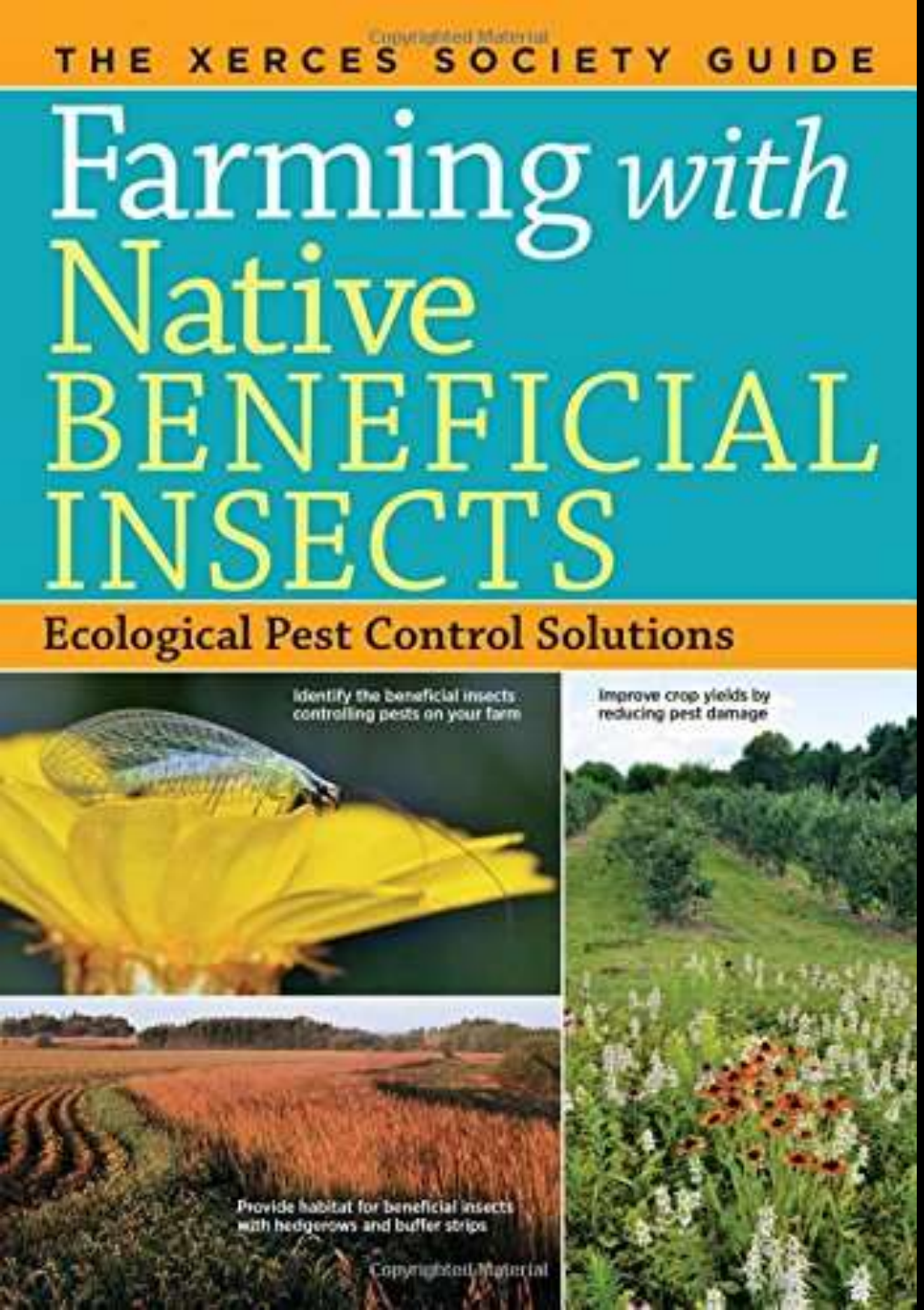
- Learn to recognize them – and don’t kill them
- Provide for food needs of adults
- **Provide for food needs of immature stages**

Spirea aphids on my bridal wreath spirea shrub – A pest??

Perennial plants that consistently provide predator food sources in my garden

Intercropping

- Increases diversity of site
- May impact ability of insects to locate crop
- Can provide habitat for natural enemies, including more consistent sources of prey/hosts



An excellent publication by the Xerces Society on improving habitat for natural enemies of insect pests

Want more? Search
Conservation Biological Control

Branches of Biological Control of Insect and Mite Pests

- Introduction of new species for permanent establishment
- Rearing/Distribution of natural enemies
- Conservation and enhancement of existing natural enemies
  - Involves on-site manipulations
    - Continuation of favorable practices can provide long-term effects

Branches of Biological Control of Insect and Mite Pests

- Introduction of new species for permanent establishment
- Rearing/Distribution of natural enemies
  - Commercial sources typically used (“Bugs for Hire”)
  - Effects are typically short-lived
- Conservation and enhancement of existing natural enemies

BIOLOGICAL CONTROL ORGANISMS FOR INSECTS AND MITES: Sources and Uses for Pest Management Situations in Colorado

A list of commercially available biological controls. It includes 36 insect predators, 21 parasitoids of insects, and 17 insect pathogens. There are 36 suppliers.

Whitney Cranshaw and Andrew Miller
Colorado State University
January 1, 2020 Version

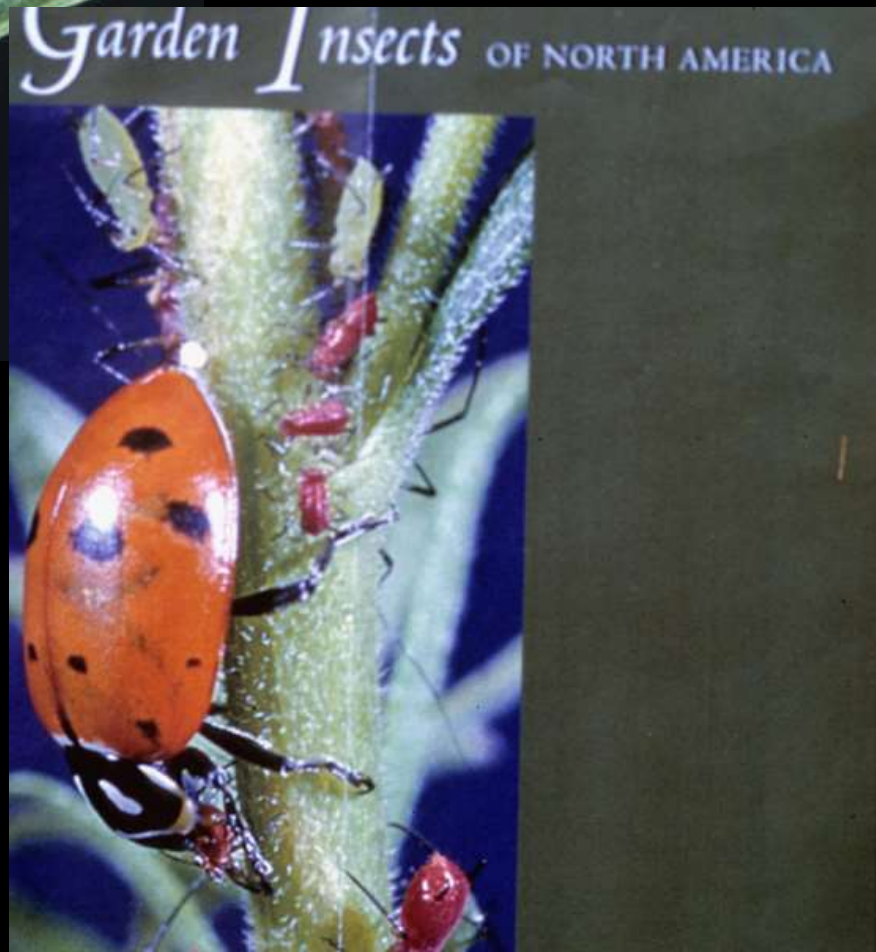
nisms are offered for sale by several suppliers to assist in management of
; is a listing of most of the US suppliers and it is organized into three
ion of organisms with potential applications followed by reference to
based. This is followed by a brief summary listing of pest groups and the
ontrols. At the end is a listing of addresses of many suppliers/producers.

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

Bulk purchase of field collected *Hippodamia convergens*



Convergent lady beetle (*Hippodamia convergens*) – the lady beetle of commerce

Unlike most lady beetles, the convergent lady beetle often masses during the dormant period

Photograph courtesy of Jim Kalisch, University of Nebraska

Lady beetles are the only biological control of insects that are field collected

Purchasing lady beetles?

Egg cases of the Chinese mantid are sold by some nurseries and in some garden catalogs

Chinese Mantid

Tenodera sinensis

Note: This species **does not seem to survive through winter** outdoors in Colorado

Green Lacewings

These are insects that are able to be economically reared in **insectaries.**

Most often these are **sold as eggs.**

Green lacewing eggs **are available from many suppliers that rear/ distribute insects**

Predatory Mites

Several species are reared and sold to control **spider mites** and **thrips**

Three species of **parasitoid wasps** are sold to control aphids

Whitefly parasites –
Parasitic wasps that selectively attack whiteflies

Trichogramma wasps, a parasitoid of eggs of various caterpillars (Order: Lepidoptera)

The list of commercially available biological control organism is available at the **Insect Information Website**

BIOLOGICAL CONTROL ORGANISMS FOR INSECTS AND MITES: Sources and Uses for Pest Management Situations in Colorado

Whitney Cranshaw and Andrew Miller
Colorado State University
January 1, 2020 Version

A wide variety of beneficial organisms are offered for sale by several suppliers to assist in management of insects and mites. The following is a listing of most of the US suppliers and it is organized into three sections. First is a brief description of organisms with potential applications followed by reference to sources where they may be purchased. This is followed by a brief summary listing of pest groups and the associated potential biological controls. At the end is a listing of addresses of many suppliers/producers.

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Branches of Biological Control of Insect and Mite Pests

- Introduction of new species for permanent establishment
  - Always coordinated by government and regulatory agencies
  - Effects are long-term
- Rearing/Distribution of natural enemies
- Conservation and enhancement of existing natural enemies

The origin of

Classic Biological Control

Cottony cushion scale and the Vedalia beetle

Cottony Cushion Scale – Enters California in 1860s and devastates citrus industry within next two decades

To the rescue – the *Vedalia beetle*

- Albert Koebele visits Australia and searches for natural enemies of cottony cushion scale
- Vedalia beetle (and a predatory fly) are introduced into California – 1888
- **Complete control of cottony cushion scale within two years after introduction**

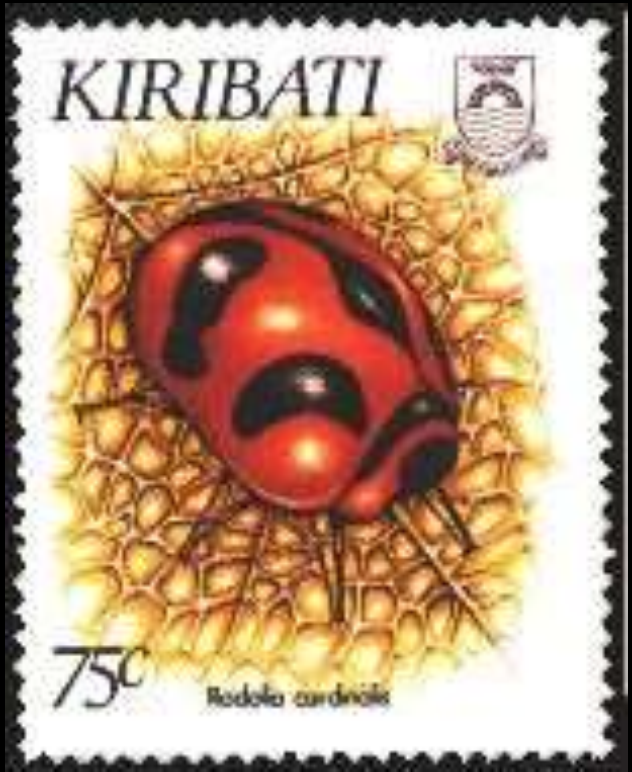

Cottony cushion scale
and vedalia


Cottony cushion scale
with vedalia eggs


Larva


Adult and pupa

The vedalia beetle was subsequently introduced into dozens of other areas plagued by the cottony cushion scale



Control of Cottony Cushion Scale by the Vedalia Beetle

Birth of the ‘Classic’ biological control technique for insect pests

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Palisade Insectary

Colorado Dept. Agriculture
Conservation Services Division
Biological Control Program
750 37.8 Rd.
Palisade, CO 81526
(970) 464-7916

Presently the CDA Insectary at Palisade is involved with producing and releasing insects that can help **reduce invasive weeds**

COLORADO
Department of Agriculture

Home | Animals | Brands | Conservation | Inspection/Consumer Svcs | Markets | Plants | State Fair

Conservation › Biocontrol

Biocontrol

Biological pest control helps decrease agriculture's reliance on chemical pest control. The Insectary imports, rears, establishes, and colonizes new beneficial organisms for control of specific plant and insect pests. Successful biological pest control reduces production costs, decreases amounts of chemicals entering the environment, and establishes colonies of beneficial insects offering a natural permanent pest control solution.

Contact the Insectary

Weed and Insect Programs

Approximately 30 weed predators are being cultured, released, and established on weed infestations throughout the State. In addition to the biological weed control programs, this section conducts control programs for the alfalfa weevil, and Oriental fruit moth, with a total of twelve

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Views Fees & Request A Bug

Canada Thistle Biocontrol

Dalmatian Toadflax Biocontrol

Diffuse/Spotted Knapweed Biocontrol

Field Bindweed Biocontrol

Leafy Spurge Biocontrol

Musk Thistle Biocontrol

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The Insectary at Palisade is celebrating its 75th Anniversary in August!

It is open to tours.
Please call ahead.

Palisade Insectary

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