

# Introduction to Entomology

Master Gardener Training

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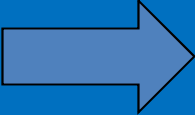
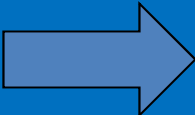
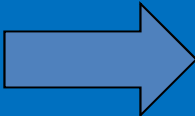
Mary Louise Flint, UC IPM

# Learning objectives for Entomology

- ❖ Learn basic structure (anatomy), life cycles, and distribution
- ❖ Be familiar with the major groups of insects found in the home garden
- ❖ Understand insect damage and the associated insect pests
- ❖ Understand management options for pest problems in the home garden
- ❖ Know what resources are available to help in the diagnostic process



## Insect questions all MGs face:

- What is it?  **Taxonomy**
- What does it do?  **Ecology**
- How do I get rid of it?  **Management**

# Phylum Arthropoda

- Phylum in the Animal Kingdom: Arthropoda
- Exoskeleton
- Jointed appendages
- Crabs, centipedes, spiders, mites, insects



# Phylum Arthropoda

- Subphylum Chelicerata
  - Class Merostomata
  - Class Arachnida – spiders, mites, ticks, scorpions
  - Class Pycnogonida
- Subphylum Crustacea - pillbugs
- Subphylum Atelocerata
  - Class Diplopoda - millipedes
  - Class Chilopoda - centipedes
  - Class Pauropoda
  - Class Symphyla
  - Class Hexapoda (Insecta) – INSECTS!!



# Insect relatives in the home and garden

- Spiders, mites, ticks, scorpions
- Centipedes, millipedes
- Pillbugs
- Snails and slugs (Phylum Mollusca)

# Insects versus Mites

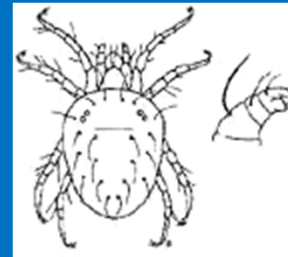
## Insects

Head, thorax, and abdomen  
3 pairs of legs



## Mouthparts

- **chewing** (beetles, caterpillars)
- **piercing-sucking** (aphids, bugs)
- **sponging** (flies)
- **siphoning** (moths)
- **rasping-sucking** (thrips)
- **cutting-sponging** (biting flies)
- **chewing-lapping** (wasps)



## Mites

(Arachnids)

Two body parts  
4 pairs of legs

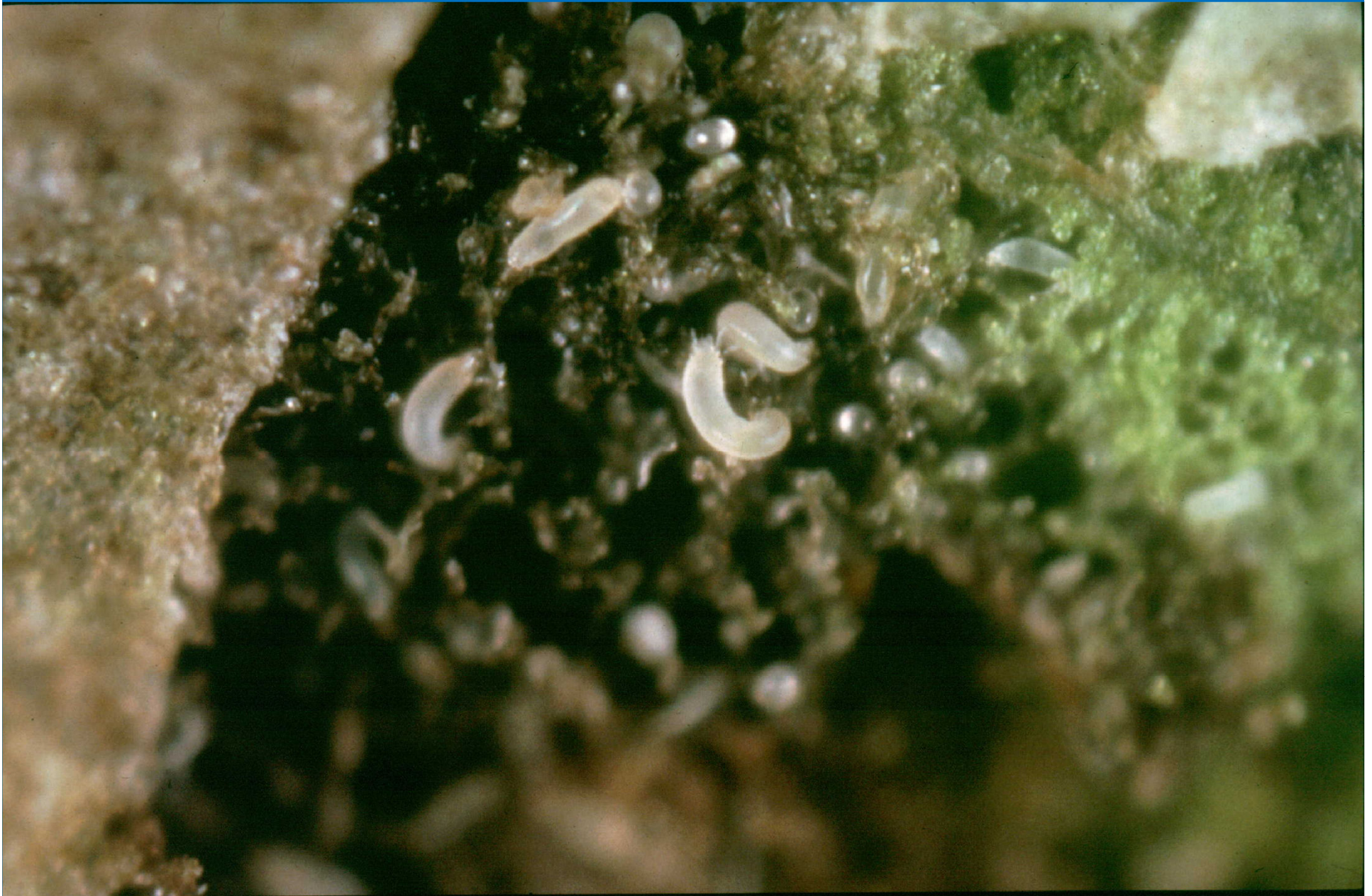
**piercing-sucking**

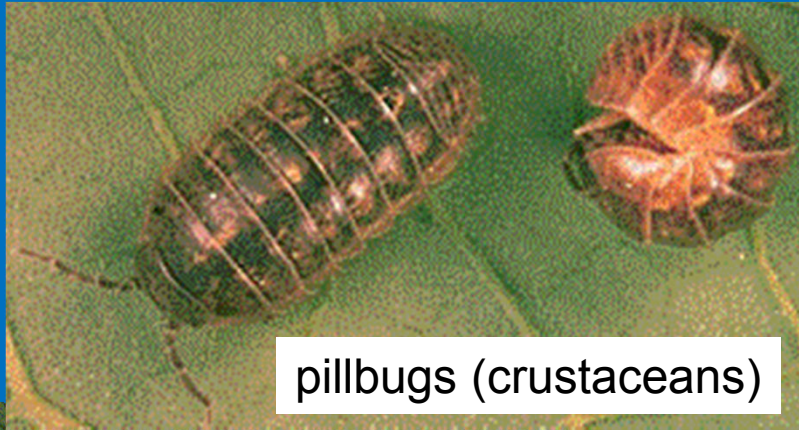
# Two spotted spider mite



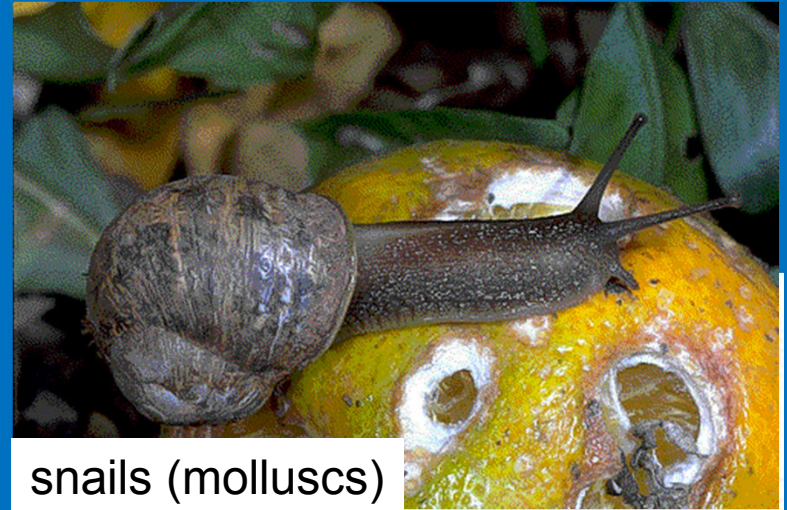


# Rust mites





pillbugs (crustaceans)



snails (molluscs)

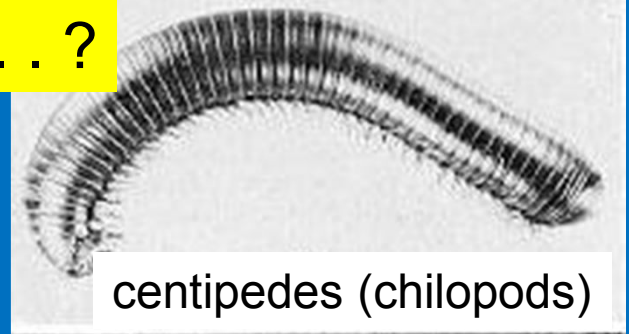


spiders (arachnids)

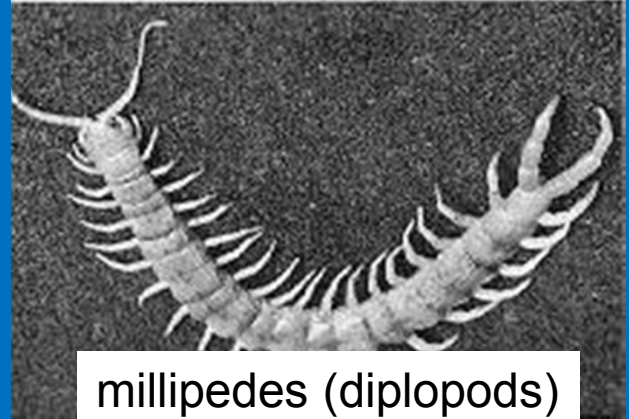
Are they insects. . ?



mites (arachnids)



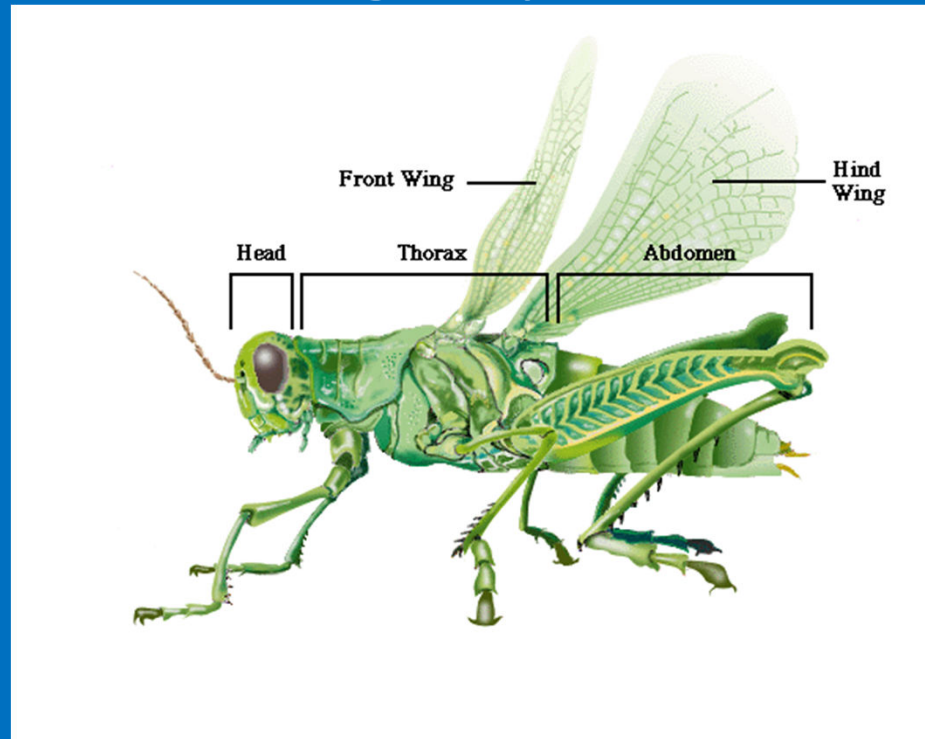
centipedes (chilopods)



millipedes (diplopods)

# Insect anatomy

- Three body segments: Head, thorax, abdomen
- Wings, antennae, legs, eyes



# Insect anatomy: mouthparts

- Chewing – grasshoppers, beetles, caterpillars
- Piercing-sucking – true bugs, hoppers, whiteflies, psyllids, aphids, scale insects, mosquitoes, spider mites
- Rasping-sucking - thrips
- Siphoning – moths and butterflies
- Sponging – house fly, fruit fly
- Cutting-sponging – stable fly, horse fly
- Chewing-lapping – bees and wasps

# Chewing – grasshoppers, beetles, caterpillars



Piercing-sucking – true bugs, hoppers, whiteflies, psyllids, aphids, scale insects, mosquitoes, spider mites



# Rasping-sucking - thrips



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Siphoning – moths and butterflies  
Sponging – house fly, fruit fly





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## Defoliators



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## Skeletonizers



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## Leaf miners



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## Borers

Stunning



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Curling



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Deformed plant parts



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Mottling



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Honeydew

Sooty mold



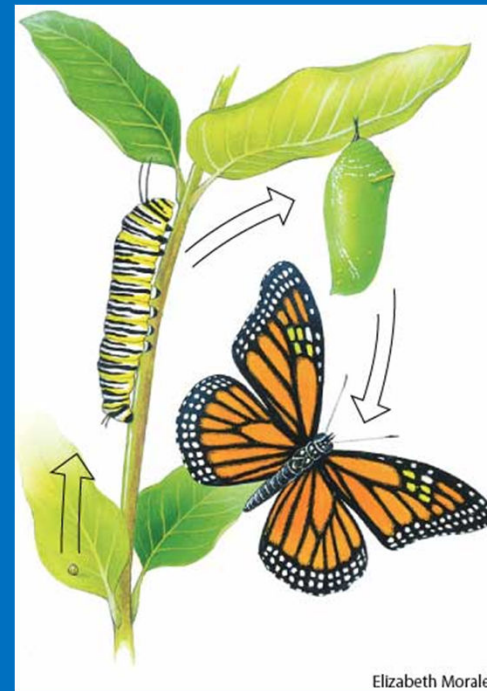
Webbing



Bronzing

# Insect Growth and Development

- Life stages – egg, immature (nymphs, larvae, naiads), pupae, adult
- Immature instars
- Molting
- Metamorphosis
  - Simple
  - Complete



# Simple Metamorphosis

Life Cycle of a Leaf-Footed Bug

(*Leptoglossus* spp.)



Nymphs



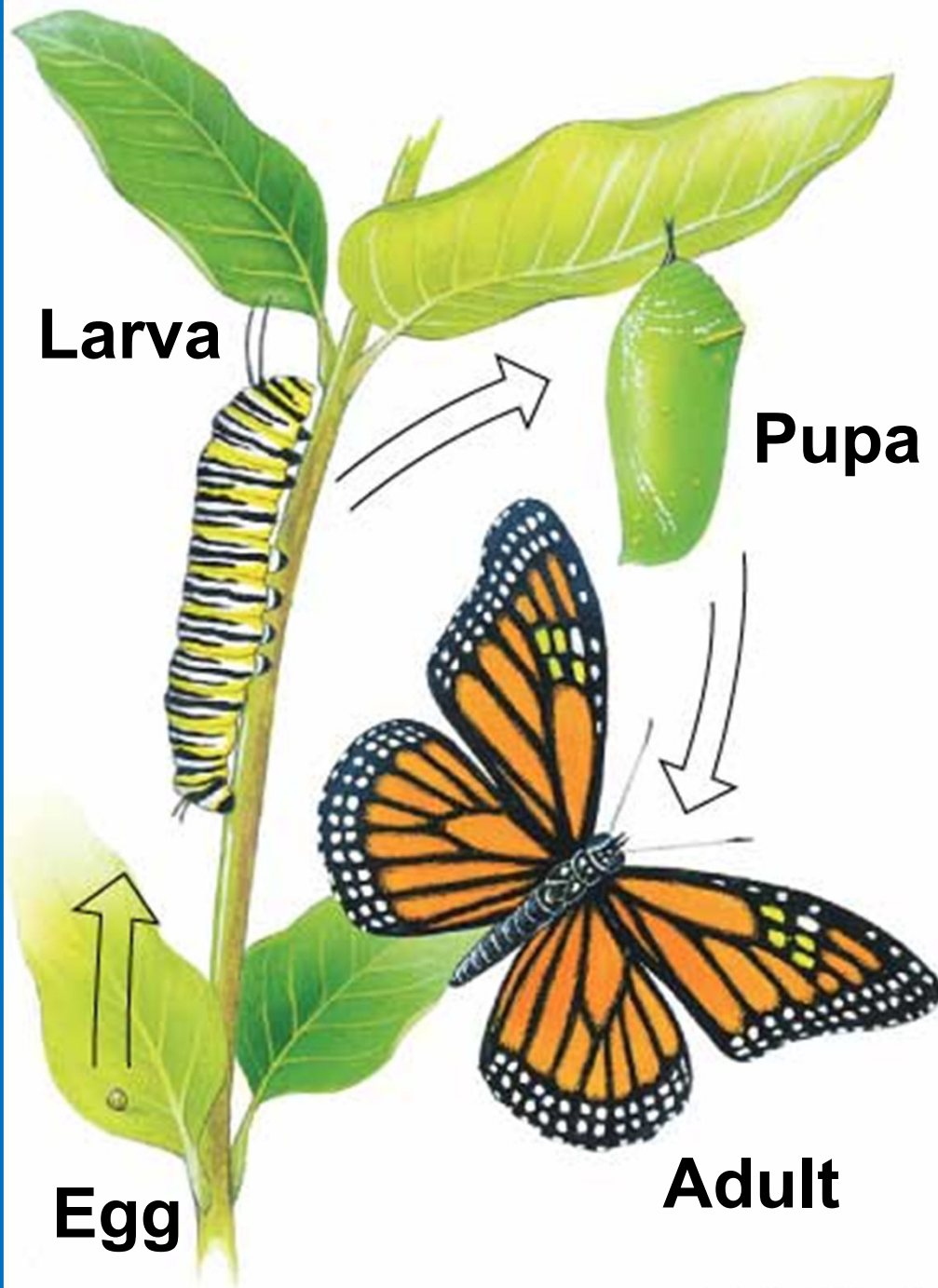
Adult



Eggs

No pupa, wings develop externally, nymphs

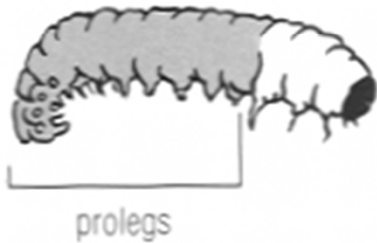
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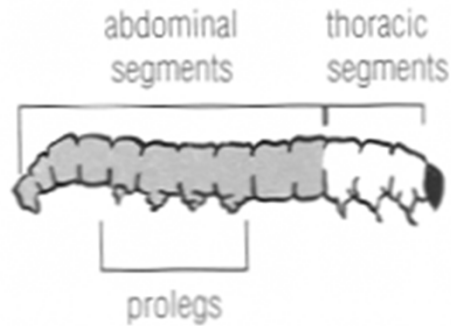
Pupa present,  
wings develop  
internally, larvae

# Complete metamorphosis larval types

Sawfly larva



Caterpillar



Leaf beetle larva

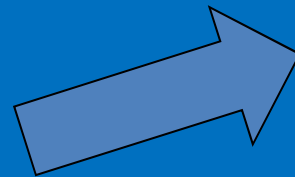


Fly larva

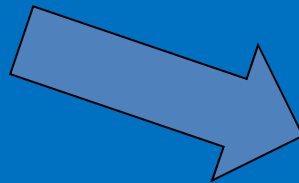


# Pests

- Organism interfering with human activity



Eating wood in the  
middle of the  
forest:  
NOT A PEST



Eating wood in a  
house: PEST

# Pests

- Cause economic losses
- Agricultural pests – numbers
- Urban pests – houses, cities
- Garden and ornamental pests
- Medical pests
- Categories of pests: key pest, secondary pest, direct pest, indirect pest

# Natural enemies

- Insects (or other organisms) that kill insects, weaken them or reduce their numbers

**Predators**

**Parasitoids**

**Pathogens**

# Natural enemies

## Predators

- Consume many prey
- Prey usually smaller
- Immature and adult free-living

## Parasitoids

- Consume one host
- Host bigger or smaller
- Immature parasitic, adult free-living



# Parasitic wasps



# *Trichogramma* spp.



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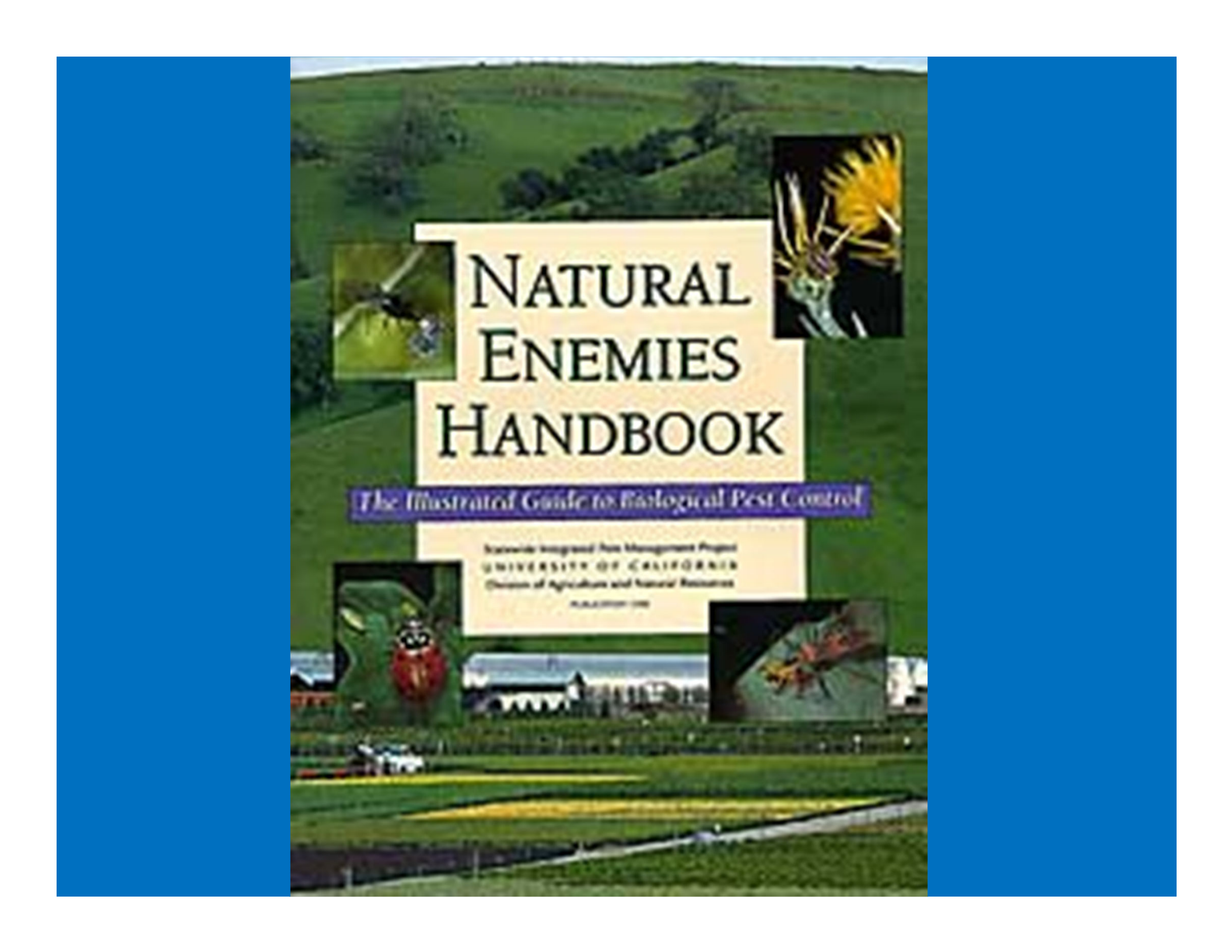


# Tachinid flies

# Pathogens

- Insect diseases
- Bacteria, fungi, nematodes, virus
  - *Bacillus* spp.
  - *Bacillus thuringiensis* (*Bt*)
  - *Metarhizium*
  - *Beauverin bassiana*
  - *Paecilomyces*





# NATURAL ENEMIES HANDBOOK

*The Illustrated Guide to Biological Pest Control*

Statewide Integrated Pest Management Project  
UNIVERSITY OF CALIFORNIA  
Division of Agriculture and Natural Resources

PUBLISHED 1992

# Taxonomy

- The science of classification, describing and naming

Phylum	Arthropoda
Class	Insecta
Order	Lepidoptera
Family	Tortricidae
Tribe	Laspeyresiini
Genus	<i>Cydia</i>
Species	<i>Cydia pomonella</i>

# Taxonomy

- Scientific name vs. common name
- *Cydia pomonella* (L.) (Lepidoptera, Tortricidae)
- *C. pomonella* = Codling moth



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# Taxonomic keys

## Key to the Families of Hemiptera

This key is based on adults, but it will work for some nymphs. Families marked with an asterisk are relatively rare or are unlikely to be taken by a general collector. Some brachypterous forms may not key out correctly in this key, because they either lack ocelli or do not show the wing characteristics used in the key.

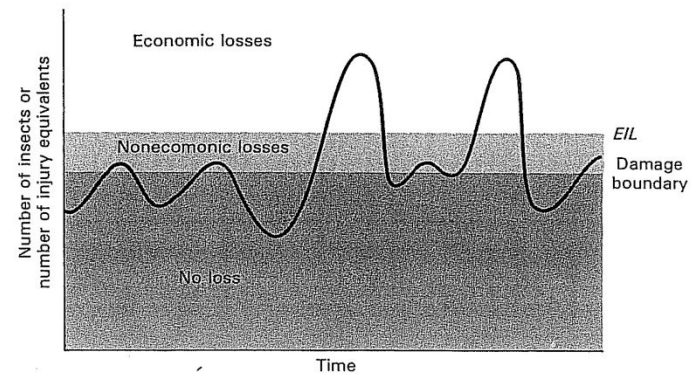
- |        |   |                       |        |
|--------|---|-----------------------|--------|
| 1.     | Compound eyes present .....   | 2                     |        |
| 1'.    | Compound eyes absent; ectoparasites of bats, 3.5–4.5 mm in length; western United States .....  | <b>Polycténidae*</b>  | p. 301 |
| 2(1).  | Antennae shorter than head, usually (except <i>Ochtéridae*</i> ) hidden in cavities beneath eyes (Figure 24–5A); no arolia; aquatic or semiaquatic (suborder <i>Nepomórpha</i> ) .....              | 3                     |        |
| 2'.    | Antennae as long as or longer than head, usually free and visible from above; arolia present or absent; habits variable .....   | 10                    |        |
| 3(2).  | Ocelli present (Figure 24–5B); length 10 mm or less; shore species .....  | 4                     |        |
| 3'.    | Ocelli absent; size variable; aquatic species .....   | 5                     |        |
| 4(3).  | Antennae hidden; front legs shorter than middle legs; eyes strongly protuberant (Figure 24–12); beak short, concealed by front femora .....   | <b>Gelastocòridae</b> | p. 295 |
| 4'.    | Antennae exposed; front legs as long as middle legs; eyes not strongly protuberant; beak long, extending at least to hind coxae .....   | <b>Ochtéridae*</b>    | p. 295 |
| 5(3'). | Front tarsi 1-segmented and modified into scoop-shaped structures (Figure 24–6); beak very short and hidden, appearing 1-segmented; dorsal surface of body usually with fine transverse lines ..... | <b>Corixidae</b>      | p. 295 |

# Integrated Pest Management (IPM)

The use of several pest management tactics to reduce a pest population to non-damaging levels, in an environmental sound way

- Monitoring
- Threshold
- Action
  - Cultural control (irrigation)
  - Host resistance
  - Biological control
  - Mechanical control (pest exclusion)
  - Environment modification
  - Chemical control (insecticides)

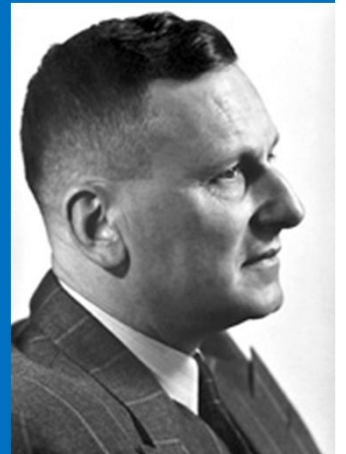
ECONOMIC DECISION LEVELS FOR PEST POPULATIONS / 259



**Figure 7.3** Graph showing relationships of a hypothetical insect population with the damage boundary and the economic-injury level.

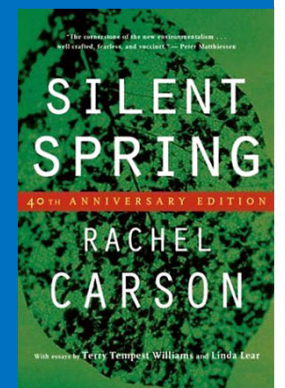
# A brief history of... insecticides

- Pre-WWII: Rotenone, sulfur, oils, nicotine, pyrethrum
- 1942: DDT introduced to the US
- New chemistries followed: chlordane, toxaphene, aldrin and parathion
- In agriculture, insecticides became the driving force of insect control
- Many lives and bank accounts saved by insecticides
- 1948: Paul Muller awarded Nobel Prize in medicine for discovery of insecticidal properties of DDT



# A brief history of... insecticides

- 1950s: insect control failures in many parts of the world
- 1959: Stern's paper published
- 1962: Rachel Carson's "Silent Spring" published
- 1960s and 1970s: ecological and biological control research comes back
- 1980's on: more specific insecticides developed, transgenic crops



# Insecticides

- Commercial product = active + inert ingredients
- Active ingredient always on the label
- Grouped by chemistry and mode of action

# Insecticides

- **Chlorinated** – DDT and derivatives
- **Organophosphates (OPs)** – contain phosphorus – malathion, parathion
- **Carbamates** – derivatives of carbamic acid – carbaryl, carbofuran
- **Pyrethroids** – derivatives of pyrethrum – cypermethrin, deltamethrin
- **Neo-nicotinoids** - mode of action similar to nicotine - imidacloprid

# Insecticides

- **Spinosyns** – fermentation of a bacteria found in an abandoned rum distillery – spinosad
- **Avermectins** – fermentation of soil bacterium
- **Phenylpyrazoles** – fipronil
- **Insect Growth Regulators (IGRs)** – disrupt metamorphosis or molting – methoprene, diflubenzuron
- **Botanicals** – pyrethrum, nicotine, rotenone. Limonene, neem
- **Microbial** - Bt, *Beauveria bassiana*, viruses

# Ecological backlash of insecticides

- Remember the three “R”s
  - Resistance: pest is more tolerant of insecticide
  - Resurgence: pest comes back stronger
  - Replacement: a secondary pest becomes a key pest

# Insect orders – Why????

- Prediction of morphology, behavior
- 31 insect orders
- Mostly organized according to structure of wings, mouthparts and metamorphosis