

Overview of Lepidoptera families

Taxonomic Workshop for Early Detection of
Important Tortricidae and Other Lepidopteran
Agricultural and Silvicultural Pests

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Families of Lepidoptera

- Major ditrysian superfamilies

- Tineoidea
- Gracillarioidea
- Yponomeutoidea
- Gelechioidea
- Cossioidea
- Zygaenoidea
- Pterophoroidea
- Bombycoidea
- Lasiocampoidea
- Geometroidea
- Tortricidae *
- Pyralidae *
- Noctuoidea *

* Contains the largest number of pest species

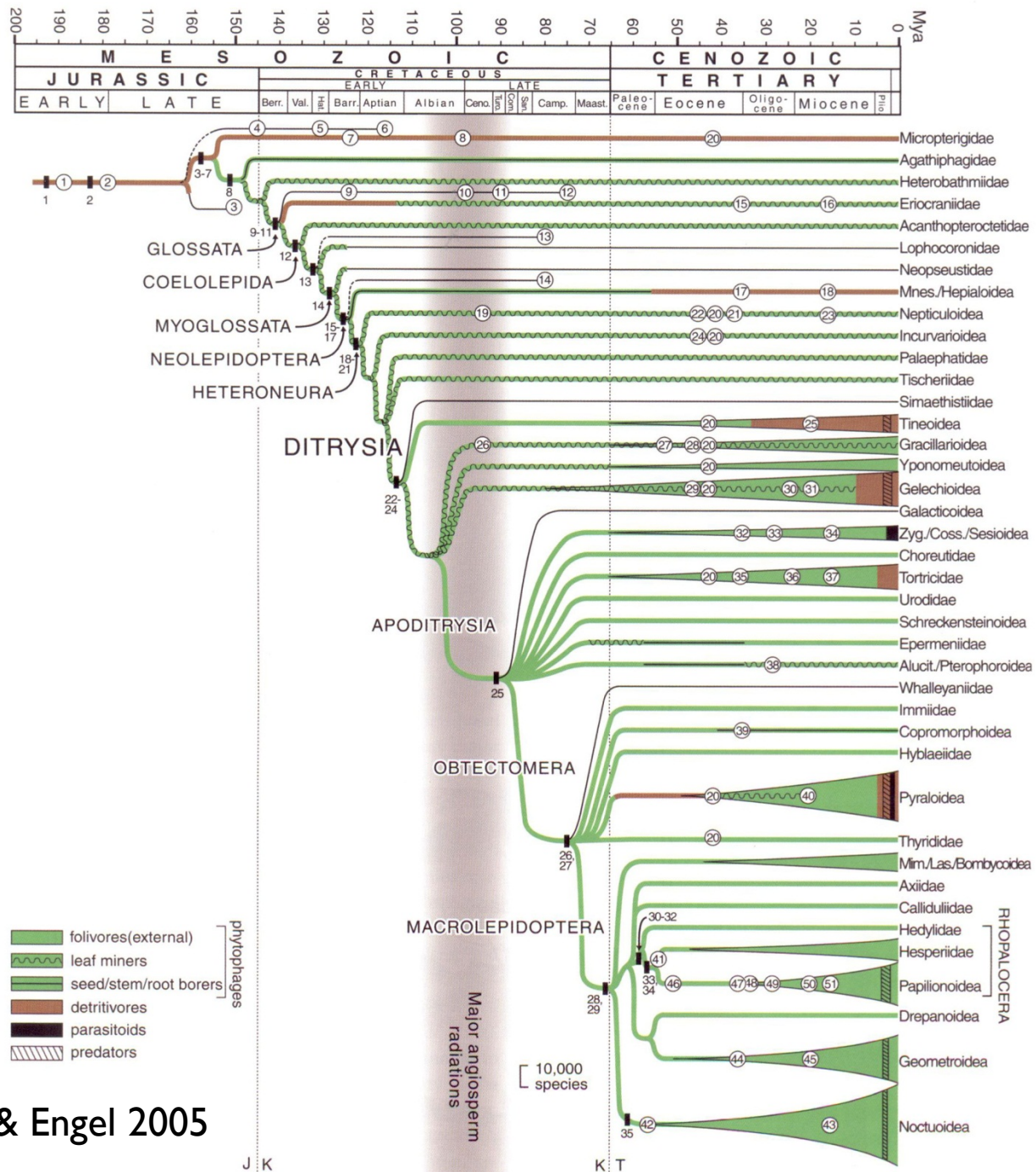
Families of Lepidoptera

- 47 Superfamilies
- Microlepidoptera
 - 75% of families, 25% of described species
- Macrolepidoptera
 - 25% of families, 75% of described species
- Highest levels of diversity in the Neotropics
- We are only going to review Ditrysian moth families (and ignore butterflies!)



Ditrysia

- All of the Ditrysiian families have (with some exceptions):
 - Developed proboscis
 - Frenulo-retinacular wing coupling
 - Heteroneurous wing venation
 - Separate copulation and oviposition openings in the female



Grimaldi & Engel 2005

Tineoidea

- 3 families, ca. 3,700 described species
 - Tineidae
 - Eriocottidae
 - Psychidae
- Includes “clothes moths” and “bagworms”
- The most basal ditrysians
- Well developed mouthparts with a reduced proboscis

Tineoidea

Tineidae (clothes moths)

- Fine, erect scales on head
- Often with conspicuous maxillary palpi
- Labial palpi short to moderately long, often with a few fine black bristles
- Forewing usually somewhat “shiny”

Acrolophinae (subfamily of Tineidae)

- Fuzzy head and body
- Large, dark brown adults
- Males often with elongate labial palpi, often extending over dorsum of thorax

Psychidae (bagworms)

- Wings dark-smoky, without scales
- Short antennae (feathery at base)
- Characteristic larval cases



Gracillarioidea

- 3 families, ca. 2,200 described species
 - Roeslerstammiidae
 - Bucculatricidae
 - Gracillariidae
- Larvae are leaf or grass miners
- Very small adults
- Well developed mouthparts, labial palpi often with lateral bristles (as in Tineidae)



Figure 41



Yponomeutoidea

- 10 families, ca. 1,700 described species
- Classification historically unstable; families currently recognized:
 - Yponomeutidae, Plutellidae, Ypsolophidae, Acrolepiidae, Glyphipterigidae, Argyresthiidae, Heliodinidae, Lyonetidae, Attevidae, Praydidae, Heliodinidae, Bedelliidae, Lyonetiidae
- Defined by pleural lobes anterior to the genitalia
- Mouthparts well developed, labial palpi variable but always large and conspicuous

Yponomeutoidea

Yponomeutidae (ermine moths)

- Smooth scaled head
- Palpi slender, smooth-scaled
- Proboscis unscaled
- Apex of hindwing usually rounded



Attevidae (webworms)

- Smooth scaled head
- Palpi slender, smooth-scaled
- Proboscis unscaled
- Apex of hindwing usually rounded
- Colorful moths (characteristic pattern)



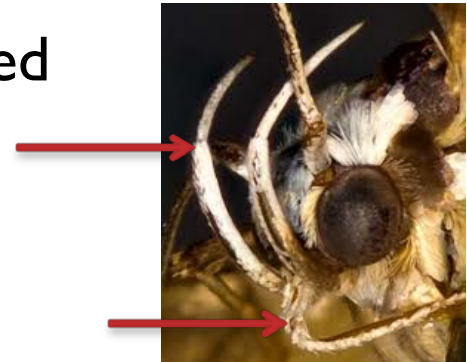
Plutellidae (diamondback moths)

- Smooth scaled head
- Labial palpi with rough-scaled second segment, smooth-scaled, upturned third
- Proboscis unscaled
- Apex of hindwing oblong-lanceolate with pointed apex



Gelechioidea

- 21 families, ca. 18,500 described species
- Classification historically unstable; families currently recognized:
 - Gelechiidae, Elachistidae (Stenomatidae, Ethmiidae, Depressariidae, Agonoxenidae), Xyloryctidae (Scythrididae) Schistomeoidae, Oecophoridae (Stathmopodidae), Amphisbatidae, Lecithoceridae, Batrachedridae, Deocloniidae, Coleophoridae, Blastobasidae, Momphidae, Autostichidae (Symmocidae), Cosmopterigidae, others?
- Mouthparts well developed
 - Labial palpi long, strongly recurved
 - Proboscis scaled



Gelechioidea

Elachistidae (Ethmiinae)

- Head smooth-scaled
- Labial palpi moderately long, upturned
- Proboscis scaled
- Hindwing with rounded apex
- Characteristic black and white forewing pattern
- Pale yellow-orange abdomen



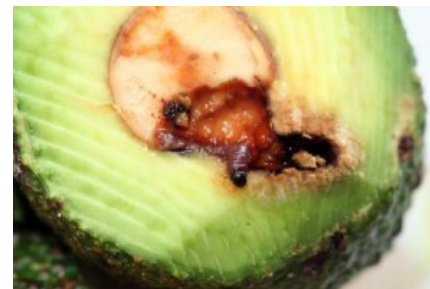
Ethmiinae – *Ethmia*



Stenommatinae – *Antaeotricha*

Elachistidae (Stenommatinae)

- Head smooth-scaled
- Labial palpi moderately long, upturned
- Proboscis scaled
- Hindwing with rounded apex
- Forewing pattern variable



Stenommatinae – *Stenoma catenifer*

Gelechioidea

Oecophoridae

- Head smooth-scaled
- Labial palpi large, upturned
- Proboscis scaled
- Apex of hindwing rounded (variable)



Oecophoridae
Promalactis



Oecophoridae
Callima



Oecophoridae
Pleurota

Gelechioidea

Coleophoridae (case-bearers)

- Head slightly rough scaled
- Labial palpi usually porrect (straight), not conspicuously upturned, and smooth-scaled
- Proboscis scaled
- Narrow, lanceolate wings (pointed apically)
- Inconspicuous paired patches of special scales/spines subdorsally on most abdominal segments
- Larvae are case-bearers



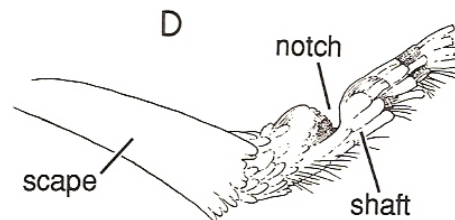
Gelechioidea

Blastobasidae (really ugly brown moths)

- Smooth scales on head
- Shorter upturned labial palpi
- Proboscis scaled
- Wings “broadly lanceolate”
- Rows of bronze spines on abdominal segments
- Males of some species with notch near base of antenna



www.microleps.org



Gelechioidea

Gelechiidae

- Smooth scaled head
- Long upturned labial palpi
- Proboscis scaled
- Hindwing with falcate apex (or at least pointed)
- Forewing pattern and shape extremely variable
- Many pest species
 - *Anarsia*, *Pectinophora*, etc.



Cossoidea

- 7 families, ca. 2,800 described species
- Families currently recognized:
 - Cossidae, Brachodidae, Dudgeoneidae, Metarbelidae, Retardidae, Castniidae, Sesiidae
- Larvae are wood-boring (mostly)
- Specialized wing coupling in Sesiidae
- Mouthparts well developed
- Several pest groups
 - Carpenter moths (Cossidae)
 - Tree borers (Sesiidae, *P. archon*)



Zygaenoidea

- 12 families, ca. 2,700 described species
- Families currently recognized include (not all listed):
 - Limacodidae
 - Megalopygidae
 - Dalceridae
 - Zygaenidae
- Adults small to medium, “fuzzy”
- Palpi reduced, proboscis present
- Bizarre larvae for many species
- Many Zygaenidae are diurnal



Zygaenoidea

Limacodidae

- Nocturnal
- Short triangular forewing
- Basal portion of antennae feathery
- Legs somewhat “furry”



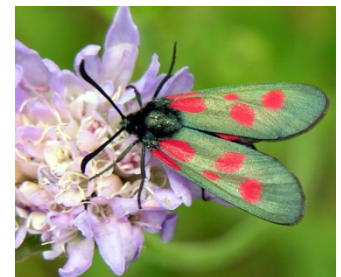
Megalopygidae

- Nocturnal
- Short triangular forewing
- Feathery antennae
- Legs “very furry” – densely scaled



Zygaenidae

- Frequently diurnal
- Slenderer body
- Feathery antennae
- Legs not densely scaled



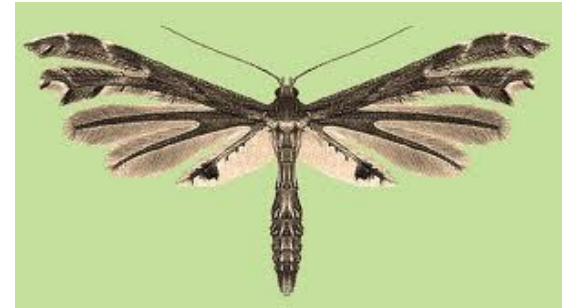
Zygaenoidea

- Examples of Limacodidae larvae



Pterophoroidea

- 1 family, ca. 1,000 described species
- Characteristically incised (divided) wings
- Long slender legs
- Distinctive resting posture
- Labial palpi variable in shape



Bombycoidea

- 10 families, ca. 4,700 described species
- Families include:
 - Bombycidae
 - Saturniidae
 - Sphingidae
- Stout-bodied, large moths
- Broad wings
- Lack tympanal organs
- Mouthparts, frenulum-retinaculum reduced or absent in some families (Saturniidae)



Bombycoidea

- Sphingidae
 - Hawk moths, horn worms, hummingbird moths, etc.
 - Long narrow forewings
 - Thick antennae, often swollen distally
 - Long proboscis
 - Some feed diurnally or at dusk
 - Larvae with posterior “horn”



Bombycoidea

- Saturniidae
 - Giant silk moths
 - Broad triangular forewings
 - Short antennae, plumose in male
 - Proboscis reduced or absent
 - Frenulum-retinaculum absent



Lasiocampoidea

- 1 families (Lasiocampidae), ca. 1,950 described species
- Lappet moths, tent caterpillars
- Broad, rounded, triangular forewings
- Usually sexually dimorphic
- Proboscis reduced or absent
- Larvae of some species defoliate trees



Geometroidea

- 4 families, ca. 23,700 described species
- Currently recognized families:
 - Epicopeiidae, Sematuridae, Uraniidae, Geometridae
- Abdominal tympanum
- Triangular forewings, characteristic resting posture
- Antennae moderate in length, frequently plumose in males
- Larvae commonly called “inch worms” (abdominal prolegs on A6 and A10 only)
- Females of some species brachypterous



Most economically important superfamilies

- 1. Noctuoidea: 1034 species
- 2. Pyraloidea: 748 species
- 3. Tortricoidea: 687 species



Tortricoidea

- 1 family (Tortricidae), ca. 10,300 described species
- Three subfamilies currently recognized:
 - Olethreutinae, Tortricinae, Chlidanotinae
- Mouthparts well developed, labial palpi porrect or weakly upturned
- Female with flat ovipositor lobes
- Chaetosemata present
- Proboscis unscaled
- Large number of pest species
- More tomorrow!



Tortricidae importance



The screenshot shows the Tortricid.net website interface. At the top, there's a header with the site name "Tortricid.net" and the tagline "TORTRICIDAE RESOURCES ON THE WEB VERSION 2.0". Below this is a navigation bar with links: HOME, CATALOGUE, HOST PLANTS, LIBRARY, TORTS, BOOK, TORTRICIDNA, ABOUT, and SITE MAP. The main content area features a sidebar on the left with a book cover image and a list of links: Introduction, Search, Suprageneric Classification, Catalogue Stats (highlighted), and Identification Photos. The main content area displays the "T@RTS Online World Catalogue of the Tortricidae" logo and version information: "Version 2.0 last updated 16 Jul 2012". It also states "The catalogue is current through the end of 2010." and provides "Catalogue Statistics":

- Total number of genera (including synonyms): **1704**
- Total number of senior genera: **1077**
- Total number of species (including synonyms): **14574**
- Total number of senior species: **10361**
- Total number of species with photo: **1207**

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T@RTS: Online world catalogue of the Tortricidae

Percent pest species:

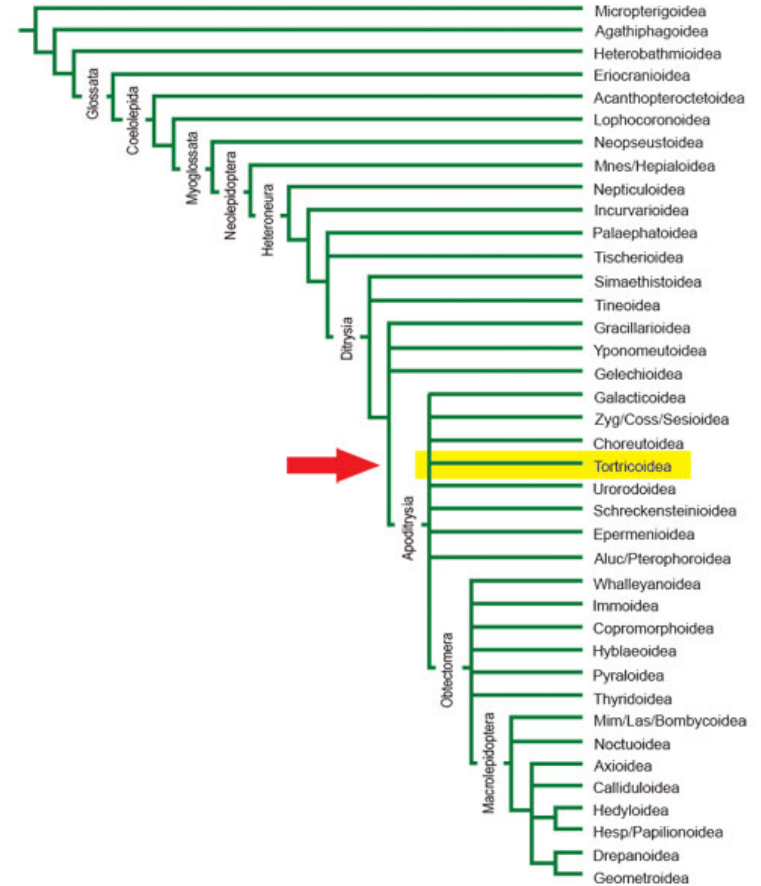
Tortricioidea: 687 / 10,300 total described = 6.5%

Noctuoidea: 1034 / 70,000 total described = 1.5%

Tortricidae overview

The family Tortricidae

- Superfamily Tortricoidea 2nd most diverse in the microlepidoptera
- 3 subfamilies: Tortricinae, Olethreutinae, Chlidanotinae
- Larvae are often referred to as “leafrollers”
- Phylogenetic position in the order is uncertain



Tortricidae overview

Tortricinae

Tortricini
Cochylini
Cnephasiini
~~Euliini~~
Schoenotenini
Sparganothini
Atteriini
Archipini*
Epitymbiini
Ceracini
Phricanthini



Olethreutinae

Microcorsini
~~Bactrini~~
Gatesclarkeanini
Olethreutini
Enarmoniini
Eucosmini
Grapholitini*



Chlidanotinae

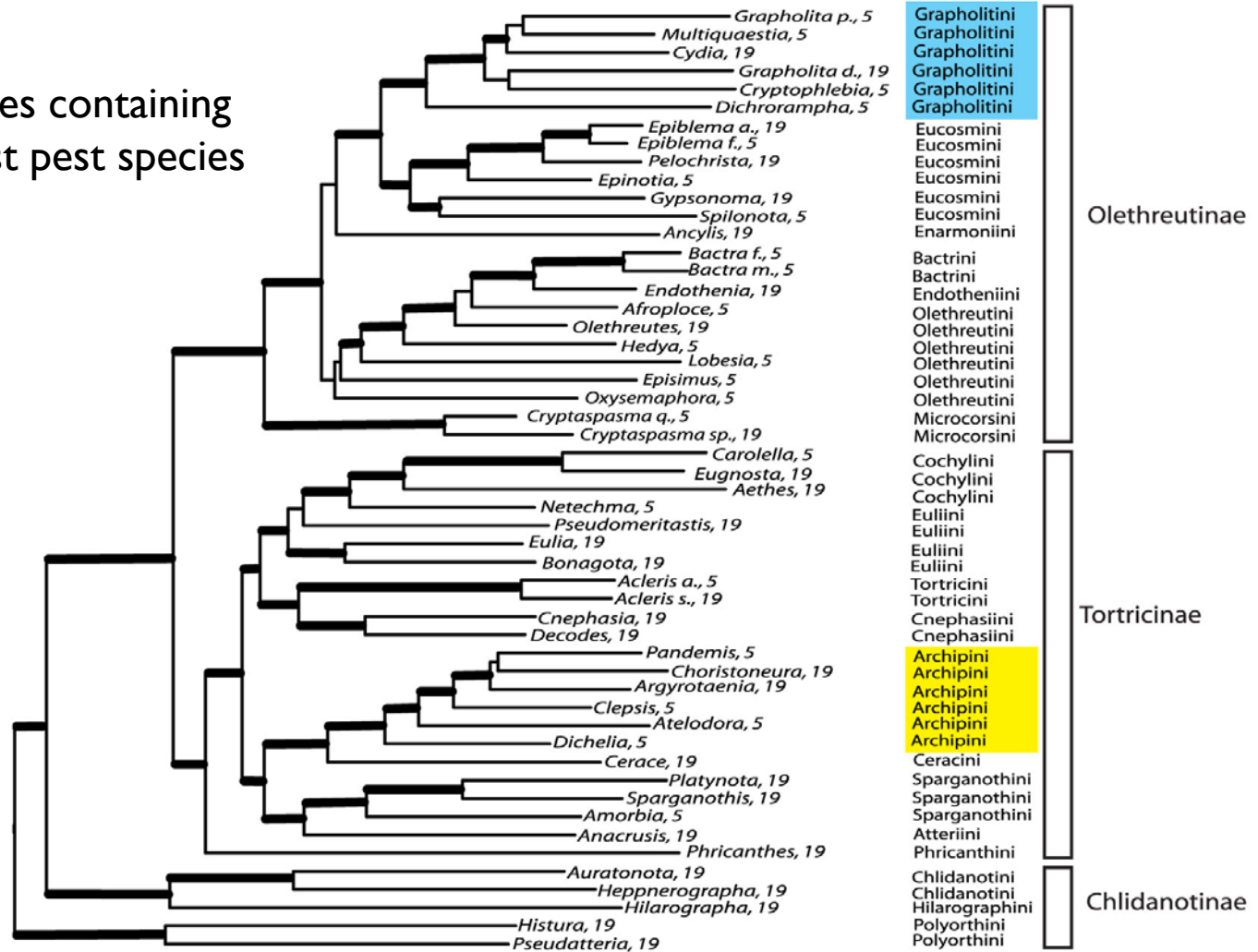
Chlidanotini
Hilarographini
Polyorthini



* contains the most important pest species

Tortricidae overview

Tribes containing
most pest species



(Adapted from Regier et al. 2012, Figure 4)

Tortricidae overview

Feeding habits of “leaf-rollers”

- Leaf-rollers
- Gall-makers
- Root-borers
- Fruit-borers
- Seed-predators
- Flower-feeders
- Tip-tiers
- Detritus feeders
- Leaf litter, inquilines in galls, and predators



Few specialists: *Phricanthini* (Dilleniaceae), *Epitymbiini* (leaf-litter of Myrtaceae), *Arotrophora* (Proteaceae), *Bactra* (*Cyperus*, *Scirpus*, *Typha*), *Cochylini* (Asteraceae with many exceptions)

Tortricidae morphology

Recognizing adult tortricids

Adult tortricids have:

- Chaetosemata (small sensory organ located above the compound eye)
- Porrect labial palpi (extending forward horizontally)
- Maxillary palpi small and inconspicuous
- All wing veins present, often separate

Adult tortricids don't have:

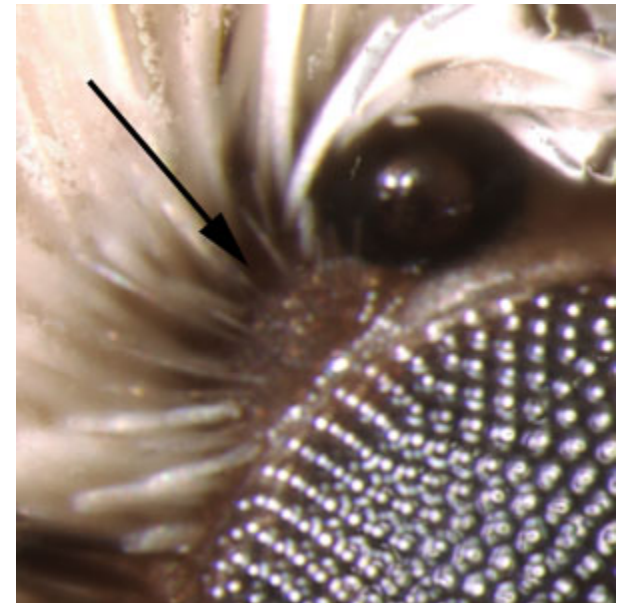
- Scaled proboscis (Pyraloidea)
- Tympana – thoracic or abdominal (Noctuoidea/ Pyraloidea/ Geometroidea)
- Conspicuous maxillary palpi (Pyraloidea)
- Rough-scaled head (Tineoidea)
- Upturned labial palpi that extend over head (Gelechioidea)

Tortricidae morphology

Recognizing adult tortricids – head



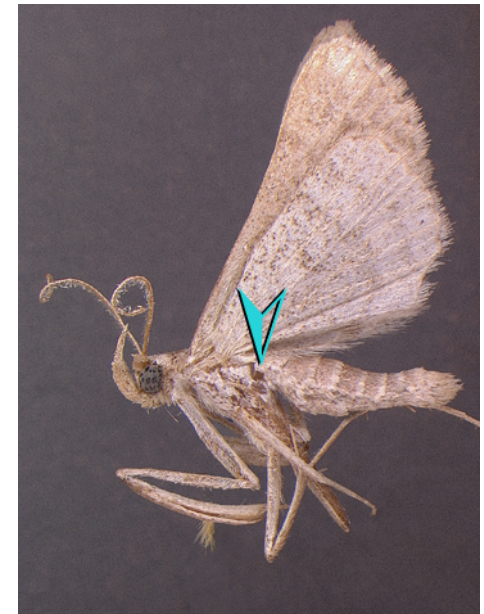
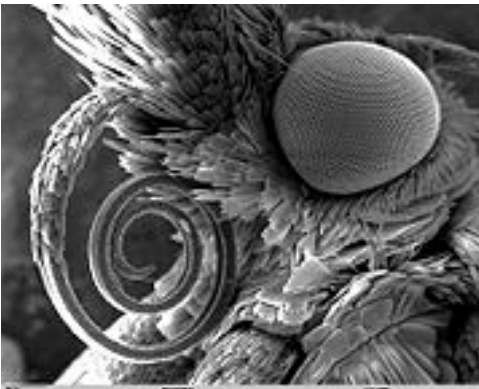
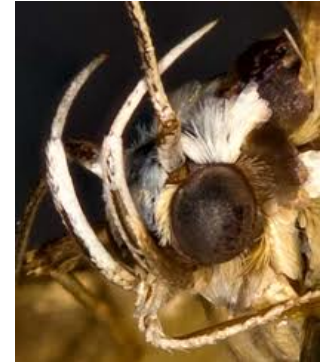
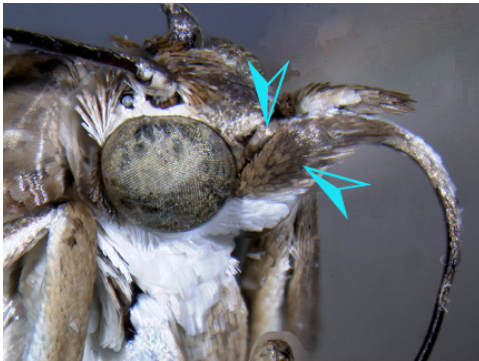
ch: chaetosemata; lp: labial palpi; oc: ocelli



Chaetosemata = “pin cushion”

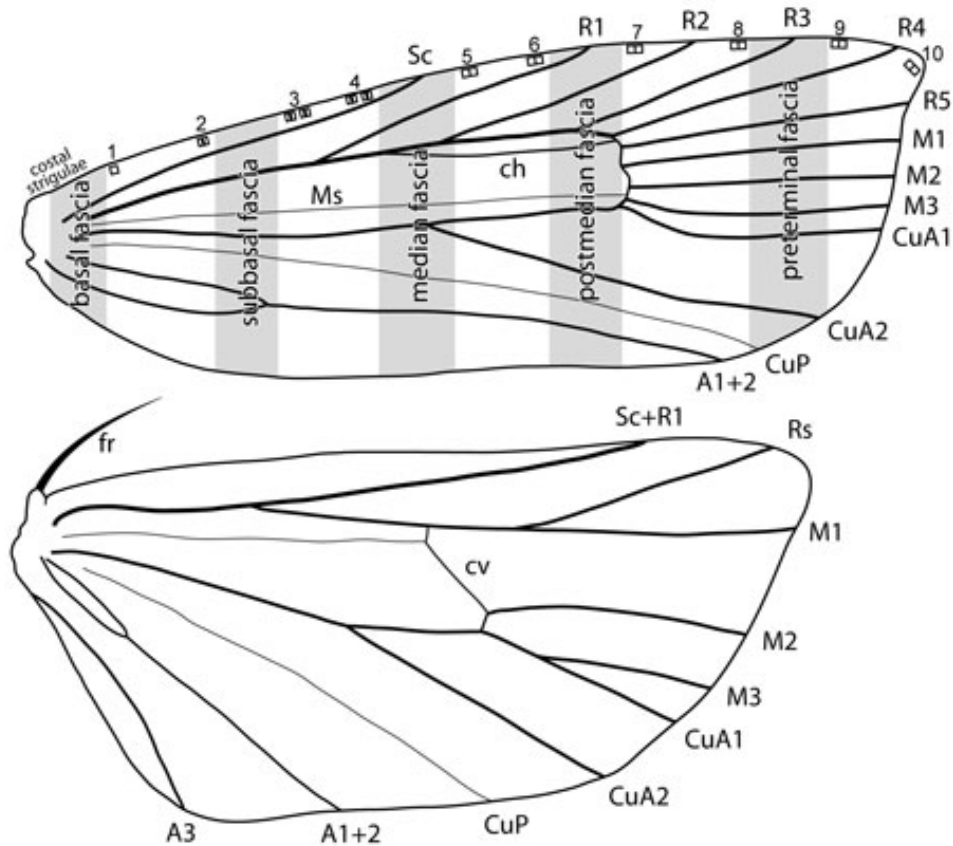
Tortricidae morphology

NOT Tortricidae



Tortricidae morphology

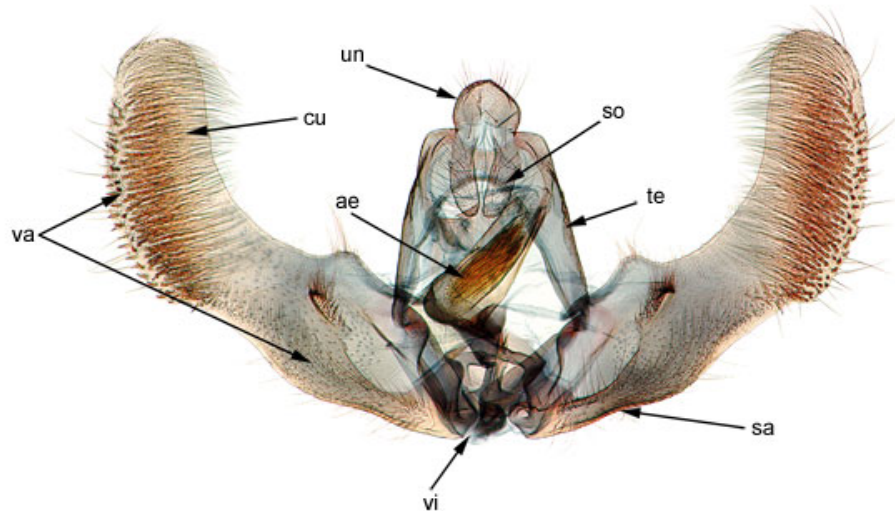
Recognizing adult tortricids – wing venation and major pattern elements



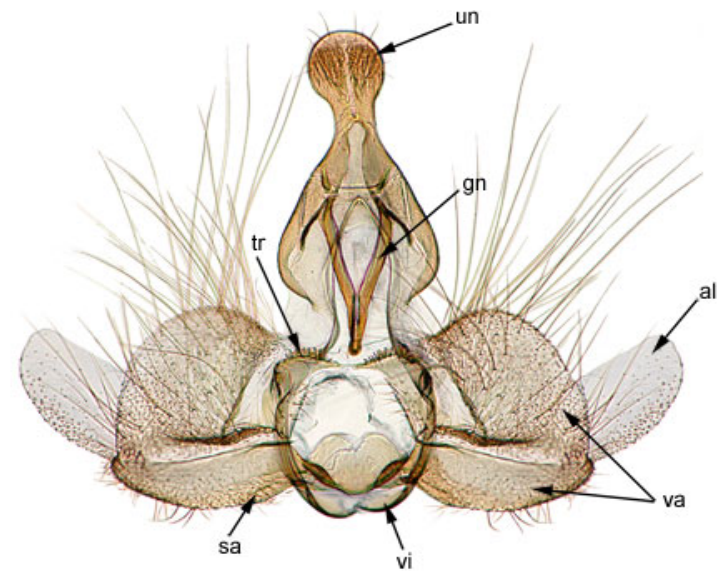
Tortricidae morphology

Recognizing adult tortricids – male genitalia

Olethreutinae (Eucosmini)



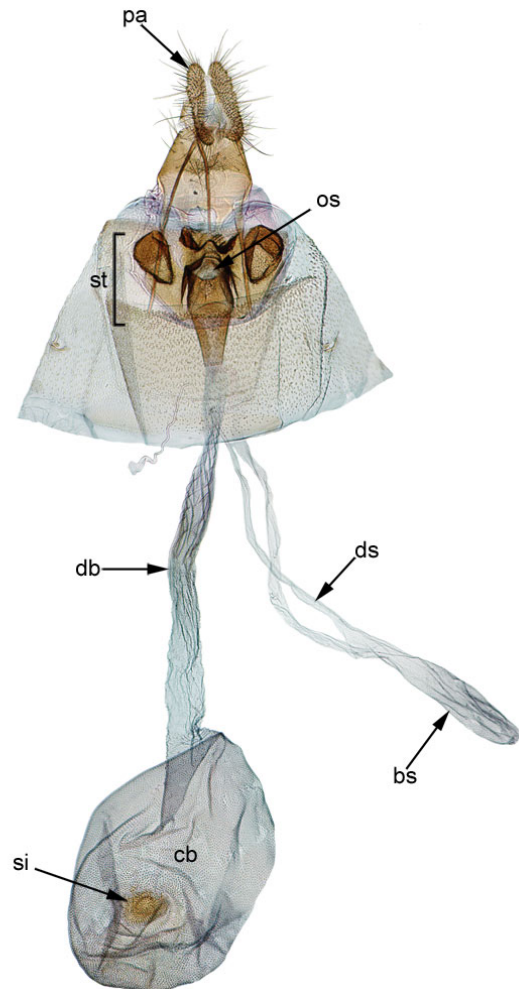
Tortricinae (Archipini)



ae: aedeagus (and cornuti); al: apical lobe; cu: cucullus; gn: gnathos; sa: sacculus; so: socii; tr: transtilla;
un: uncus; va: valva; vi: vinculum

Tortricidae morphology

Recognizing adult tortricids – female genitalia



Olethreutinae (Olethreutini)

bs: bulla seminalis; cb: corpus bursae; ds: ductus seminalis; db: ductus bursae; pa: papillae analis; os: ostium; si: signum; st: sterigma

Pyraloidea

- 2 families, ca. 15,000 described species
 - Crambidae
 - Pyralidae
- Proboscis scaled basally
- Maxillary palpi conspicuous
- Abdominal tympanal organs present
 - Different forms of tympani in each family
- Contains many pest species
 - Stored product pests, wax moth, cone worms, pod borers, pickleworm, etc.



Pyraloidea

○ Pyralidae

- forewing vein R5 stalked or fused with R3+4
- forewing without oval sclerotization costad of base of vein A1+2
- bullae tympani closed cephalad
- tympanum and conjunctivum in the same plane
- processus tympani absent
- praecinctorium absent
- accessory tympana absent
- male genitalia with uncus arms, (paired processes arising laterally from base of uncus)
- segment A8 of larvae almost always with sclerotized ring around base of SD I



○ Crambidae

- forewing vein R5 free
- forewing with oval sclerotization costad of base of vein A1+2
- bullae tympani open cephalad
- tympanum and conjunctivum lying at a blunt angle
- processus tympani present
- praecinctorium present
- accessory tympana present caudally of metacoxae
- male genitalia without uncus arms
- segment A8 of larvae without sclerotized ring around base of SD I



Pyraloidea

- Crambidae pest species

- *Chilo* spp.
- *Duponchelia fovealis*
- *Diatraea considerata*, *D. lineolata*
- *Maruca vitrata*
- *Ostrinia* spp.
- *Diaphania nitidalis*, *D. indica*
- *Leucinodes orbinalis*



M. vitrata



D. nitidalis



L. orbinalis



D. indica

Pyraloidea

- Pyralidae pest species

- *Galleria melonella*
- *Plodia interpunctella*
- *Cactoblastis cactorum*
- *Cadra cautella*
- *Ectomyelois ceratoniae*



C. cautella



E. ceratoniae



G. melonella



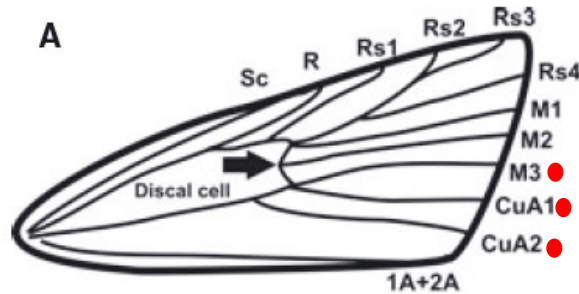
P. interpunctella

Noctuoidea

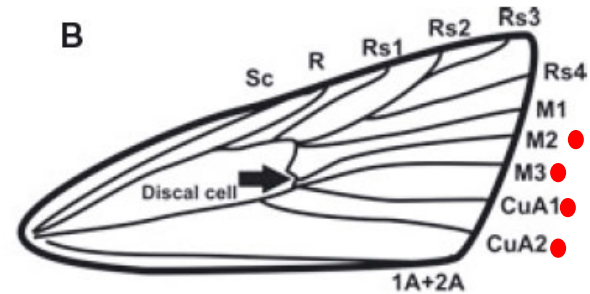
- 6 families, ca. 42,400 described species
- Currently recognized families:
 - Oenosandridae
 - Notodontidae
 - Erebidae
 - Lymantriinae
 - Arctiinae
 - Euteliidae
 - Nolidae
 - Noctuidae
- Thoracic tympanum
- Largest group of pest species
- Families separated by wing venation



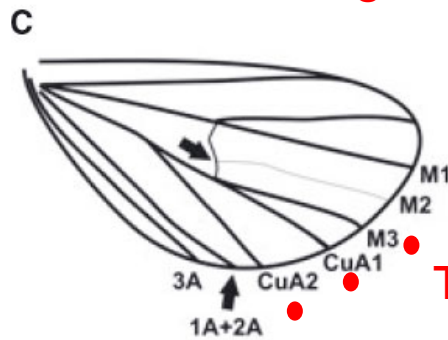
Noctuoidea



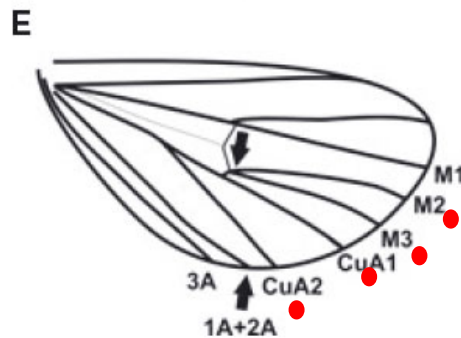
Trifid forewing



Quadrifid forewing



Trifine hindwings



Quadrifine hindwing

(CuA appears to branch into 3 or 4 veins depending on position of M2)

From Zahiri, R. et al. 2011. Molecular phylogenetics of Erebiidae (Lepidoptera, Noctuoidea). Sys. Entomol.

Noctuoidea

- Trifid forewing venation:
 - Doidae, Notodontidae
- Quadrifid forewing venation:
 - Quadrifine hindwing venation:
 - Erebidae, Nolidae, Euteliidae
 - Trifine hindwing venation:
 - Noctuidae

Noctuoidea

- Notodontidae
 - “Prominents”
 - Trifid forewing venation
 - Reduced mouthparts
 - Long, triangular forewings
 - Tips of tibial spurs have serrated edges
 - Swollen area of thorax above tympanum
 - Larvae are usually very colorful and distinctive, often with long tail-like projections formed by anal prolegs
 - Larvae rarely considered pests



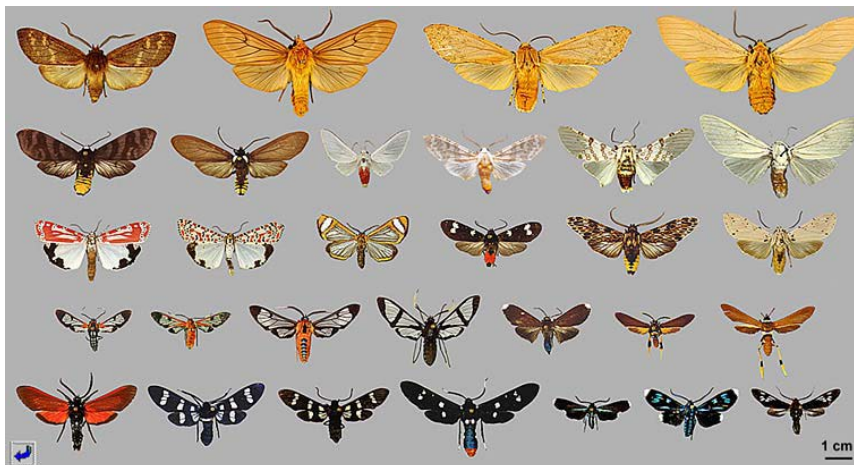
Noctuoidea

- Erebidae
 - Very diverse large family
 - Tiger moths (Arctiinae)
 - Tussock moths (Lymantriinae)
 - Quadrifid forewing, quadrifine hindwing venation
 - Medium to large nocturnal moths
 - Mouthparts variable
 - Usually long triangular forewings



Noctuoidea

- Erebidae
 - Arctiinae
 - Tiger moths
 - Formally a separate family
 - Adults capable of making sound
 - Females with dorsal pheromone gland
 - Adults with bright colored wings
 - Larvae often very “hairy”



Noctuoidea

- Erebidae
 - Lymantriinae
 - Tussock moths
 - Formally a separate family
 - Males have prominent plumose antennae
 - Adults extend forelegs forward when resting
 - Larvae have long hairs, often bright and tufted (=tussocks)
 - Larvae of some species serious pests (gypsy moth)



Noctuoidea

- Noctuidae
 - Includes many pest species
 - Quadrifid forewing, triline hindwing venation
 - Heavy bodied, forewings narrow, hindwings broad
 - Mouthparts variable
 - Mostly subdued colors
 - Tent-like or overlapping forewings when resting
 - Larvae commonly called cutworms (Noctuinae), loopers (Plusiinae)



Noctuoidea

- Noctuidae

- Plusiinae

- Pest species include:

- *Autographa* spp.
 - *Trichoplusia ni*
 - *Plusia* spp.

- Cuculliinae

- Pest species include:

- *Copitarsia* spp.

- Heliothinae

- Pest species include:

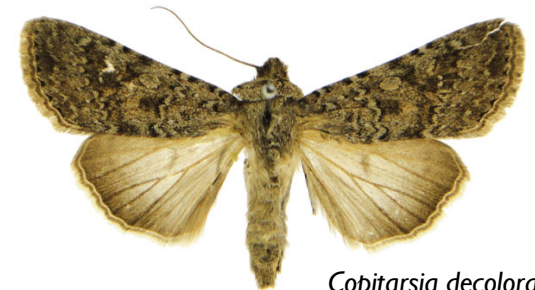
- *Helicoverpa* spp.
 - *Heliothis* spp.



Trichoplusia ni



Copitarsia corruda



Copitarsia decolora



Helicoverpa armigera



Helicoverpa assulta



Helicoverpa zea

Noctuoidea

- Noctuidae
 - Noctuinae
 - Pest species include:
 - *Spodoptera litura*
 - *Spodoptera littoralis*
 - Other *Spodoptera* spp.
 - *Mamestra brassicae*



Mamestra brassicae



Spodoptera litura



Spodoptera littoralis



Spodoptera exigua



Spodoptera frugiperda