

AG/BIO 345 - General Entomology - Fall 2013

Insect Orders

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Part I.

Introduction

1. Classification

Animals are classified into the animal kingdom. Each kingdom is then further divided into increasingly smaller groups based on similarities. The different levels of groups are named by the convention of taxonomists (scientists who study classifications). The standard groups in a typical complete classification of species are (the example is for a honey bee, *Apis mellifera* Linnaeus):

Kingdom Animalia
Phylum Arthropoda
Class Insecta
Order Hymenoptera
Family Apidae
Genus *Apis*
Species *Apis mellifera* Linnaeus

There are often additional groups used that are intermediate to the groups listed. These groups often use a prefix of super- (above) or sub- (below) to indicate the position of the new group in the above list. Thus, superfamily groups fall between order and family while subfamily groups fall between family and genus. An insect name is complete if the genus, species and author names are given because of the rules that govern taxonomy. The author is the person who first described the species as new to science.

2. Terminology, Classification and Use of Scientific Names

No capital letters are used in common names unless they contain a proper noun. Common names are written as two words if the species actually belongs to that classification, e.g., honey bee, or as one word if not within the classification, e.g., sawfly is not in Diptera, the order containing true flies.

Scientific names (genus, species and subspecies) are italicized or underlined with the genus (first) name capitalized. Names of the authors of species follow. These names are in parentheses if the classification of the species has changed since it was described.

Insects belong to a larger group called Arthropoda which includes all animals with segmented legs, segmented bodies and exoskeletons. The phylum Arthropoda includes: spiders, ticks, mites, centipedes, millipedes, shrimps, lobsters, and many other organisms. Entomology is concerned primarily with the study of two classes belonging to:

- Class Hexapoda or Insecta - (insects)
- Class Arachnida - (spiders, ticks, mites, scorpions, and relatives)

However, some other arthropod classes like Diplopoda (millipedes) and Chilopoda (centipedes) are often considered by entomologists. Even a few non-arthropod groups like snails and slugs (Phylum - Mollusca) are sometimes referred to entomologists.

3. Class Hexapoda (Insecta) Insect Characteristics

Most adult insects have the following characteristics:

1. A body divided into three parts (head, thorax and abdomen)

2. Three pairs of legs
3. Usually one pair of antennae and a pair of compound eyes (a few exceptions to these characteristics are found)
4. Usually two pairs of wings (absent in many insects such as lice, fleas, ants; flies have one pair of wings)

4. Insect Orders - Introduction

The Class Hexapoda is generally studied under a classification system with approximately 30 orders. Many of these are of minor importance and are studied only from the standpoint of scientific interest. Considered here are some of the more important orders which are likely to be encountered. Many taxonomists disagree on the number of orders and their names. Thus, this scheme will often vary with different authors.

5. List of Insect Orders Studied in AG/BIO 345

Orders shown in **bold face** will be covered. Other orders either do not occur on Guam or are unlikely to be encountered. This taxonomy comes from **ITIS** and it is sorted in alphabetic order.

Kingdom: Animalia

Phylum: Arthropoda

Subphylum: Hexapoda

Class: Entognatha

Order: Collembola

Order: Diplura

Order: Protura

Class: Insecta

Subclass: Archaeognatha

Order: Archaeognatha

Subclass: Dicondylia

Order: Zygentoma

Subclass: Pterygota

Infraclass: Neoptera

Order: Coleoptera

Order: Dermaptera

Order: Dictyoptera

Order: Diptera

Order: Embiidina

Order: Grylloblattodea

Order: Hemiptera

Order: Hymenoptera

Order: Isoptera

Order: Lepidoptera

Order: Mantophasmatodea

Order: Mecoptera

Order: Orthoptera

Order: Phasmatodea

Order: Phthiraptera

Order: Plecoptera

Order: Psocoptera

Order: Siphonaptera

Order: Strepsiptera

Order: Thysanoptera

Order: Trichoptera

Order: Zoraptera

Superorder: Neuropterida

Order: Megaloptera

Order: Neuroptera

Order: Raphidioptera

Infraclass: Palaeoptera

Order: Ephemeroptera

Order: Odonata

Part II.

Insect Orders with a Complete Life Cycle

Conventionally, insect orders are studied from those which are considered to be the most primitive, progressing through those which are more advanced (flies, moths, bees, and beetles). I prefer to go in the opposite order, because the more advanced orders are more commonly encountered and these will be more familiar to you.

6. Coleoptera (Beetles)

coleo, sheath, *ptera*, wings

6.1. Characteristics

Based on <http://insects.tamu.edu/fieldguide/orders/coleoptera.html>

The largest order by number of species is Coleoptera. One in five living animal species is a beetle.

Coleoptera usually have two pairs of wings. The front pair of wings, called elytra, are thick and form a hard shell over the abdomen of the most beetles. Elytra meet in a straight line down the middle of the back. Some have short elytra and may be confused with earwigs but the caudal appendages on beetles are segmented rather a single piece like in earwigs. The hind wings are membranous and are folded under the front wings when at rest. Mouthparts are formed for chewing in adult beetles and immatures but some are modified considerable for piercing or pollen feeding. Weevils may have a snout which can be long and slender giving them the appearance of a sucking mouth but mandibles are at the end.

Immatures can have six legs or be legless almost maggot-like, and generally are called grubs. They come in many sizes and shapes and include the wireworms, white grubs and many others. Some are more worm-like. They generally short antennae, and a distant head capsule. Prolegs are never present but there may be extensions or hooks on the end of the abdomen.

Coleoptera is the largest order of insects, including about 1/4 of all known insects with about 280,000 different species in the world. Food habits are varied. Some feed on living plants; some are predaceous; some are scavengers; and others bore in wood. This order includes some of the best known and most important of our insect enemies. Most of the members are terrestrial, but some are aquatic. Perhaps the most famous members of this group are lady beetles, June beetles and the cotton boll weevil.

Beetles go through complete metamorphosis. They are microscopic to over 2 inches long.

6.2. Common Coleoptera on Guam

6.2.1. Family Cerambycidae, longhorn beetles

[images](#) [text](#)

Dihammus marianarum [images](#) [text](#)

6.2.2. Family Chrysomelidae, leaf beetles

[images](#) [text](#)

Brontispa palauensis, coconut leaf beetle [images](#) [text](#)

Aulacophora similis, orange pumpkin beetle [images](#) [text](#)

6.2.3. Family Coccinellidae, lady beetles

[images](#) [text](#)

Henosepilachna vigintiseipunctata, Philippine lady beetle [images](#) [text](#)

6.2.4. Family Curculionidae, weevils

[images](#) [text](#)

Rhabdoscelus obscurus, New Guinea sugarcane weevil [images](#) [text](#)

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[images](#) [text](#)

Gonocephalum addpressiforme [images](#) [text](#)

6.2.10. Family Staphylinidae, rove beetles

[images](#) [text](#)

7. Hymenoptera (Ants, Bees, Wasps, Parasitic wasps)

hymeno, god of marriage (referring to the union of front and hind wings by means of hamuli),
ptera, wings

7.1. Characteristics

From the human standpoint, this order is probably the most beneficial in the entire insect class. It contains a great many species that are of value as parasites or predators of insect pests, and it contains the most important pollinators of plants, the bees. The Hymenoptera are a very interesting group in terms of their biology, for they exhibit a great diversity of habits and complexity of social behavior culminating in the social organization of wasps, bees, and ants.

The winged members of this order have four membranous wings. The hind wings are smaller than the front wings and have a row of tiny hooks called **hamuli** on their anterior margin by which the hind wing attaches to a fold on the posterior edge of the front wing. The wings contain relatively few veins, and in some minute forms, there are no veins at all. The mouth parts are mandibulate, but in many, especially the bees, the labium and maxillae form a tongue-like structure through which liquid is taken. The antennae usually contain ten or more segments and are generally fairly long. The tarsi are usually five-segmented. The ovipositor is usually well developed. In some cases it is modified into a sting, which functions as an organ of offense and defense. Because the stinging organ evolved from an egg-laying organ, only females can sting.

Sex in most Hymenoptera is controlled by the fertilization of the egg. Fertilized eggs develop into females, and unfertilized eggs usually develop into males.

Hymenoptera have **complete metamorphosis** (egg, larva, pupa, adult). Larvae are called **grubs**. Many Hymenoptera are parasitoids of other insects. Eggs are laid within the body of a host insect and the grub feeds internally, eventually killing its host. They are called **parasitoids** to differentiate them from parasites which usually do not kill their hosts. Many hymenopterous parasites have been used for biological control of insect pests.

7.2. Common Hymenoptera on Guam

- Boonie Bee

8. Lepidoptera (Moths, butterflies)

lepid, scale, *ptera*, wings

8.1. Characteristics

This is a large order of insects and one of the best known. It contains some of our most important pests; such as the bollworm, armyworms, cutworms, codling moth, clothes moth and cabbageworm.

Lepidoptera usually have four well developed wings covered with overlapping scales as adults. A few adult Lepidoptera have reduced wings or none at all. Mouthparts of the adults are formed for sucking but some have reduced or non-functional mouthparts.

Butterflies generally fly during the day and can be recognized by the clubbed antennae. Skippers are much like butterflies but have the end of the antennae hooked rather than clubbed. Moths generally fly at night but there are exceptions. Moths have antennae that are linear or feathery but not clubbed.

Lepidoptera have **complete metamorphosis** (egg, larva, pupa, adult). Larvae are called **caterpillars**. Most caterpillars feed on plants and many are agricultural pests. The 'naked' pupa of a lepidopteran is called a **chrysalis**. Some groups, such as the silk moths, pupate within a protective layer of silk called a **cocoon**.

Immature stages (larvae) are known as caterpillars. Names like cutworms, armyworms, hornworms and many others apply to groups of caterpillars that may be related taxonomically or by similar biology. Their mouthparts are formed for chewing. The well developed head capsule has short antennae. Almost all have crochets (small hooks) on the prolegs even if the prolegs are reduced. These hooks help the caterpillar hold onto the substrate. Caterpillars feed on foliage, stored products, linens. Some are leafminers and a few are borers in herbaceous and woody plants.

Most Lepidoptera feed on leaves of plants in the larval stage. Some caterpillars bore in plant stems, others are leafminers and a few are even predators. All Lepidoptera have complete metamorphosis. Microlepidoptera are often under 1/4 inch, the largest moths and butterflies are over 3 inches.

8.2. Common Lepidoptera on Guam

- Oleander hawk moth

9. Diptera (Flies)

di, two, *ptera*, wings

9.1. Characteristics

Diptera are usually winged, but have only one pair of wings with few veins. Hind wings are represented by a pair of slender, club-shaped structures called halteres. A few forms are wingless as adults, primarily parasites. Mouthparts are formed for sucking or piercing and sucking.

Fly larvae are entirely different from the adults and are usually found in different habitats. Immatures usually are known as maggots. Immature Diptera have mouthparts, modified for sucking or for piercing and sucking. Primitive flies including midges and mosquitoes which have head capsules but most immature flies have poorly formed heads. Many fly larvae are associated with aquatic habitats or very moist areas with organic matter. Some are internal parasites of mammals. Larvae may be thin and elongate or thin and wide. Some are elaborately ornamented.

True flies or Diptera occur in many shapes and sizes and are a very important group. The order includes forms that are parasitic, predaceous and others that live on either living or dead plant or animal material. Some members of the order cause a great amount of damage to crops. Many harmful flies spread diseases, such as mosquitoes that carry yellow fever and malaria, and are responsible for millions of human deaths. This is one of the most important orders from the standpoint of human health because of the species that carry diseases.

Flies have complete metamorphosis. Flies can be very small to over 1 inch in length.

9.2. Common Diptera on Guam

- Black soldier fly

10. Siphonaptera (fleas)

siphon, tube, *aptera*, wingless

10.1. Characteristics

- Complete metamorphosis
- Immatures with chewing mouthparts, feed in nests of animals
- Adults with piercing and sucking mouthparts, feed on blood
- Secondarily wingless
- A serious pest and a nuisance

10.2. Common Siphonaptera on Guam

- Cat flea

11. Neuroptera (lacewings, ant lions)

neuro, nerve (referring to the wing veins, *ptera*, wings)

11.1. Characteristics

- Complete metamorphosis
- Adults and immatures have chewing mouthparts
- Some are very important biological control organisms

11.2. Common Neuroptera on Guam

- Ant lion

Part III.

Orders of Insects with an Incomplete Life Cycle

12. Orthoptera (grasshoppers, crickets, katydids, mantids, stick insects, cockroaches)

ortho straight, *ptera* wings

12.1. Characteristics

- Incomplete metamorphosis
- Adults and immatures have chewing mouthparts
- Some are very important agricultural pests
- Many have hind legs modified for hopping
- Many communicate acoustically
- Many have cerci

12.2. Notes on Taxonomy

In your field guide, Orthoptera includes the following groups which have been split out into their own orders. To keep things simple, we will use the classification in your field guide for this course.

- mantids - Order Phasmida
- stick insects - Order Mantodea
- cockroaches - Order Blattaria

12.3. Common and Interesting Orthoptera on Guam

- large grasshopper -
- large katydid -
- large endemic katydid - *Salomona guamensis*
- stick insect - *Acanthograeffea denticulata*

13. Hemiptera (Hemiptera plus Homoptera) (true bugs, aphids, scale insects, whiteflies, psyllids, mealybugs, cicadas)

hemi half, *ptera* wing

13.1. Characteristics

- all have piercing-sucking mouthparts
- the suborder Heteroptera has wings which have a leather front part and a membranous back part
- the suborder Homoptera contains a very diverse group of insect which feed by sucking sap out of plants. Many of these live under a wax secretion or scale, and they often look nothing like insects.

13.2. Notes on Taxonomy

In your field guide, there are two related orders, Hemiptera and Homoptera. Homoptera has recently been joined with Hemiptera to make a very large and diverse order. The old Hemiptera are now a suborder called Heteroptera.

14. Isoptera (termites)

iso equal, *ptera* wing

14.1. Characteristics

- social insects which live in nest which they build
- each species has 3 or more casts: worker, soldier, king, queen

14.2. Notes on Taxonomy

Some modern taxonomist consider termites to be in the same order as roaches, Blattodea.

15. Odonata (dragonflies, damselflies)

odontos tooth

15.1. Characteristics

- all are predators
- immatures, called naiads, are aquatic. Naiads feed on aquatic insects, small fish, tadpoles, etc.
- adults feed on flying insects

15.2. Notes on Taxonomy

Odonata is divided into 2 suborders: Anisoptera, the dragonflies and Zygoptera, the damselflies.

16. Dermaptera (earwigs)

derma skin, *ptera* wing

16.1. Characteristics

- Earwigs are characterized by the cerci, or the pair of forceps-like pincers on their abdomen;
- Most earwigs are dorsoventrally flattened

17. Thysanoptera (thrips)

thysano fringe, *ptera* wings

17.1. Characteristics

- Incomplete metamorphosis
- Rasping-sucking mouthparts
- Some are very important agricultural pests
- Most phytophagous; some predaceous

18. Psocoptera (booklice, barklice)

psoco rub small, *ptera* wings

18.1. Characteristics

- Incomplete metamorphosis
- Chewing mouthparts
- Occasionally a problem in libraries

19. Anoplura (lice)

Anoplura comes from the words *anoplos*, which means unarmed, and *oura*, which means tail. This refers to the lack of cerci.

19.1. Characteristics

- Incomplete metamorphosis
- Piercing-sucking mouthparts
- Ectoparasites of warm-blooded animals; can transmit diseases

20. Thysanura (bristletails, silverfish, fire brats)

thysa fringe, *nura* tails

20.1. Characteristics

- Incomplete metamorphosis
- Chewing mouthparts
- 3 tail-like appendages at posterior end of body
- body covered in scales

21. Collembola (springtails)

coll glue, *embola* a bolt or wedge

21.1. Characteristics

- Incomplete metamorphosis
- Chewing mouthparts
- spring-like mechanism at posterior end of body
- very common in damp soil, decaying leaves, etc.
- very small insects