





Making an insect collection

- Important to document biodiversity.
- Allows for close detailed studied

Types of collection

- General
- Taxon-based
- Niche-based
- Habitat-based Plant or porchlight
- Donate your material to Museum or Universities.

**A number of
various
collection
methods**



Horntail wasps have tails longer than their bodies!



Anyone could be excused for feeling a little wary at the sight of the lengthy black tail on this colorful yellow and orange wasp.

And this was just one of several wasps with scary looking tails zipping around dipping their tails into a very old hackberry tree at Back Bay National Wildlife Refuge.

Even their name, horntail wasp, sounds formidable.

But not.

The female wasp's graceful, or menacing tail, depending on your perspective, appears to be a stinger, but it is really an organ, called an ovipositor, designed for laying eggs in wood bark.



Starting to do some Taxonomy



1. Determine if your specimen is an insect
2. Determine the order of insect
3. Make careful observation of insect's morphology
4. use a scientific identification key, and you will not find the correct identity.
5. Practice and Repeat
6. Focus on family level IDs
7. Don't try too hard to figure out what SPECIES

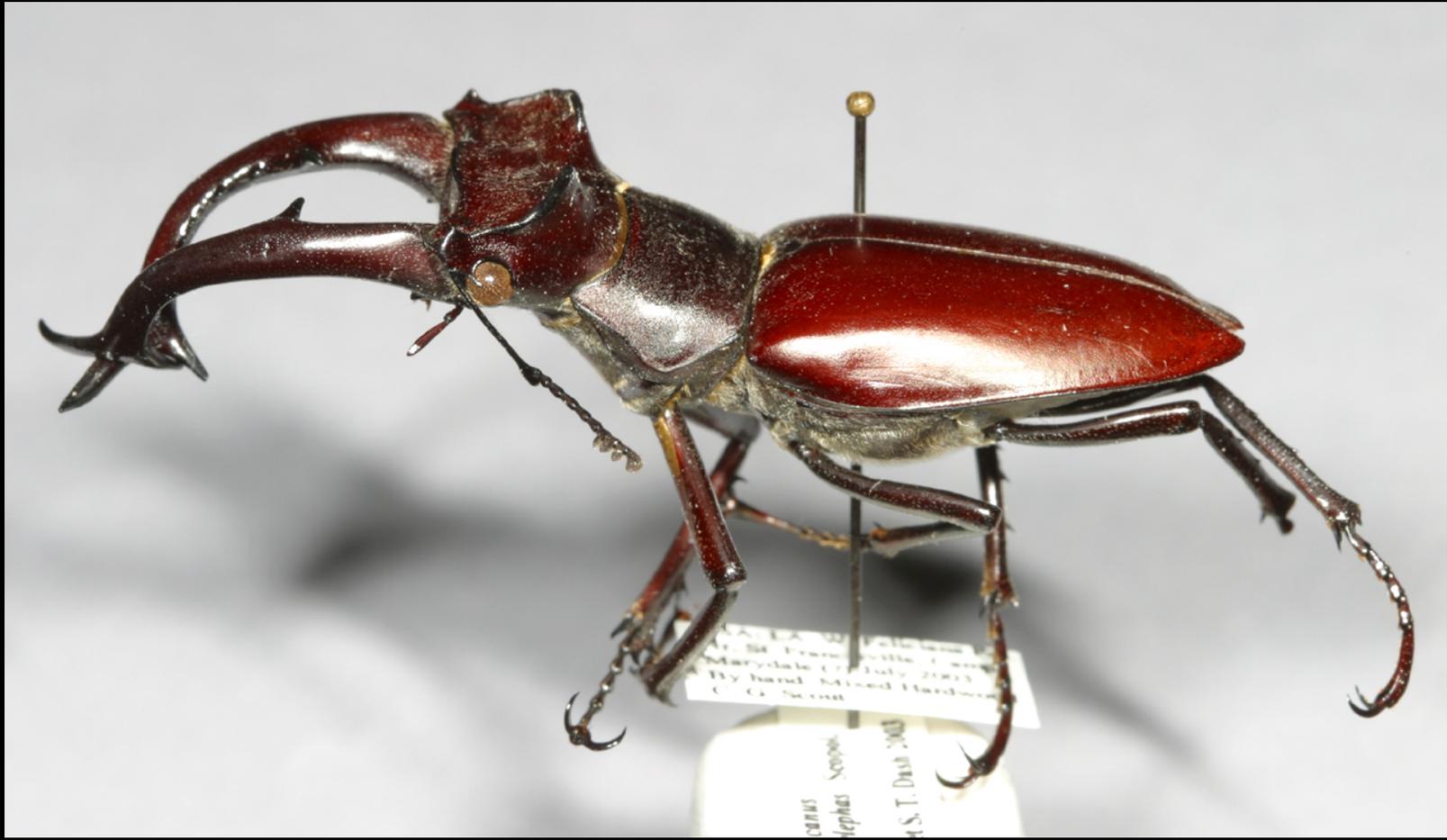












MAILED
At St Francisville, La.
Marydale Ct July 21st 1913
By hand Missed Hardware
C. G. Scott

canus Scop.
St. T. Dist. 2003

- Learning insect orders is fairly easy, however family level onward rely on deep details of morphology.
- Looking through field guides works well for some groups, but the biodiversity makes most guides too limited to be truly meaningful.
- To learn identification, we frequently most use a key
- When using a key, you will use a series of couplets (paired numbered statements which give two contrasting choices of characters states).

1 Scutum with a pair of paramedian longitudinal yellow stripes extending along almost its whole length. Metasomal pattern distinctive: queens with extremely reduced black markings tergum 2 of workers and males with an additional, discal yellow fascia (interrupted medially) in addition to apical fascia.....*V. squamosa*

1' Scutum black, sometimes with a pair of small yellow spots in posterior half. Metasoma always with well developed black pattern, tergum 2 lacking additional discal fascia.....2

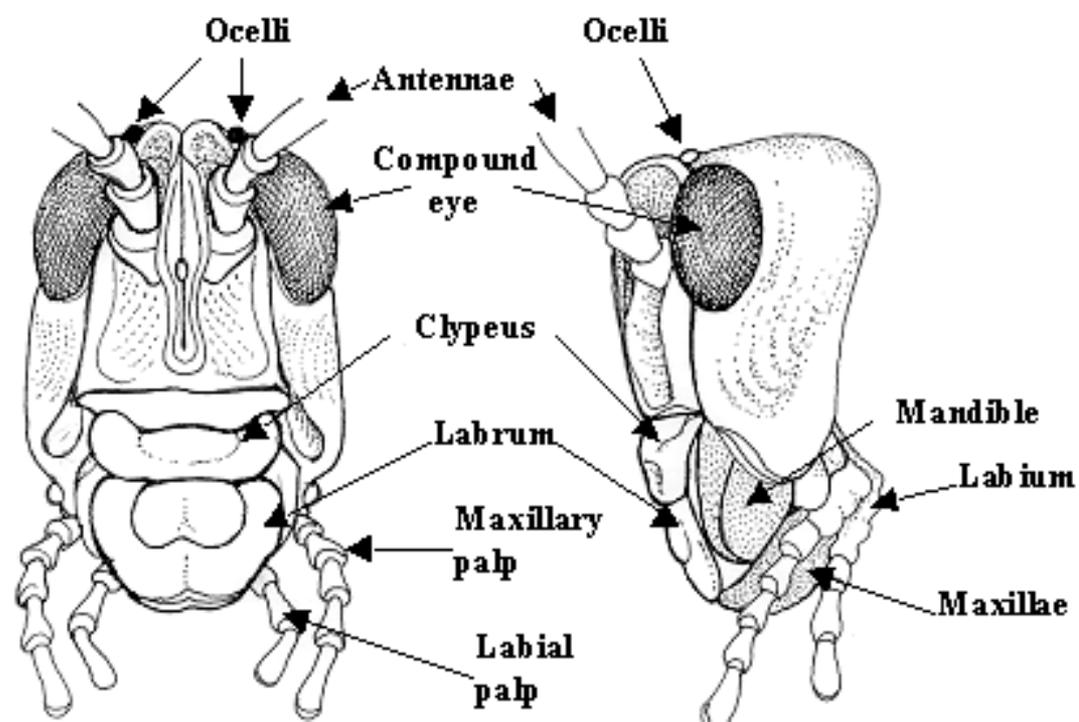
- The purpose of each statement (referred to as a lug, there are two lugs per couplet) is to divide and/or link groups. Think about what characters would separate the most groups at a time, what characters can be used to separate similar groups.



The **exoskeleton** is comprised of **sclerites**: hardened plates

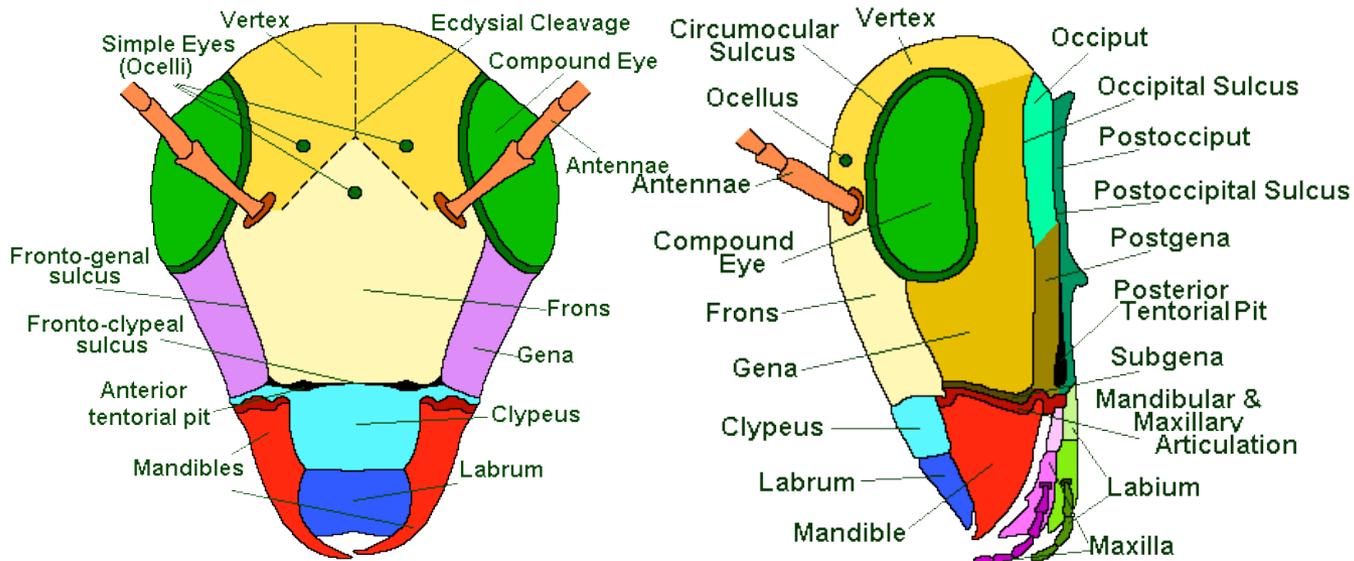
- **Tergites**: Dorsal plates
- **Sternites**: Ventral plates
- **Pleuron**: Lateral area, often membranous





The Insect Head (Frontal)

The Insect Head (Side View)



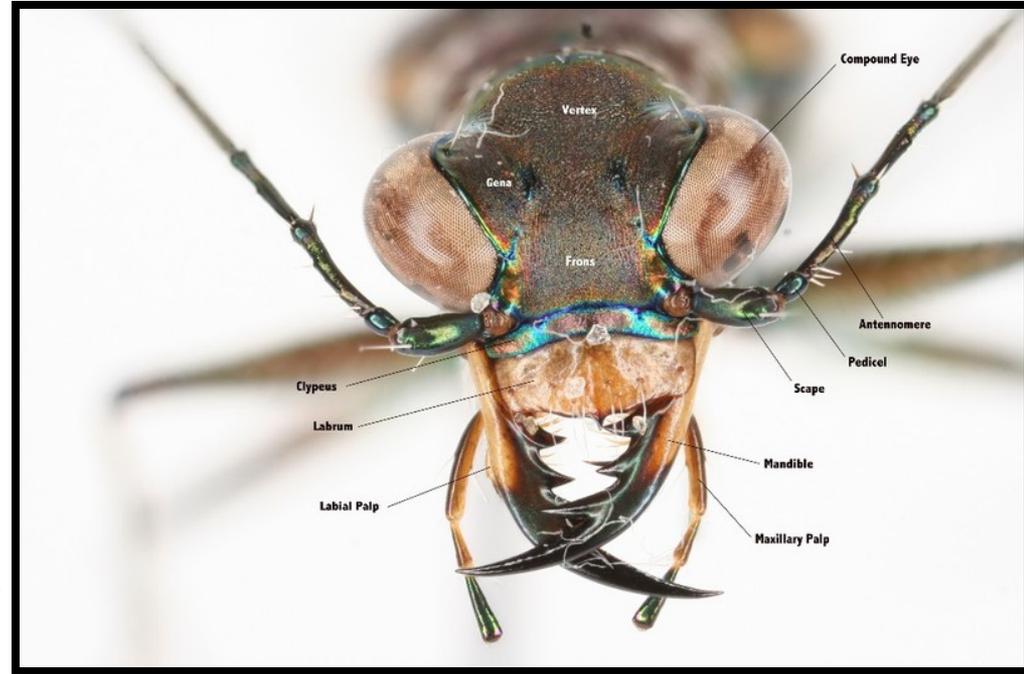
The insect head

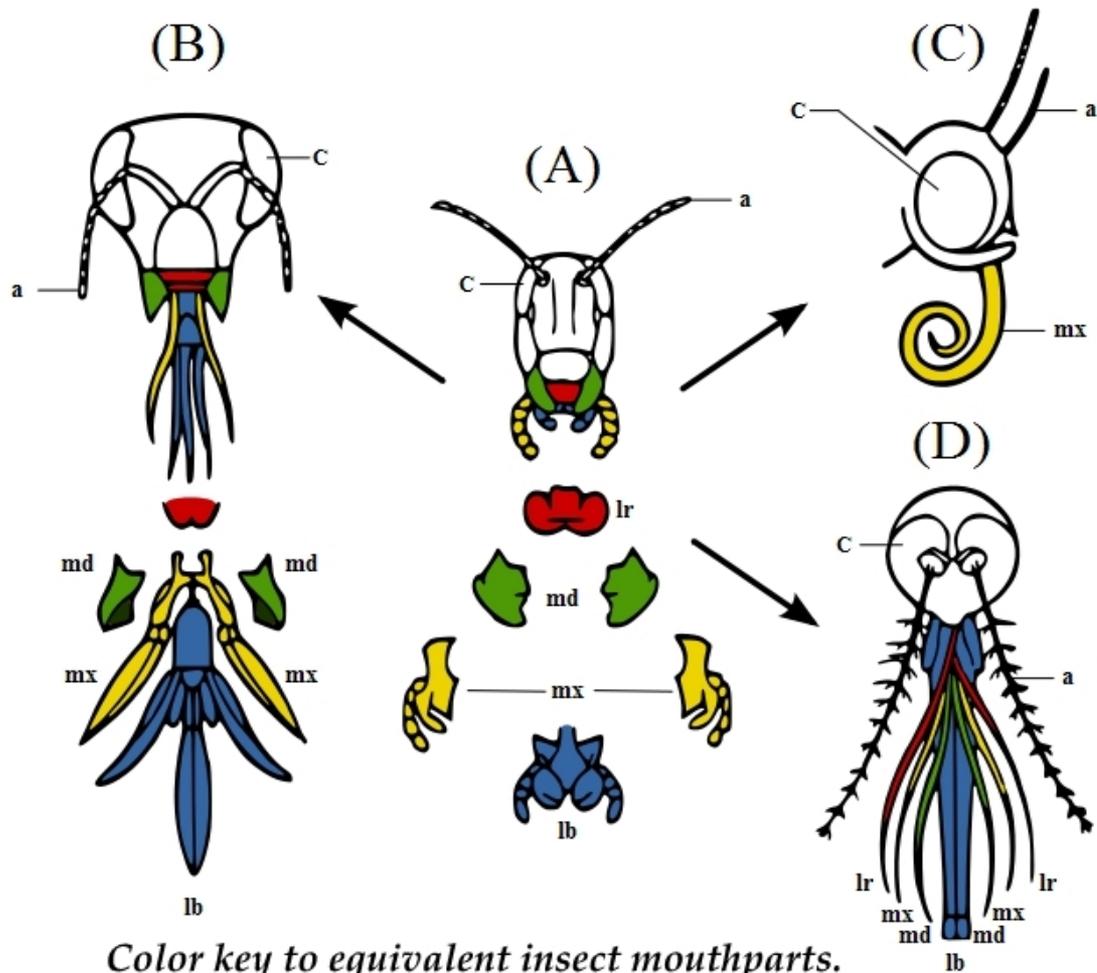
Mouthparts:

- **Labrum** (1) (Upper lip)
- **Mandibles** (2) (Jaws)
- **Maxillae** (2) (More jaws)
- **Labium** (1) (Lower lip)
- **Hypopharynx** (1)

(Tongue-like, bears openings of salivary ducts)

- **Labrum-epipharynx** (1) (Fleshy inner surface of labrum - sensory)





Color key to equivalent insect mouthparts.

A - grasshopper's cutting/chewing mouthparts

B - the bees lapping type

C - the siphoning type of moths and butterflies

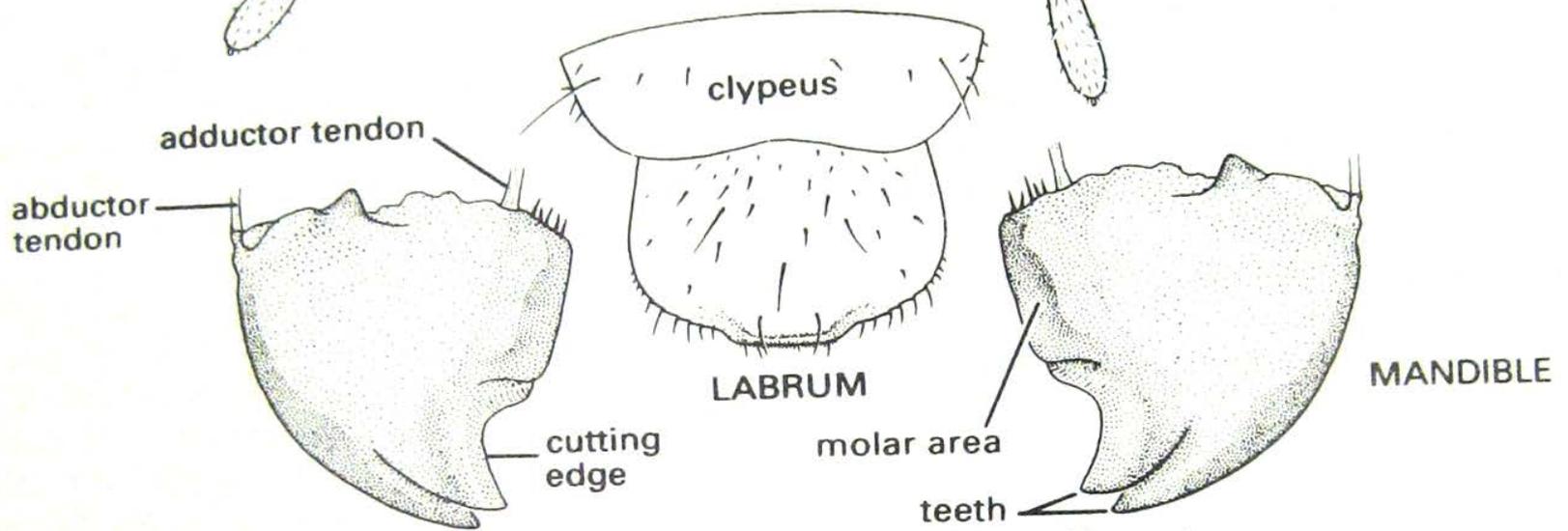
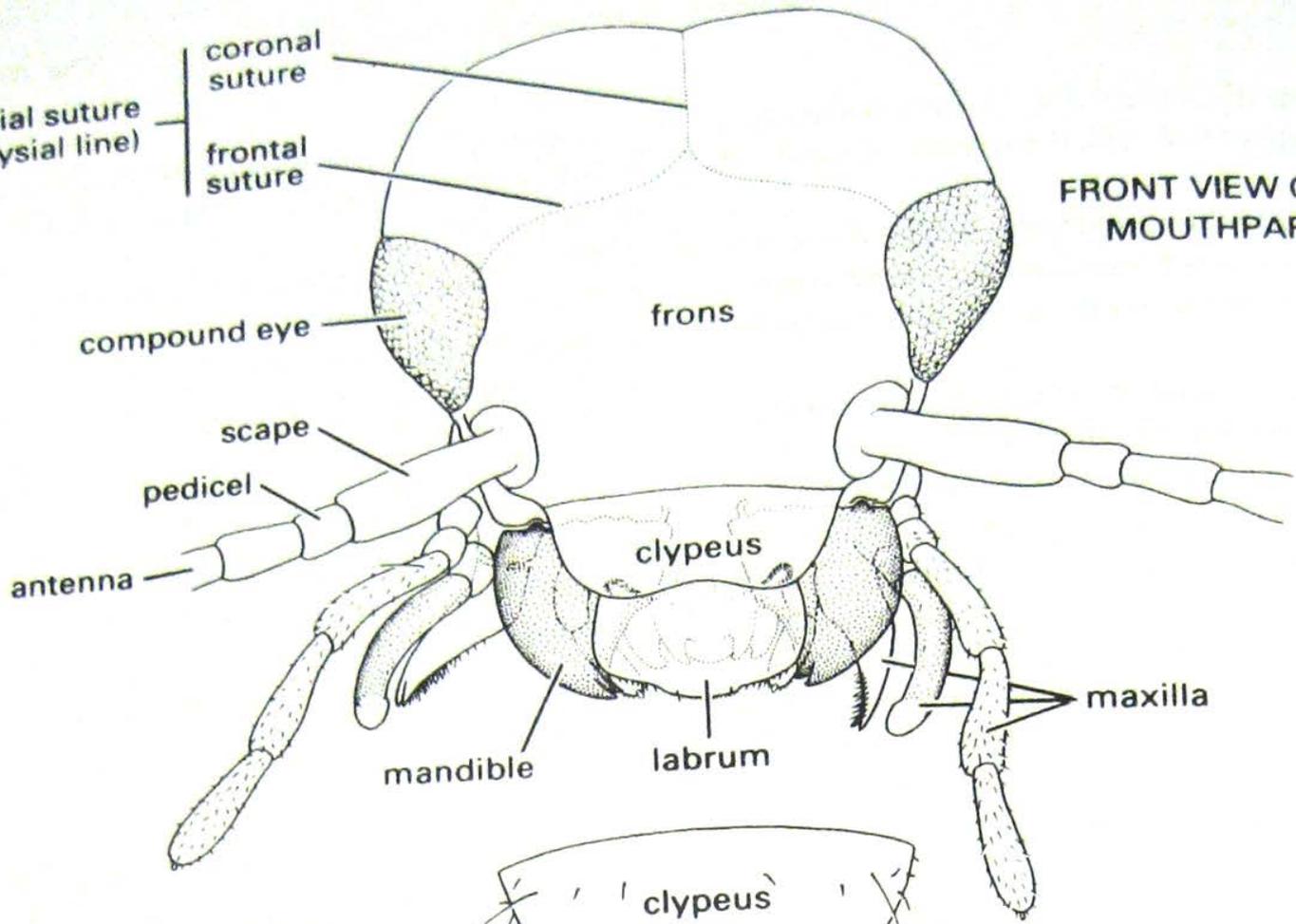
D- piercing type of the mosquito

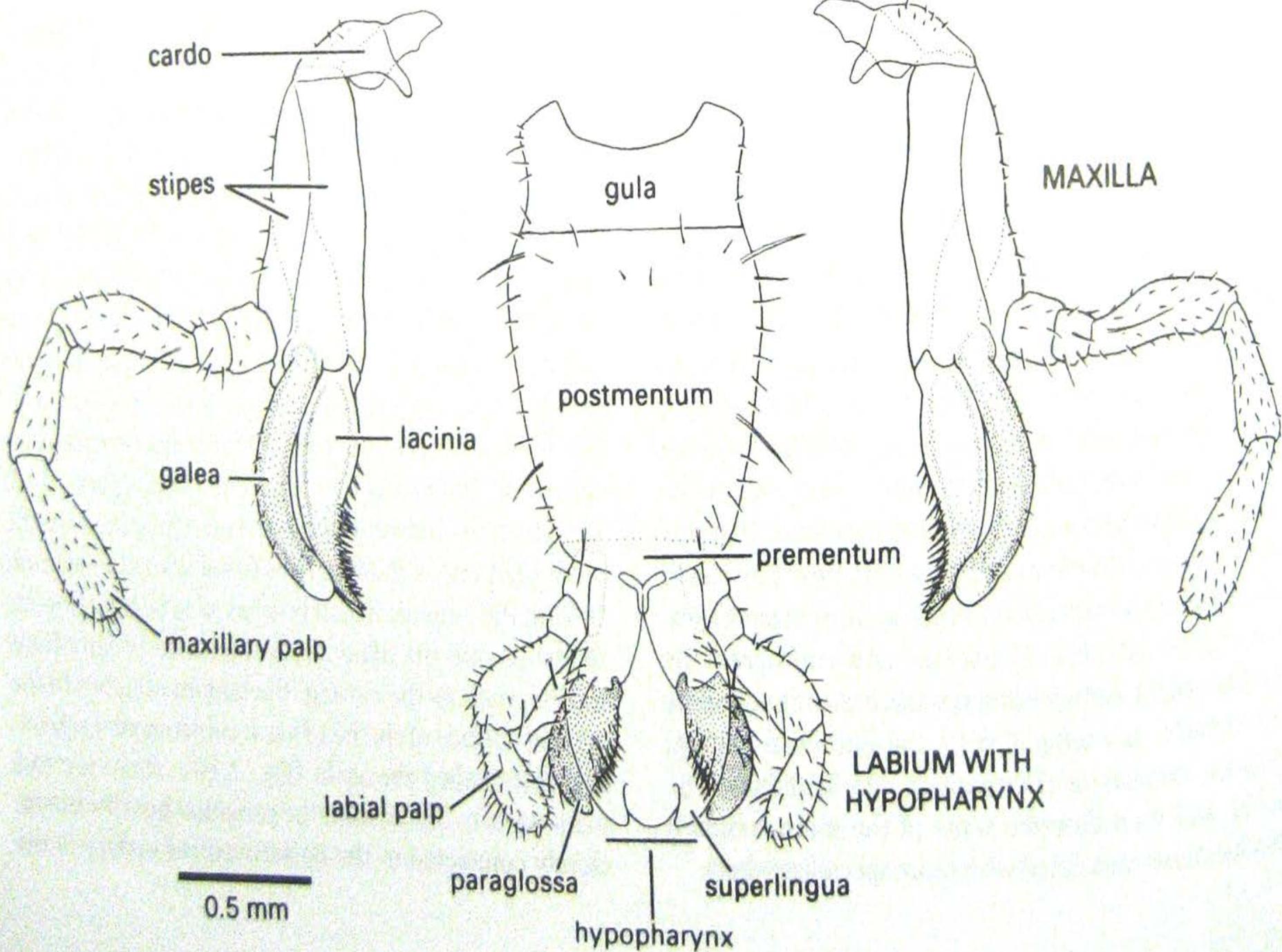
Legend: a, antennae; c, compound eye; lb, labium; lr, labrum; md, mandibles; mx, maxillae.

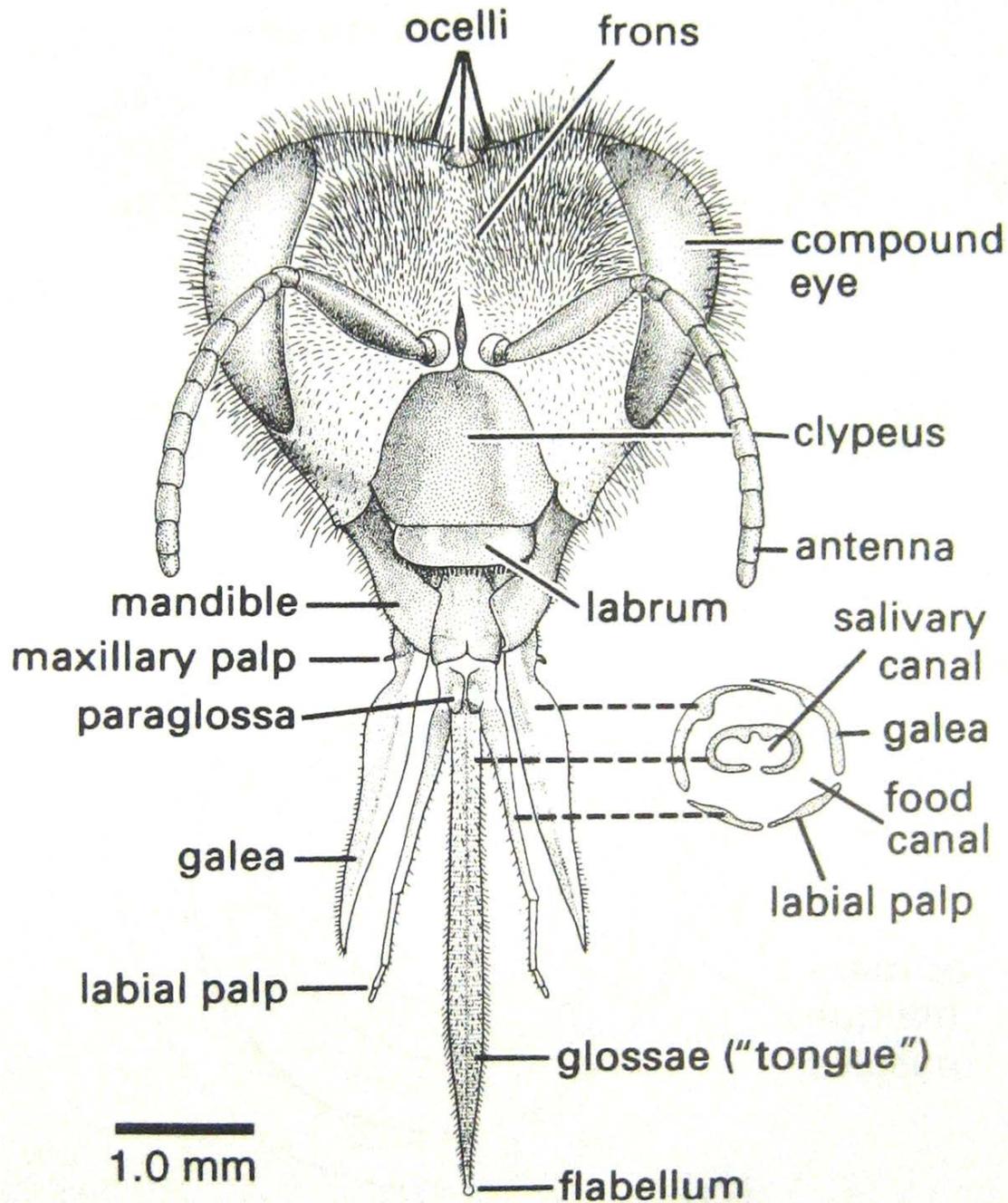
(Adapted from Wikipedia)

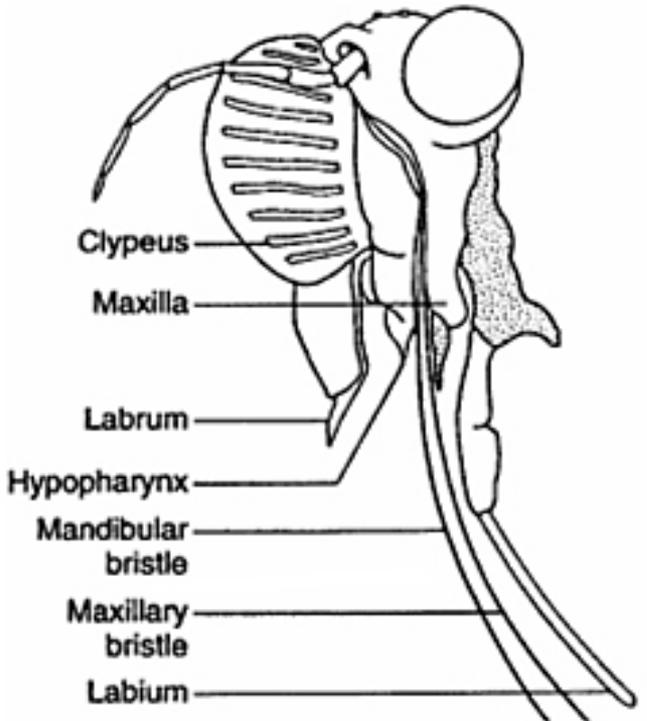
epicranial suture (an ecdysial line) — coronal suture — frontal suture

FRONT VIEW OF HEAD WITH MOUTHPARTS IN SITU





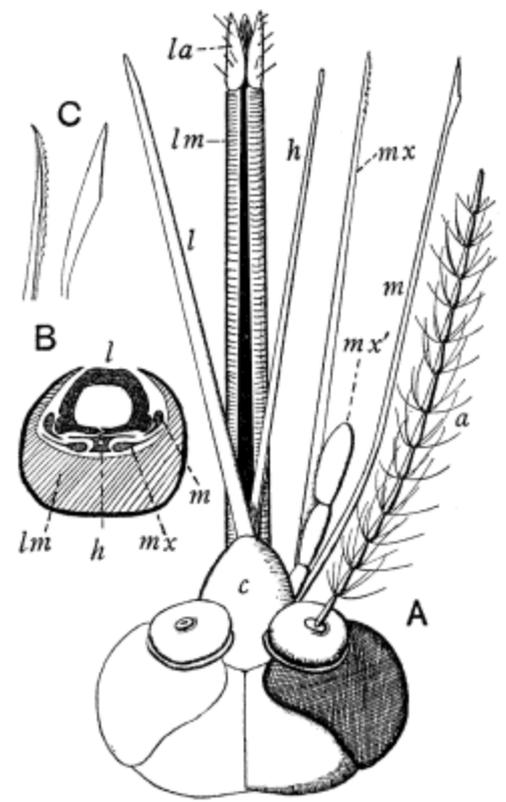




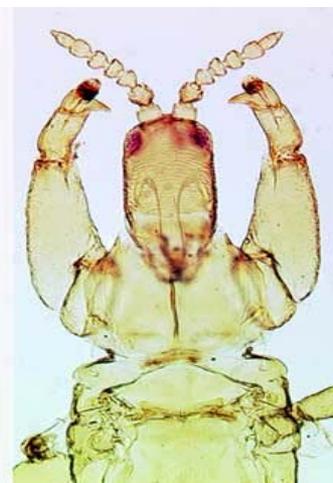
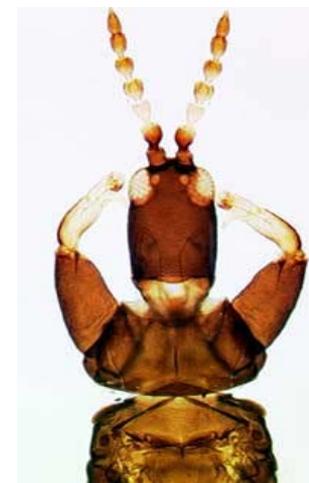
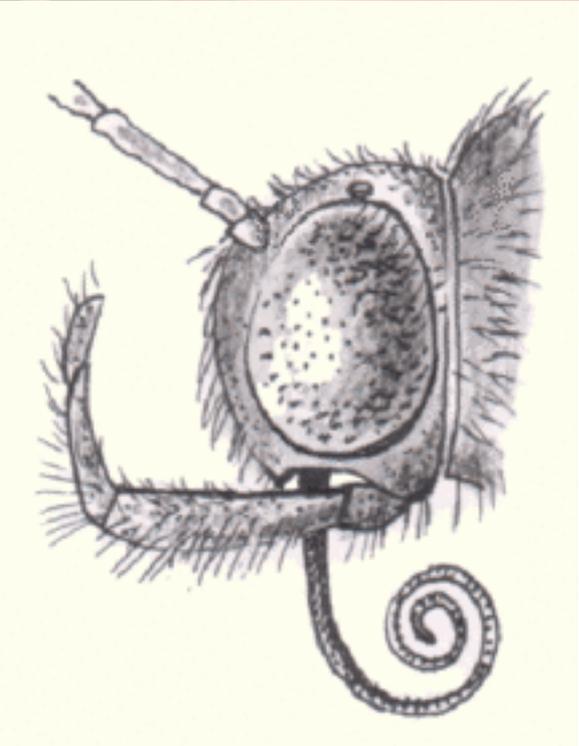
Drawings Smithsonian Institution Press.

Order Hemiptera





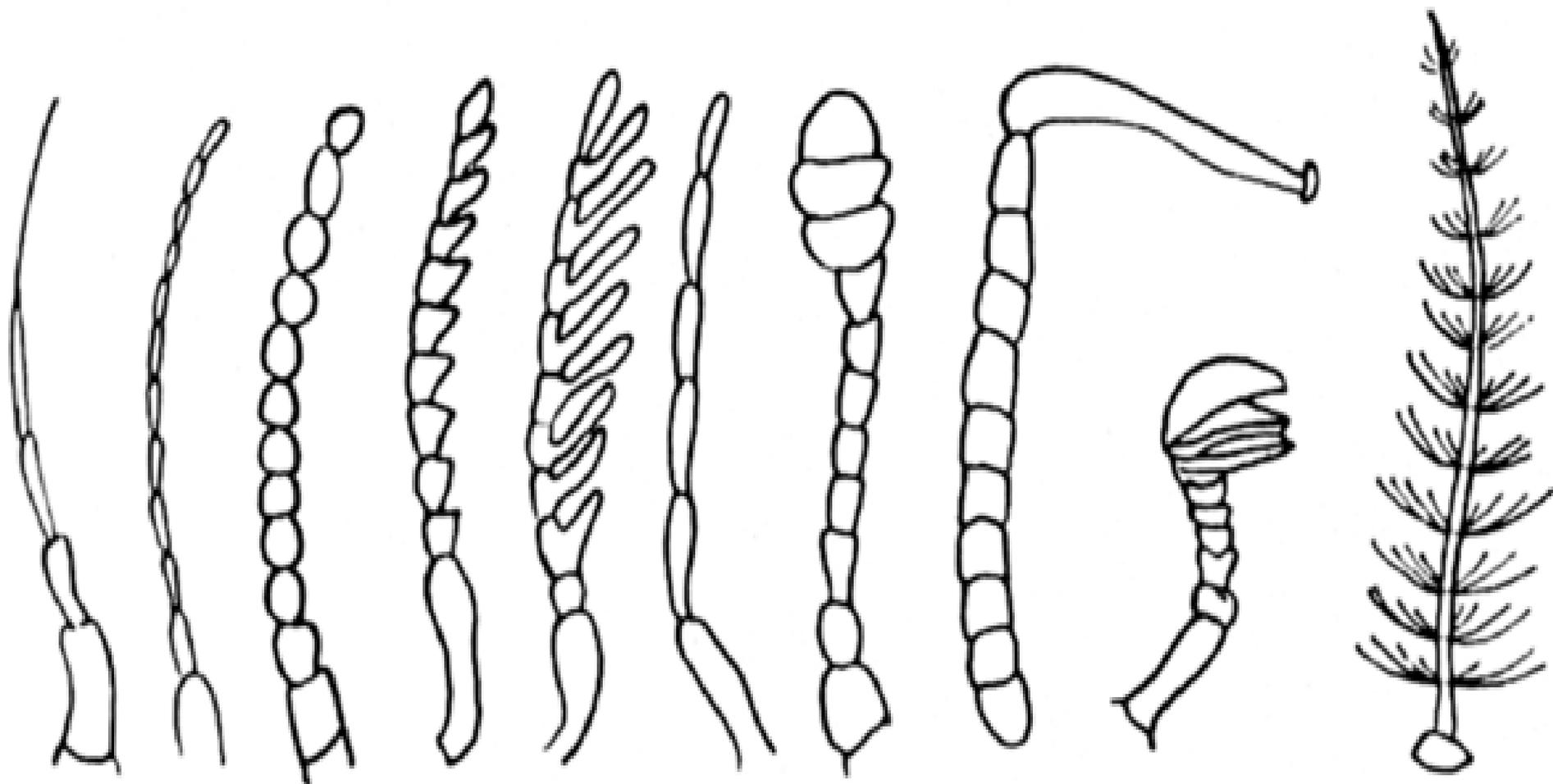
A, mouthparts of *Culex* (female). B, transverse section of same. C, apices of maxilla and mandible respectively. a, antenna; c, clypeus; h, hypo-pharynx; l, labrum; la, labellum; lm, labium; m, mandible; mx, maxilla; mx', maxillary palp.



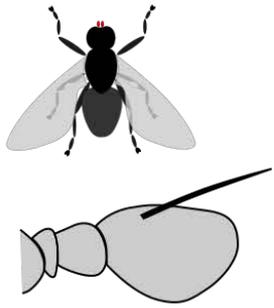
The insect head

- **Antennae:**
- 2 basal segments: scape & pedicel
- Filament comprised of several segments (actually pseudo-segments)
 - a. **setaceous:** hair-like
 - b. and f. **filiform:** thread-like
 - c. **moniliform:** bead-like
 - d. **serrate:** sawtoothed
 - e. **pectinate:** comb-like
 - g. **capitate:** headlike (less enlarged at the tip would be clavate -- clublike)
 - h. **geniculate:** elbowed
 - i. **lamellate:** plate-like
 - j. **plumose:** plumed or feather-like

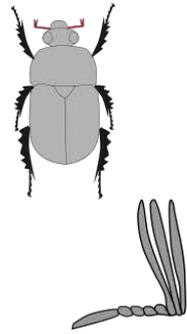




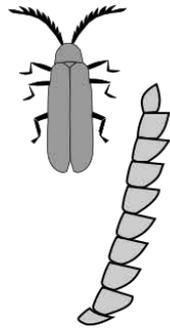
a b c d e f g h i j



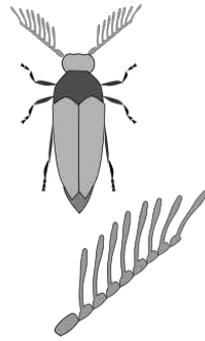
ARISTATE



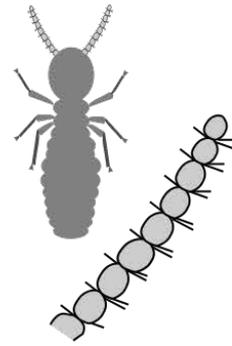
LAMELLATE



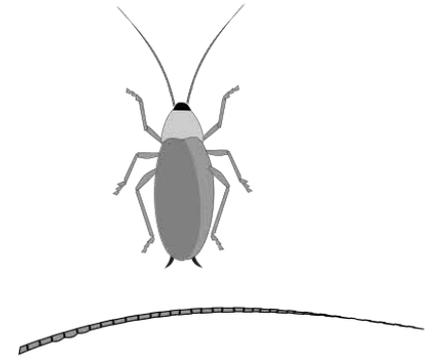
SERRATE



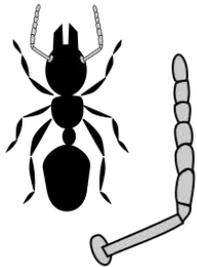
FLABELLATE



MONILIFORM



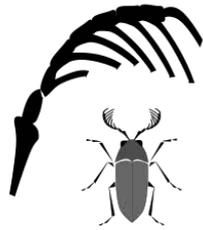
SETACEOUS



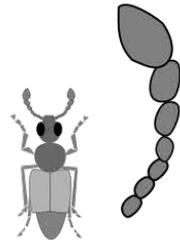
GENICULATE



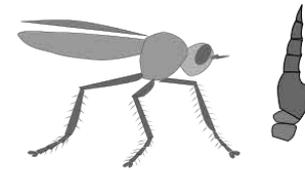
PLUMOSE



PECTINATE



CLAVATE



STYLATE

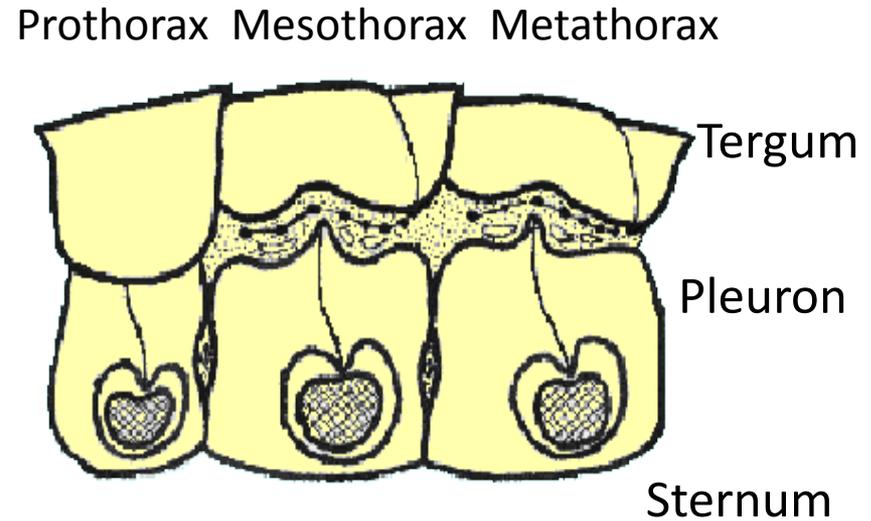
The insect thorax

3 distinct segments:

- **Prothorax:** Bears 1 pair of legs
- **Mesothorax:** Bears 1 pair of legs, 1 pair of wings
- **Metathorax:** Bears 1 pair of legs, 1 pair of wings

Sclerites that comprise the thorax are given specific names; each may be preceded by the prefixes pro-, meso-, or meta-.

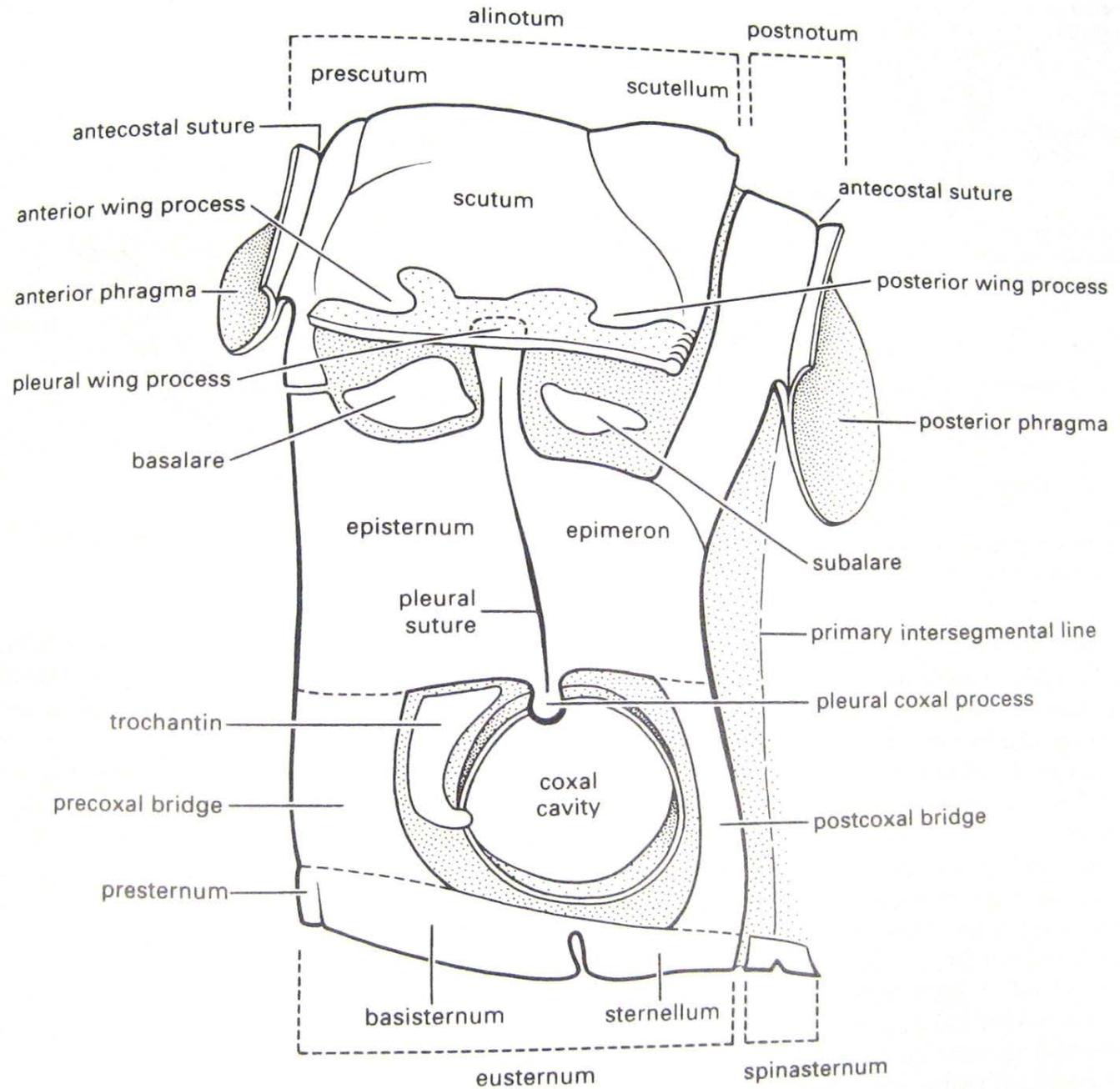
- **Notum:** Dorsal plate
- **Pleuron:** Lateral plate
- **Sternum:** Ventral plate



PROTHORAX

MESOTHORAX

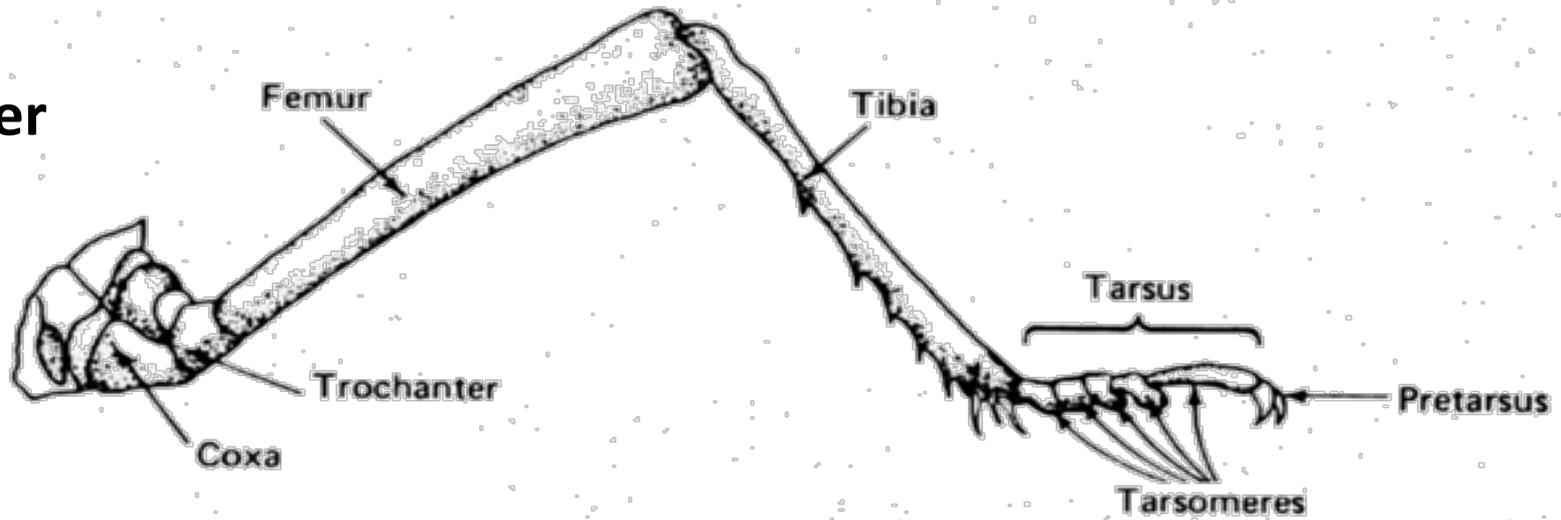
METATHORAX



Insect Leg

Legs are segmented. The names for each segment are (in order, beginning at the body and progressing outward).

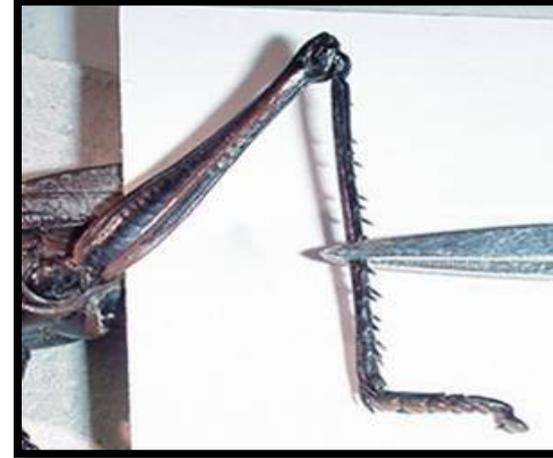
- **coxa**
- **trochanter**
- **femur**
- **tibia**
- **tarsus**



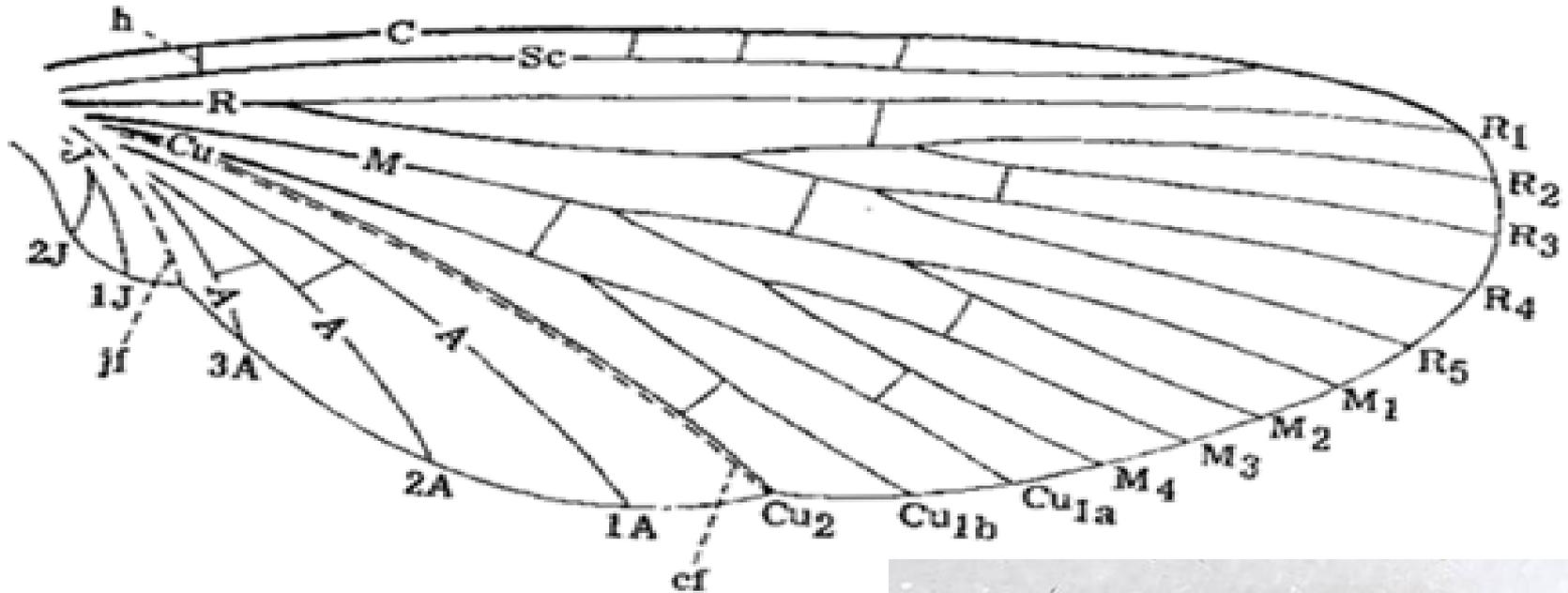
- **arolium**: Adhesive pad between tarsal claws
- **pulvilli**: Pads on the base of each tarsal claw

Legs may be modified for specific purposes

- **Jumping: saltatorial** -- grasshoppers, fleas
- **Running: cursorial** -- ground beetles, cockroaches
- **Clinging: scansorial** -- lice, sheep keds
- **Grasping: raptorial** -- mantids, giant water bugs
- **Digging: fossorial** -- cicada nymphs, mole crickets
- **Swimming: natatorial** -- water scavenger beetle, backswimmer



Wings



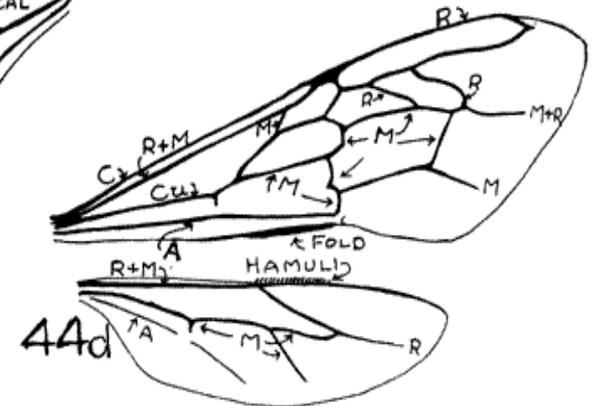
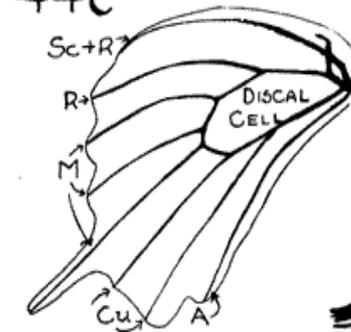
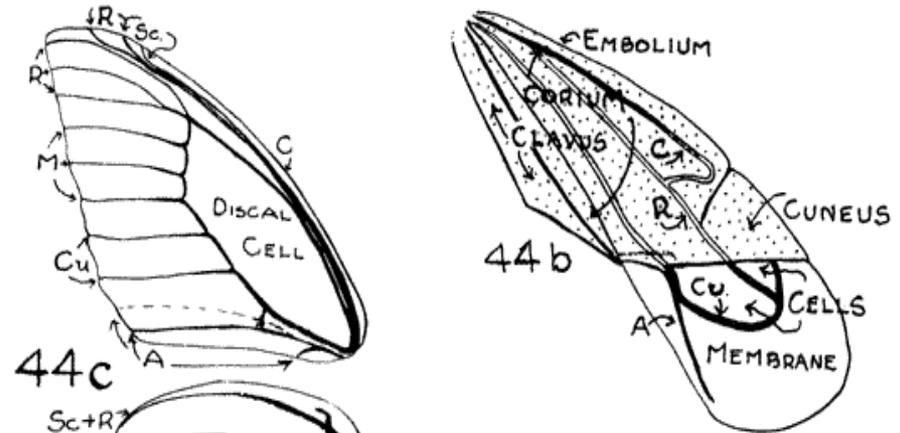
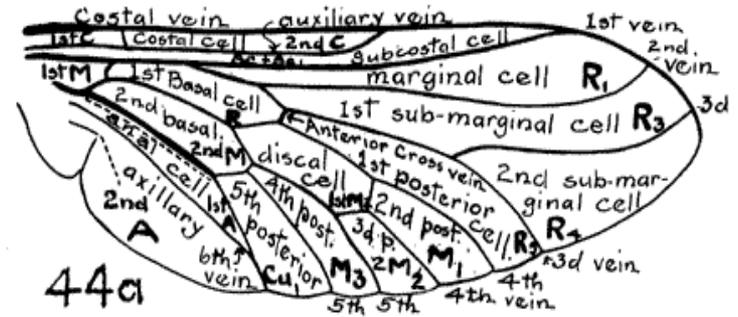
C = Costa
Sc = Subcosta
R = Radius
M = Media

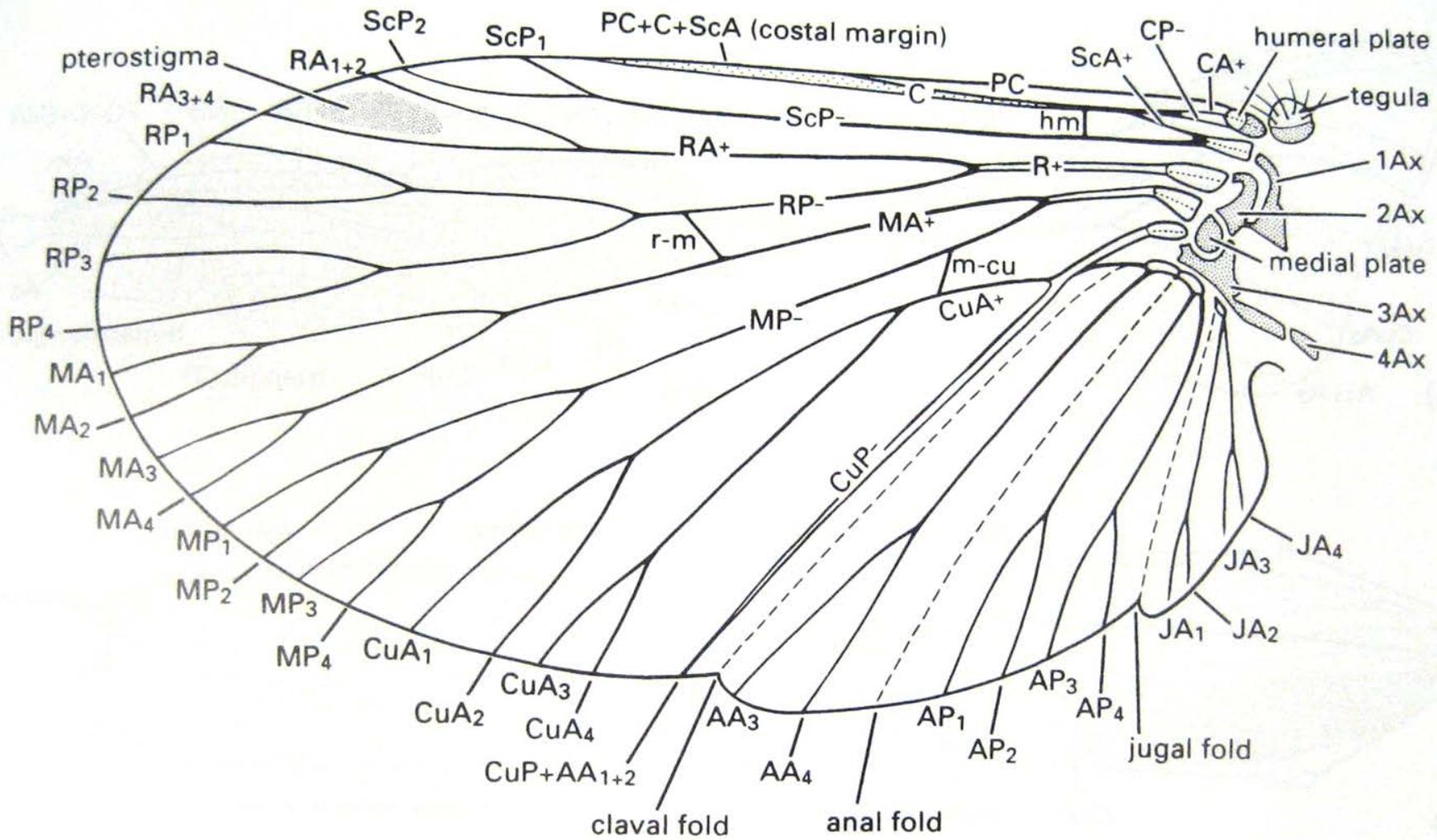
Cu = Cubitus
A = Anal
J = Jugal
h = humeral



Wing modifications:

- **Halteres (Halter):** Knob-like reduced hind wings of Diptera
- **Elytra (Elytron):** Hardened, protective forewings of Coleoptera
- **Hemelytra:** Half-hardened, half-membranous forewings of Hemiptera
- **Fringed wings:** Modified wing structure of the Thysanoptera (Thrips)
- **Scales and hairs:** Lepidoptera, Trichoptera, some Diptera





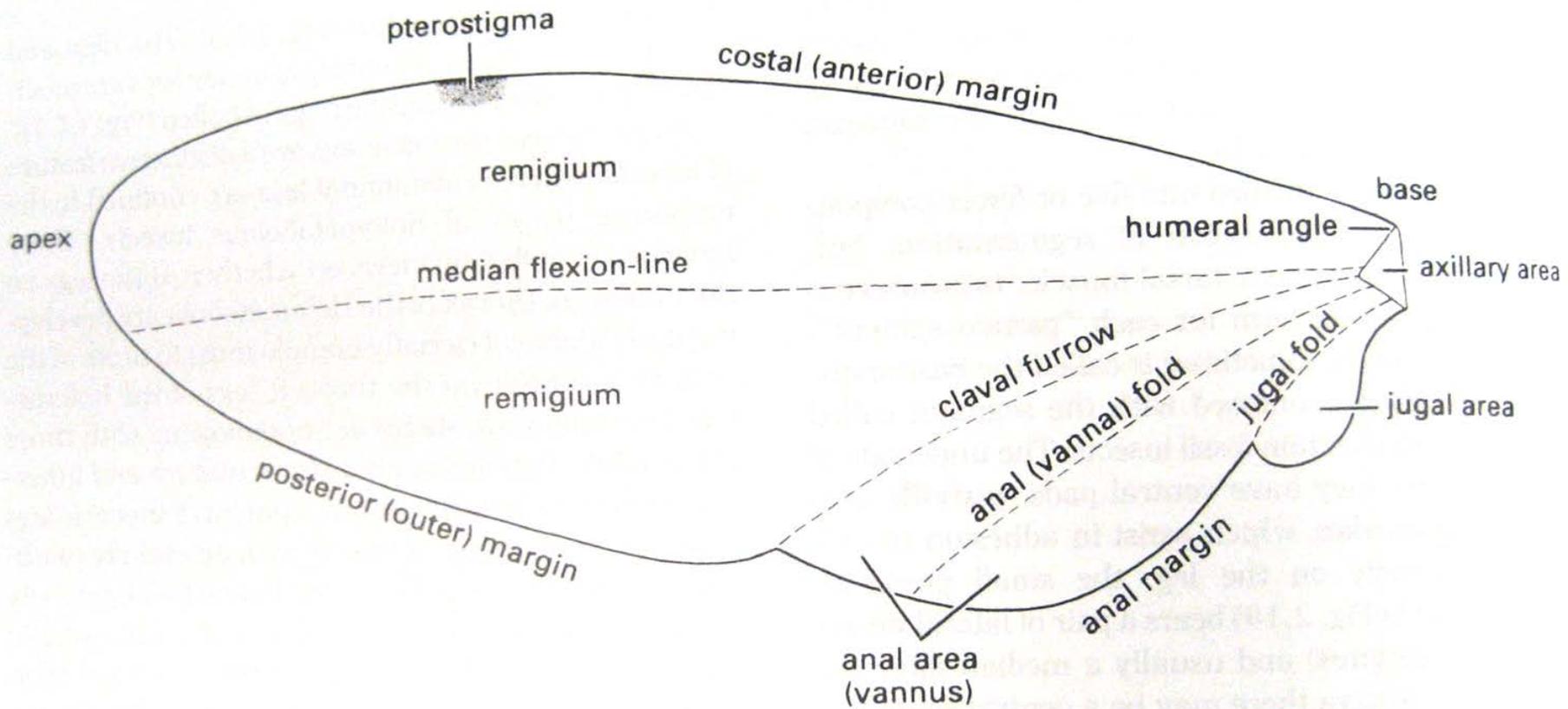
Elytra

Leathery forewings of beetles

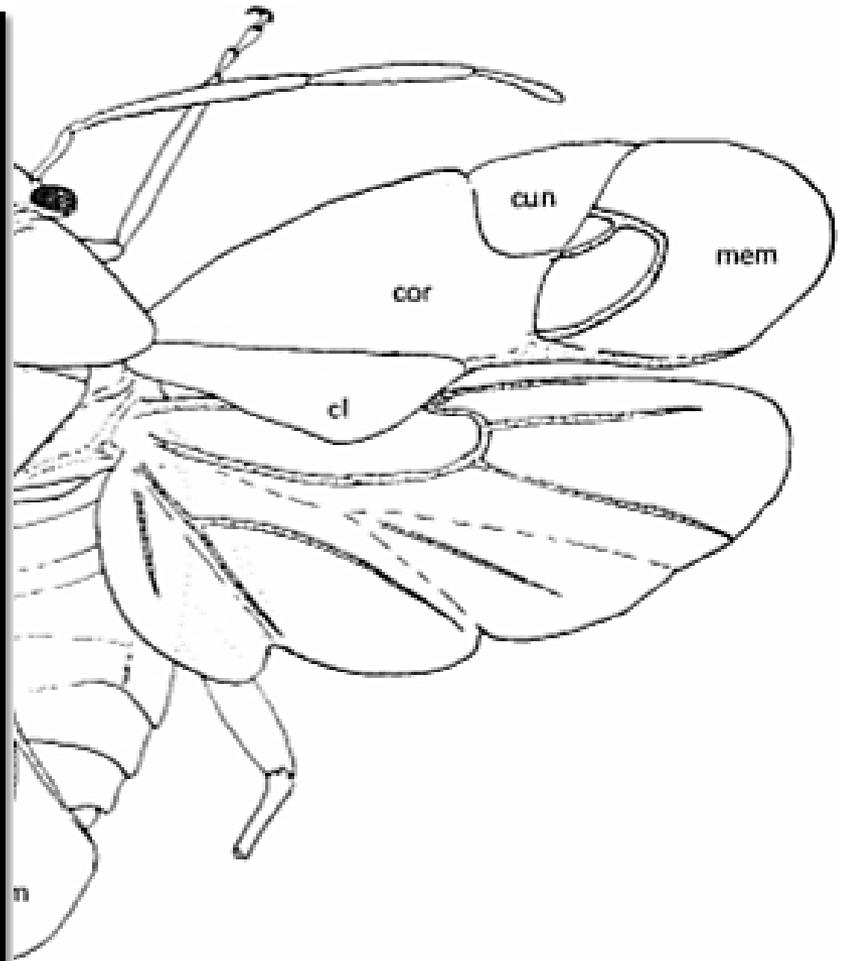




© András András 2004



Hemelytra= half membranous forewing of true bugs



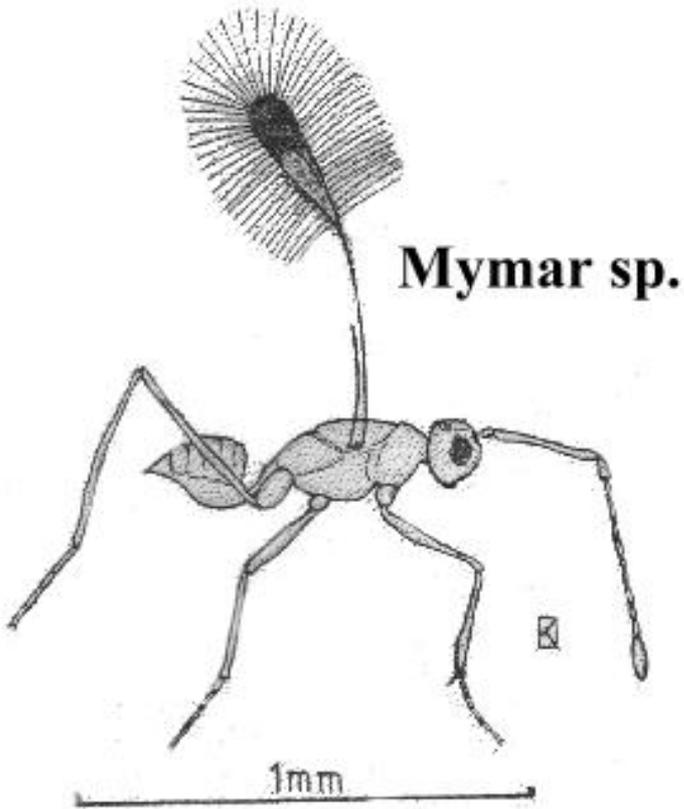
Haltere= reduced hind wing of fly



Fringed wings



thrips

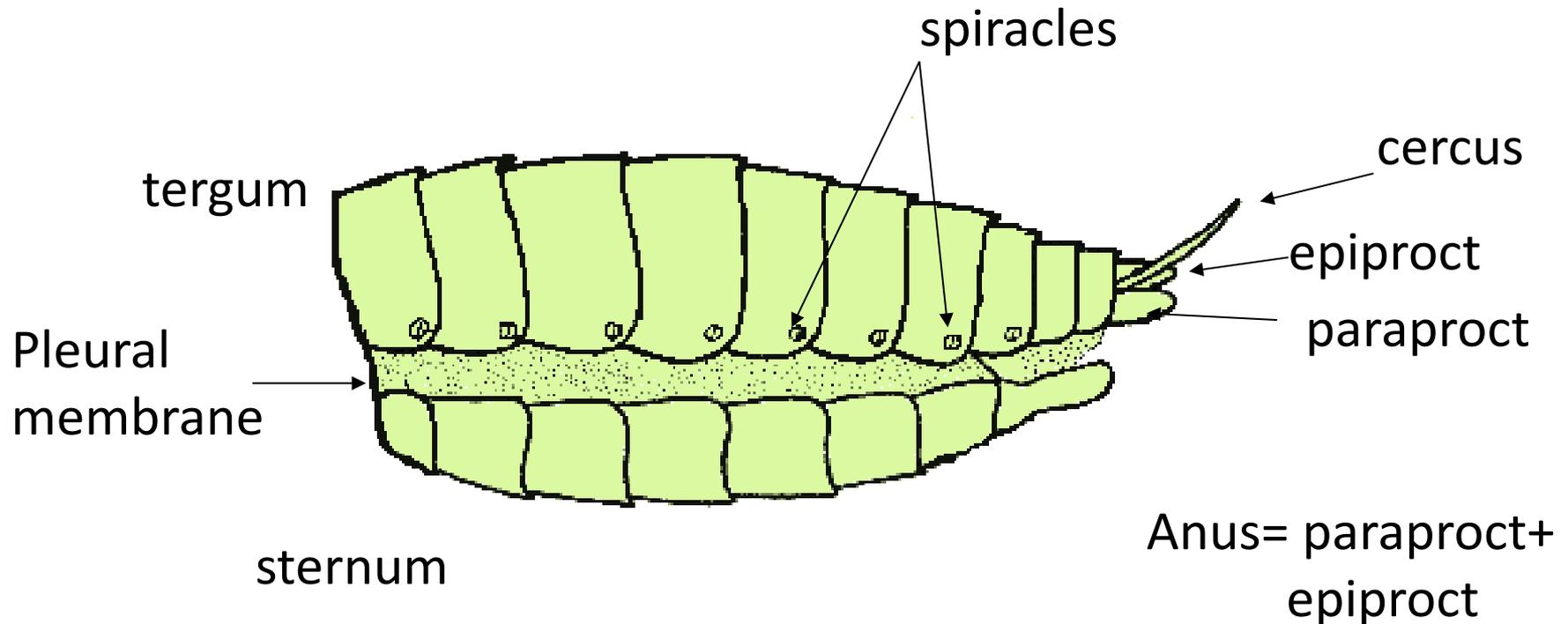


Mymar sp.

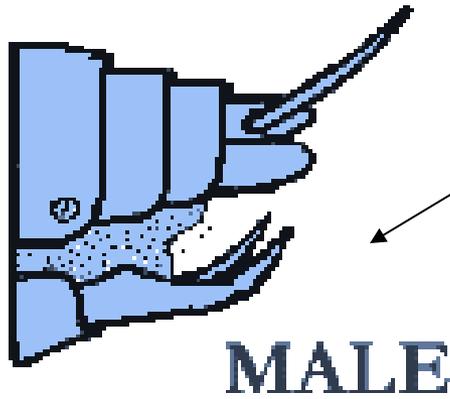
1mm

The insect abdomen

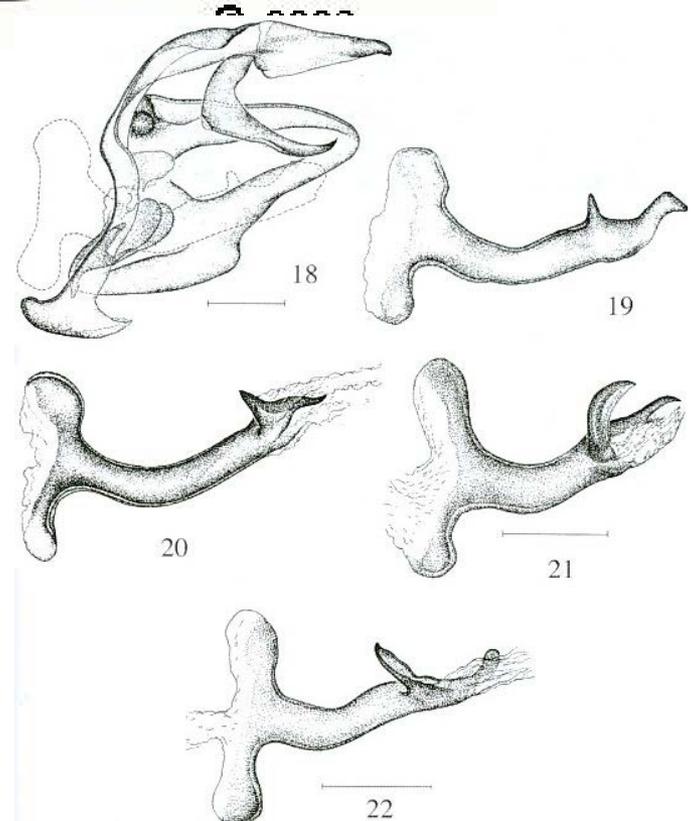
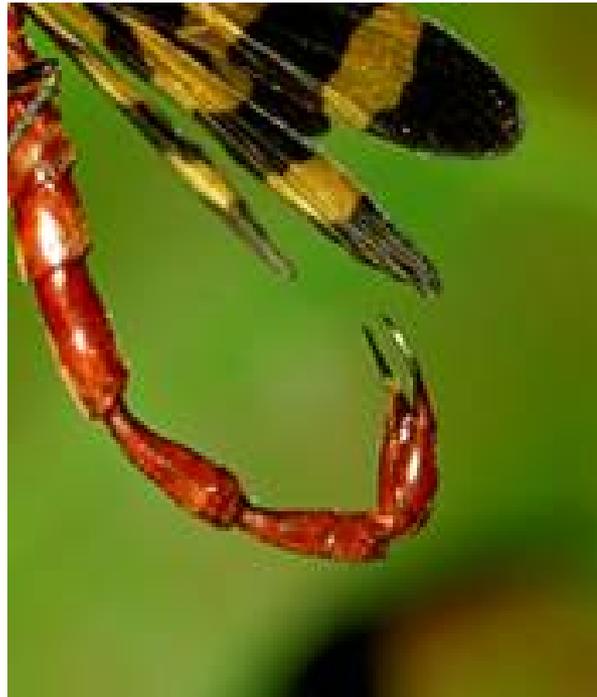
- 6 to 10 segments ending in the paraproct, through which the anus opens
- Terminal structures include:
- **Cerci:** Paired sensory projections from the terminal abdominal segment
- **Ovipositor:** Egg-laying apparatus (may be modified for other purposes)
- **Aedeagus:** Male copulatory organ, analogous to the penis in vertebrates



Posterior Male Anatomy

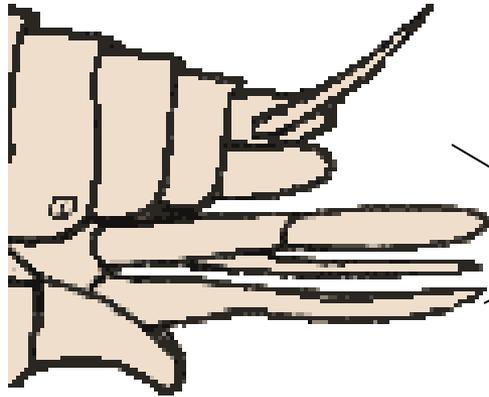


clasper



Aeadeagus (penis) is internal and retractable

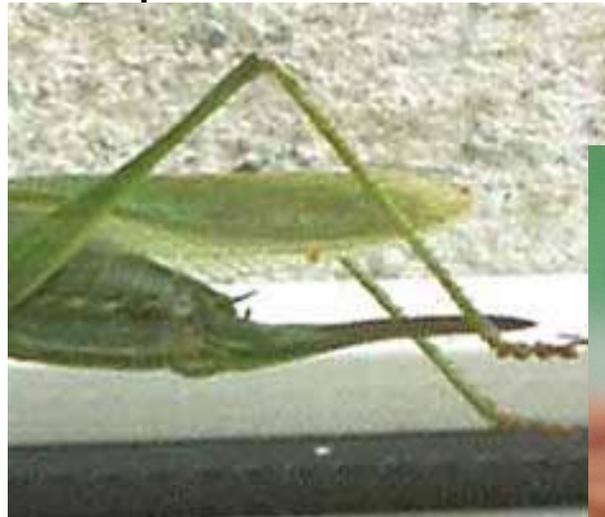
Posterior Female Anatomy



FEMALE



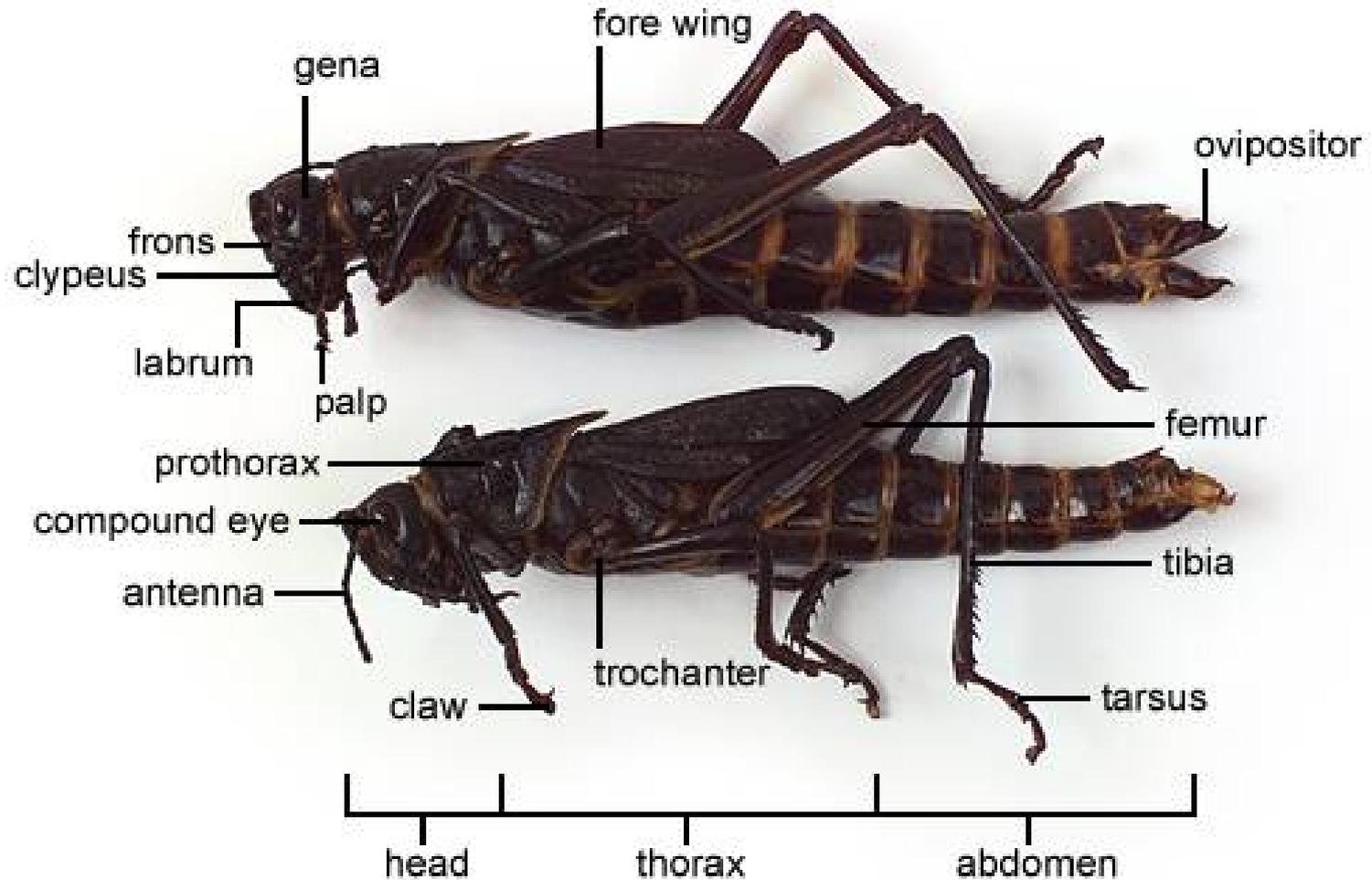
ovipositor



ovipositor



Grasshopper - External Features (Female and Male)



APTERYGOTES

- All primitive and wingless
- Juveniles and adults are very similar i.e. practically ametabolous
- Paraphyletic group, better considered at two groups; Entognathous Apterygotes and Ectognathous Apterygotes

Entognathous Apterygotes

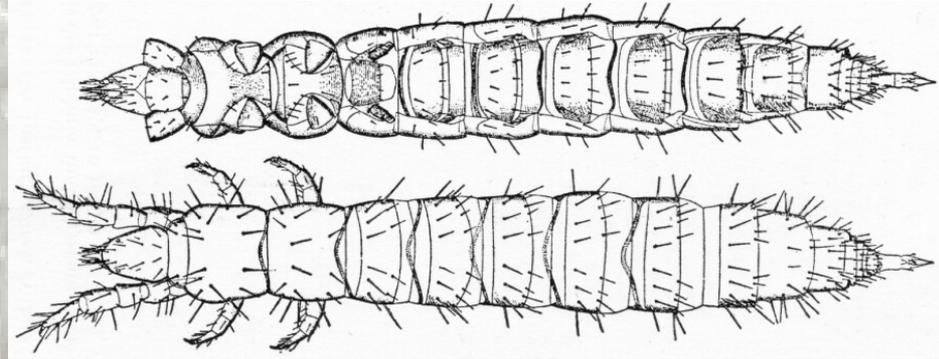
- Orders Collembolla, Protura and Diplura
- Extremely primitive mouthparts enclosed in the head
- The most primitive groups of six-legged arthropods

Ectognathous Apterygotes

- Order Thysanura
- Primitive mouthparts extend from the head
- Diverged later than the Entognatha
- Represents ancestral insects

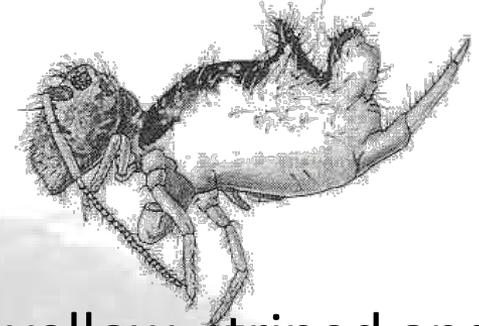
Protura

- All wingless
- Maximum 2mm long
- Entognathous mouthparts
- Have no eyes or antennae
- Head is cone-shaped, pyriform or egg-shaped
- Body is elongate, delicate and tapers to the rear
- Jointed legs on the first three segments
- Habitats: moist, e.g. soil and leaf litter
- Possibly fungivorous
- ~80 spp. in 21 genera of 4 families in our area
>70 genera of 7 families worldwide



Collembola - Springtails

- All wingless
- 0.2 - 10mm long
- Entognathous mouthparts
- Colors range from white to black, includes green, yellow, striped and mottled species
- Springing organ (**furcula**) is held beneath the body
- World-wide, from Antarctica to subarctic
- Habitats: moist environments including leaf litter, ant and termite mounds, inter-tidal zone, fresh water, from sea-level to 7000m
- Feed on decaying vegetation, algae, fungi, lichen, decomposing animal matter, spores and pollen
- over 8,200 described spp. worldwide, arranged in 10 families, 15 superfamilies, and 4 orders





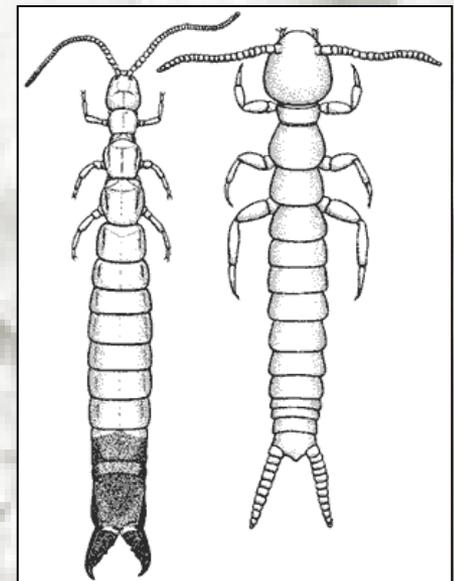
C. J. Crowley



Sheba Marx

Diplura

- All wingless
- 2 - 50mm long
- Entognathous mouthparts
- Generally white
- 2 posterior cerci
- Elongate, 10-segmented abdomen
- Clearly separated thoracic segments
- World-wide, mainly subtropical and tropical
- Habitats: damp, e.g. leaf litter, under stones, in soil
- herbivorous, others prey on smaller arthropods
- 4-5 families, 64-70 species in North America



Order Zygentoma - Silverfish

- All wingless
- 6 - 18mm long
- Biting mouthparts
- Eyes reduced or absent
- Metallic sheen of grey, brown or white scales
- World-wide
- Habitats: among leaves, in wood, under stones, on seashore etc. as well as indoors
- Mainly scavengers
- 120 spp. worldwide; 18 spp. in 14 genera of 3 families in NA



Order- Microcoryphia-Bristletails

- All wingless
- 6 - 18mm long
- Biting mouthparts
- Eyes large and contiguous, ocelli present
- Thorax is arched
- Metallic sheen of grey, brown or white scales
- World-wide
- Habitats: among leaves, in wood, under stones, on seashore etc. as well as indoors
- 2 spp. in 12 genera of 2 families in our area, ~about 350 spp. worldwide
-



EXOPTERYGOTES

- All share winged ancestor
- All undergo partial metamorphosis from nymphs to adult, i.e. are hemimetabolous
- Three assemblages: Palaeoptera, Orthopteroida, Hemipteroida

Palaeoptera

- Primitive wing venation
- Wings cannot be folded over the body



Orthopteroida

- Can fold wings over their backs
- Retain primitive, biting mouthparts

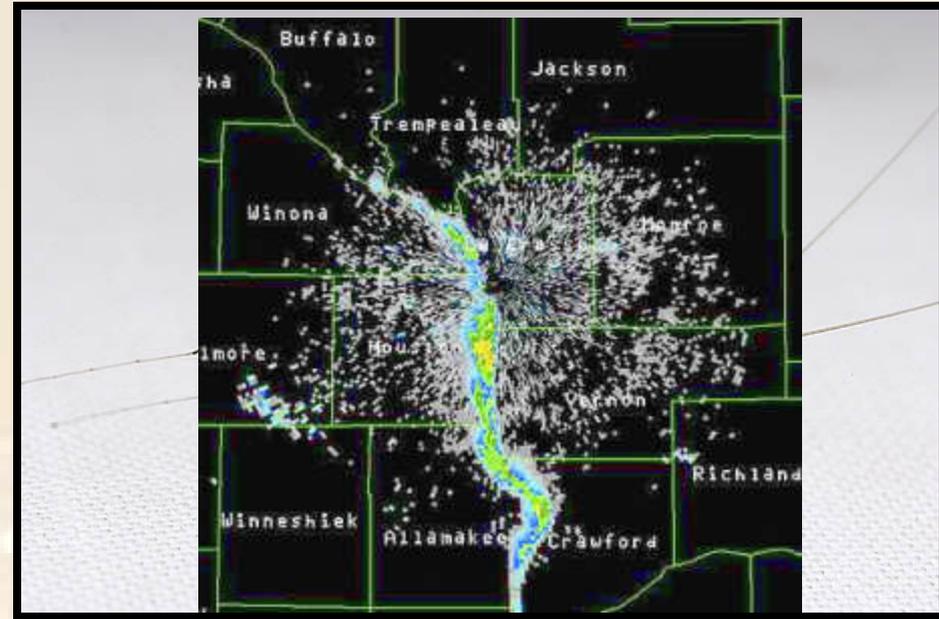


Hemipteroida

- Latest exopterygotes to diverge
- Now include many specialisations e.g. suctorial mouthparts

Order Ephemeroptera - Mayflies

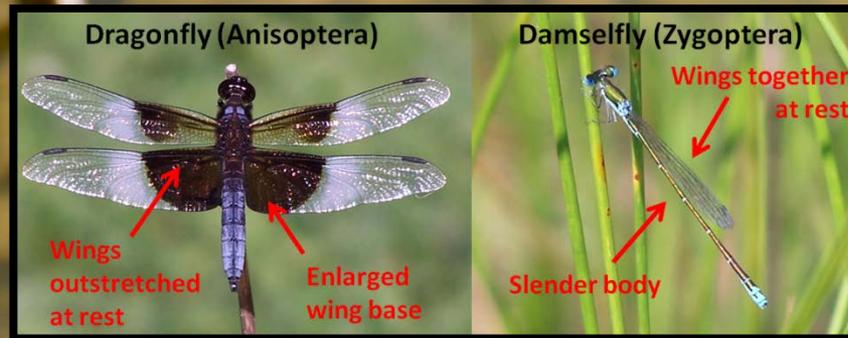
- Two pairs of membranous wings
- Both pairs have complex wing venation
- Hind wings smaller than forewings, sometimes absent
- 5 - 30mm long
- Very reduced biting mouthparts
- Rest with wings held vertically
- 2 long caudal cerci; may have long median caudal filament (i.e. three "tails")
- Delicate insects
- Habitats: all nymphs aquatic, most adults remain near water
- Adults do not feed, nymphs are scavengers and carnivores
- 611 spp. in 59 genera of 21 families in our area; worldwide, ~3350 spp. in >440 genera of at least 42 families



Order Odonata - Dragonflies, Damselflies



- Two pairs of membranous wings
- Wings have dense network of cross-veins and dark pterostigma near tip
- Wings cannot be folded over the body
- Body length: 25 - 120mm
Wingspan: 17 - 190mm
- Biting mouthparts
- Elongate body
- Most species are tropical
- Habitats: generally associated with water in temperate conditions, but occur far from water in tropical climates, and may migrate
- Predators, especially as nymphs



Characteristics	Dragonfly	Damselfly
Eyes	most have eyes that touch, or nearly touch, at the top of the head	eyes are clearly separated, usually appearing to each side of the head
Body	usually stocky	usually long and slender
Wing Shape	dissimilar wing pairs, with hind wings broader at the base	all wings similar in shape
Position at Rest	wings held open, horizontally or downwards	wings held closed, usually over abdomen
Discal Cell	divided into triangles	undivided, quadrilateral
Male Appendages	pair of superior anal appendages, single inferior appendage	two pairs of anal appendages
Female Appendages	most have vestigial ovipositors	functional ovipositors
Larvae	breathe through rectal tracheal gills; stocky bodies	breathe through caudal gills; slender bodies



©PCoin 2004



Order Plecoptera - Stoneflies

- Most species have two pairs of membranous wings
- Hind pair of wings broader than fore
- Wing veins form double ladder pattern
- 4mm - 50mm long
- Reduced, biting mouthparts
- Soft, flattened bodies
- Never brightly colored
- Often have two long caudal cerci
- World-wide
- Habitats: rarely far from water, generally on shoreline vegetation and rocks
- Adults rarely feed, possibly on algae, pollen and lichen, nymphs are phytophagous or carnivorous



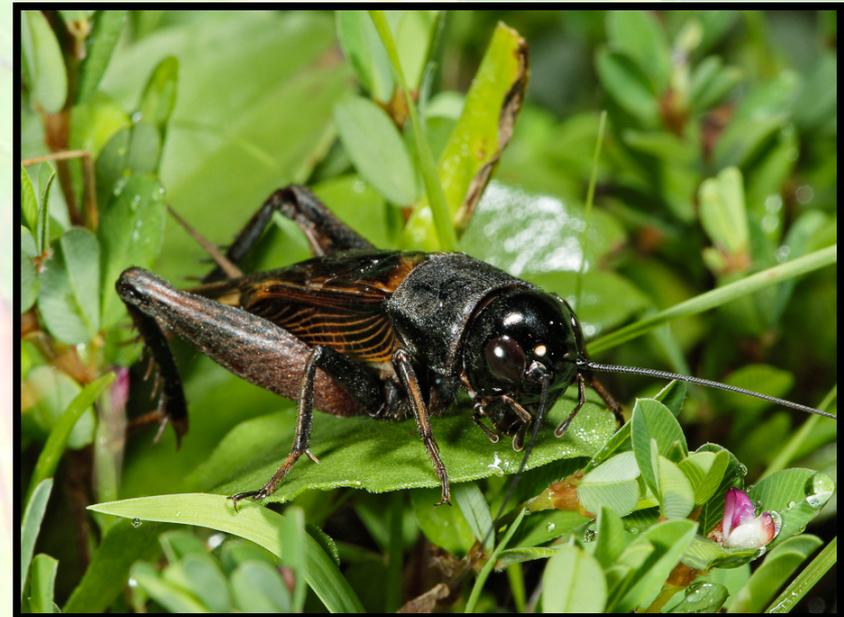
Order Embioptera - Webspinners



- Winged and wingless forms
- Males have 2 pairs of membranous wings
- 10-12mm long
- Biting mouthparts
- Elongate, slender, cylindrical insects
- Swollen first tarsi on the front legs
- Enlarged femur on hind legs
- Eyes kidney-shaped (reniform)
- Mainly tropical, some species here, introduced as well
- Habitat: build silken tunnels in wood and crevices near food sources
- Feed on dead leaves and animal matter

Order Orthoptera - Grasshoppers, Locusts, Katydid, Crickets

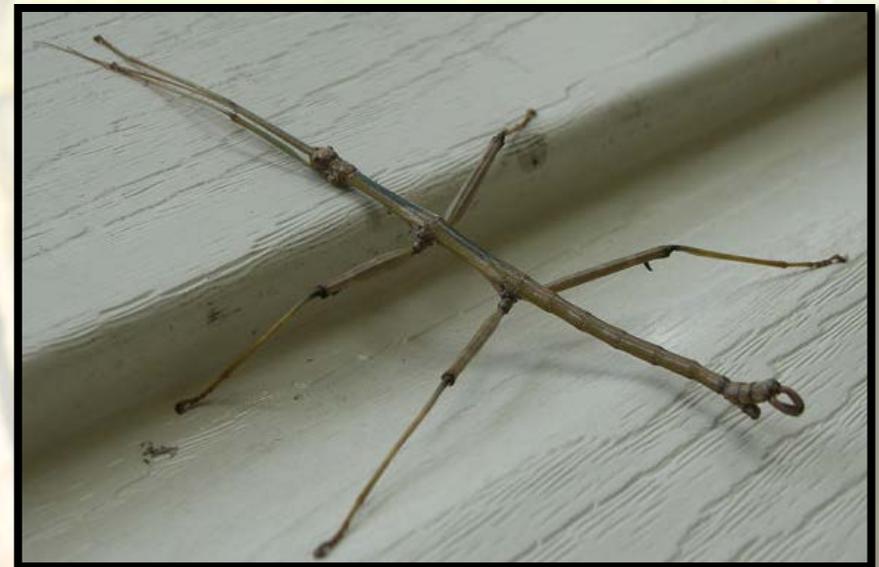
- Two pairs of wings (some species are wingless)
- Forewings are toughened and narrower than hindwings
- Forewings vary in size, from being absent to covering abdomen completely
- Few mm (nymphs) - 255mm long (adults)
- Biting and chewing mouthparts
- Enlarged hind legs for jumping
- World-wide
- Major pests in Africa, the Middle East and west Asia
- Habitats: desert to caves, in trees and subterranean burrows
- Scavengers, omnivores, herbivores and carnivores. Carnivores bite humans if disturbed
- Includes three main families and various smaller families (definite phylogeny is not established)





Order Phasmida - Stick insects, Leaf insects, Walking sticks

- Two pairs of wings but some are species wingless
- Forewings have reduced venation, occasionally mimic leaf venation
- Body length: few mm - 330mm
Length including legs can exceed 500mm
- Chewing mouthparts
- Superb camouflage as twigs or leaves
- Stick-like elongate bodies and legs
- 2,500 species, 4 occur in Britain
- World-wide, most species in S E Asia
- Habitat: amongst the foliage in which they are best camouflaged
- Herbivorous





Order Dermaptera - Earwigs



- Two pairs of wings
- Forewings short, square and veinless
- Hindwings fanlike
- 7 - 78mm long
- Biting mouthparts
- Posterior abdominal cerci form pincers
- Adults pale brown to black, temporarily white and cream after moulting
- Elongate abdomen is uncovered and very flexible
- 1,800 species, 7 in Britain
- World-wide, especially tropical
- Habitats: ground dwelling, in crevices
- Scavenge plant and animal matter

Order Zoraptera-Angel Insects

- Two pairs of membranous wings, or no wings present
- Less than 3mm long
- Very generalised mouthparts for biting
- Polymorphism within populations: they are either pale, eyeless and wingless, or dark with eyes and wings
- Distinctive three-segmented thorax with prominent pro-thorax
- Y-shaped epicranial suture on the head
- 30 species found to date
- Ethiopia, the Orient, Pacific regions, Neotropics Nearctic, and New Guinea
- Habitats: rotting logs, sawdust piles, humus and termites' nests
- Feed on fungi and small arthropods



Order Notoptera

- Rock crawlers, Ice-crawlers, Grylloblats

- Wingless (adaptation for burrowing)
- 20 - 35mm long
- Well-developed biting mouthparts
- Elongate, cylindrical, soft-bodied
- Yellow or pale brown
- Flattened head, eyes small or absent
- 20 species found to date,
- North America, Siberia, Japan, Korea and China
- Habitats: cold, wet environments at high altitude, amongst leaf litter and stones, in caves
- Herbivorous and carnivorous



Order Mantodea- Mantids

- Two pairs of wings
- Leathery forewings
- 10 - 150mm long
- Biting mouthparts
- Raptorial, spiny forelegs
- Mobile, triangular head, long neck
- 7,000 species
- Mainly tropical, some species in central and southern Europe
- Habitats: shrubs, trees and vegetation
- Prey on other insects, occasionally small reptiles etc.



Order Blattodea- Cockroach and Termites



- Two pairs of wings
- Leathery forewings
- 10 - 97mm long
- Biting mouthparts
- Very broad pronotum
- Long, spiny legs
- 3,500 species,
- Habitats: desert to semi-aquatic, mainly in humid places, including human dwellings, caves and ants' nests
- Scavenge most organic matter





suborder Isoptera - Termites

- Some have 2 pairs of membranous wings, most are wingless
- Workers: 2.5mm-15mm long
Queen up to 140mm long
- Mandibulate, biting mouthparts
- 2,300 species
- Tropical and temperate regions e.g. Africa, Australia. Few species present in Southern Europe
- Habitats: simplest species live in tunnels in wood, advanced species create termitaria from earth
- Feed on wood, and also on fungi which is cultivated within the termitaria

ENDOPTERYGOTES

- Diverged later than Exopterygotes
- All undergo full metamorphosis from larvae to adults, i.e. are holometabolous
- Three assemblages: Neuropteroida, Hymenopteroida, Panorpoidea

Neuropteroida

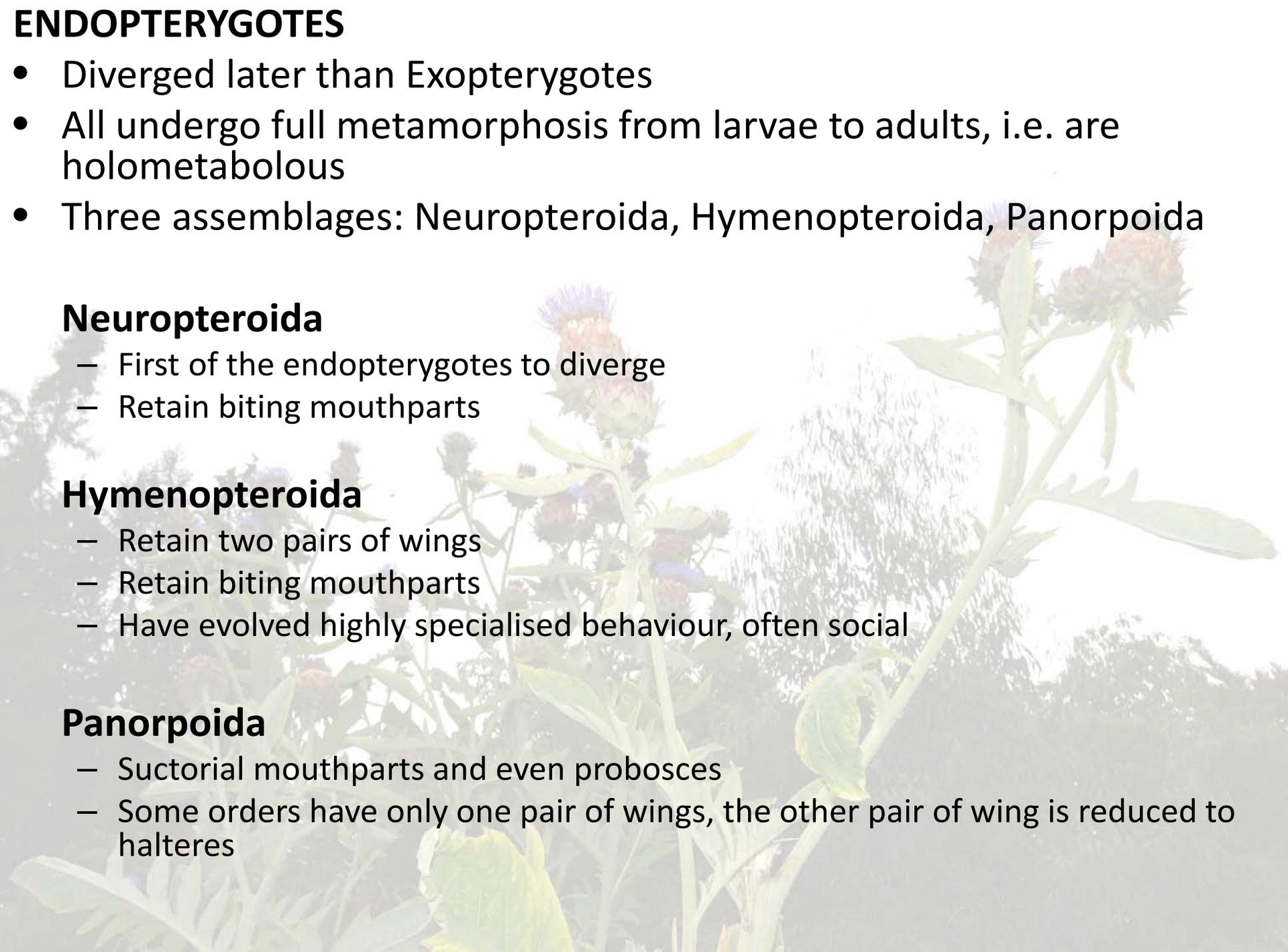
- First of the endopterygotes to diverge
- Retain biting mouthparts

Hymenopteroida

- Retain two pairs of wings
- Retain biting mouthparts
- Have evolved highly specialised behaviour, often social

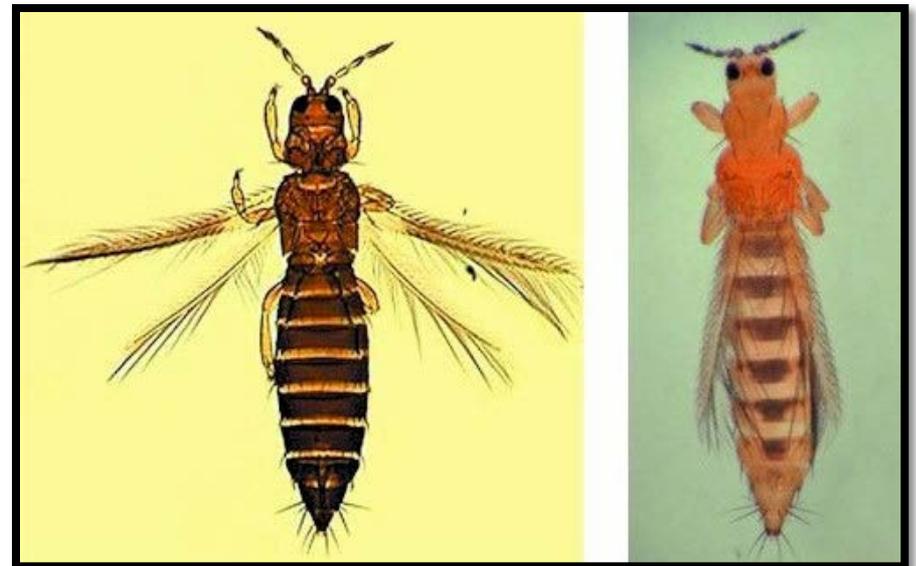
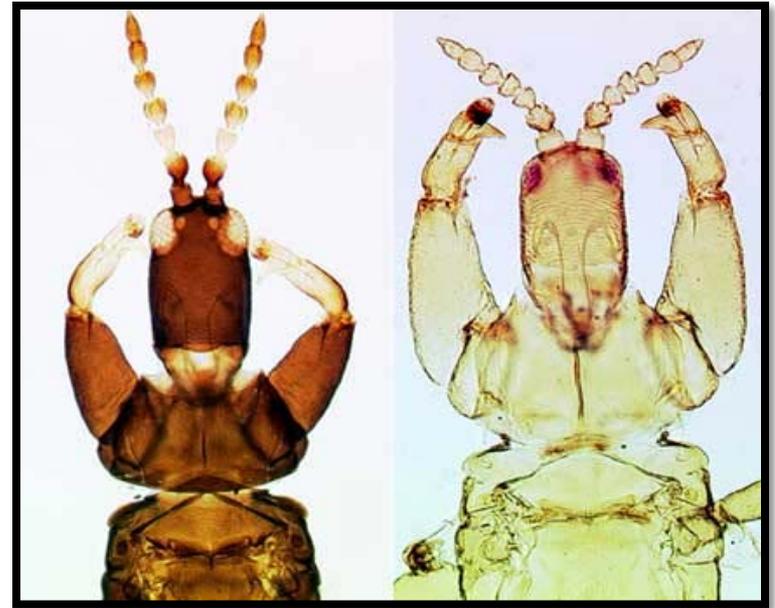
Panorpoidea

- Suctorial mouthparts and even probosces
- Some orders have only one pair of wings, the other pair of wing is reduced to halteres



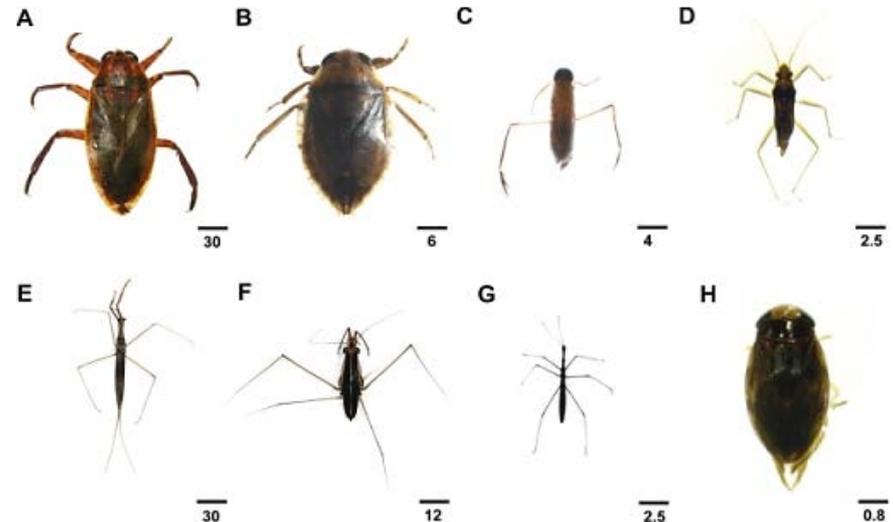
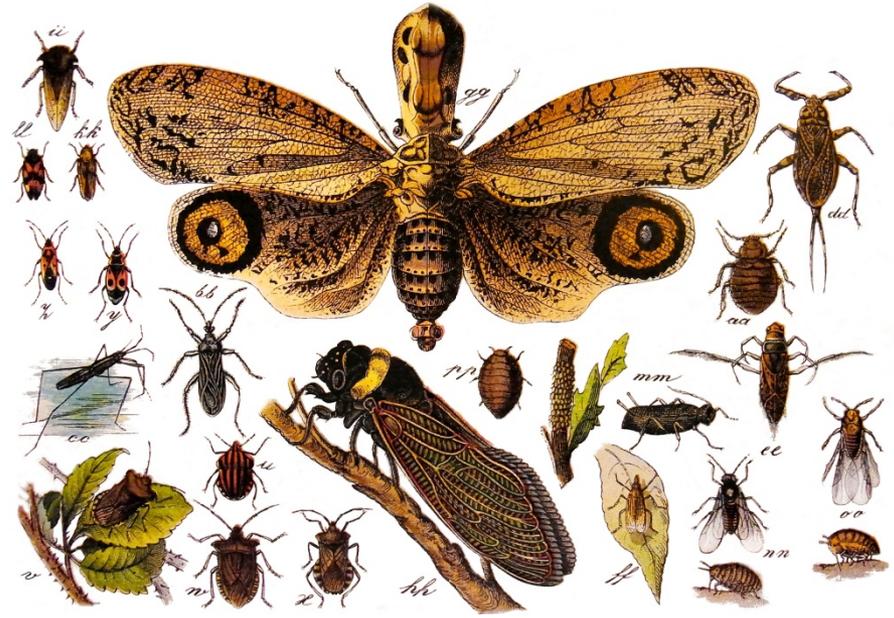
Order Thysanoptera - Thrips, Thunderflies

- 2 pairs of tiny, feather-like wings
- 0.5 - 15mm long
- Mouthparts adapted for piercing and are highly asymmetric
- Yellow, brown or black
- Very narrow body
- Prominent compound eyes
- World-wide, spread on wind currents and with cargoes
- Habitats: vegetation, especially flowers
- Feed on growing vegetation



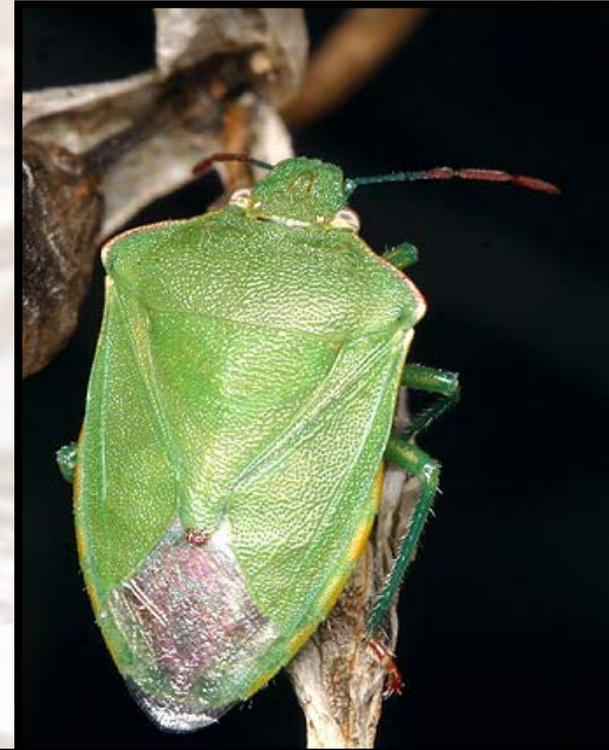
Order- Hemiptera

- 2 pairs of wings (some species wingless)
- Forewings generally hardened to some extent
- 1mm - 100mm long
- Mouthparts suctorial and developed for piercing
- Habitats: vegetation, some are aquatic
- Almost all are vegetarian, some aquatic species are carnivorous



Suborder Heteroptera- True Bugs

- Forewings divided into two regions of different textures
- Wings folded flat over the body at rest
- Head projects horizontally and is visible from above
- Rostrum develops from the front of the head





Bedbugs

How to know bed bugs.

- Dorsoventrally flattened 5-7 mm
- Light in color-unfed
- Dark-brown-feed
- Hemelytra reduced wing pads
- Prothorax wide with broad flanges

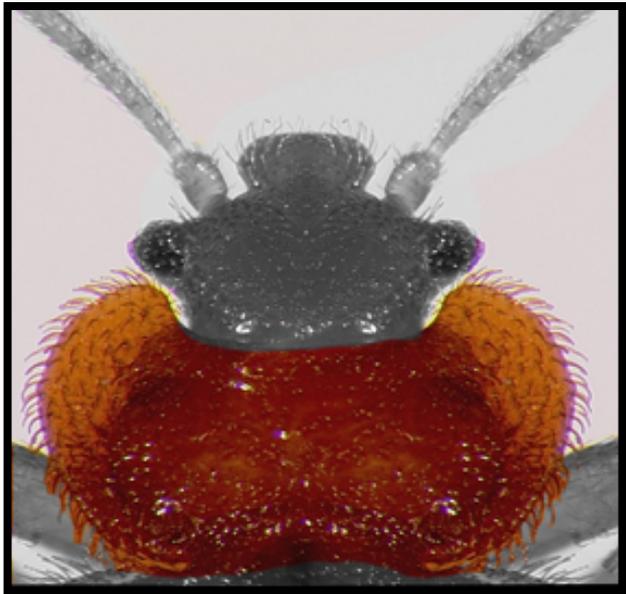
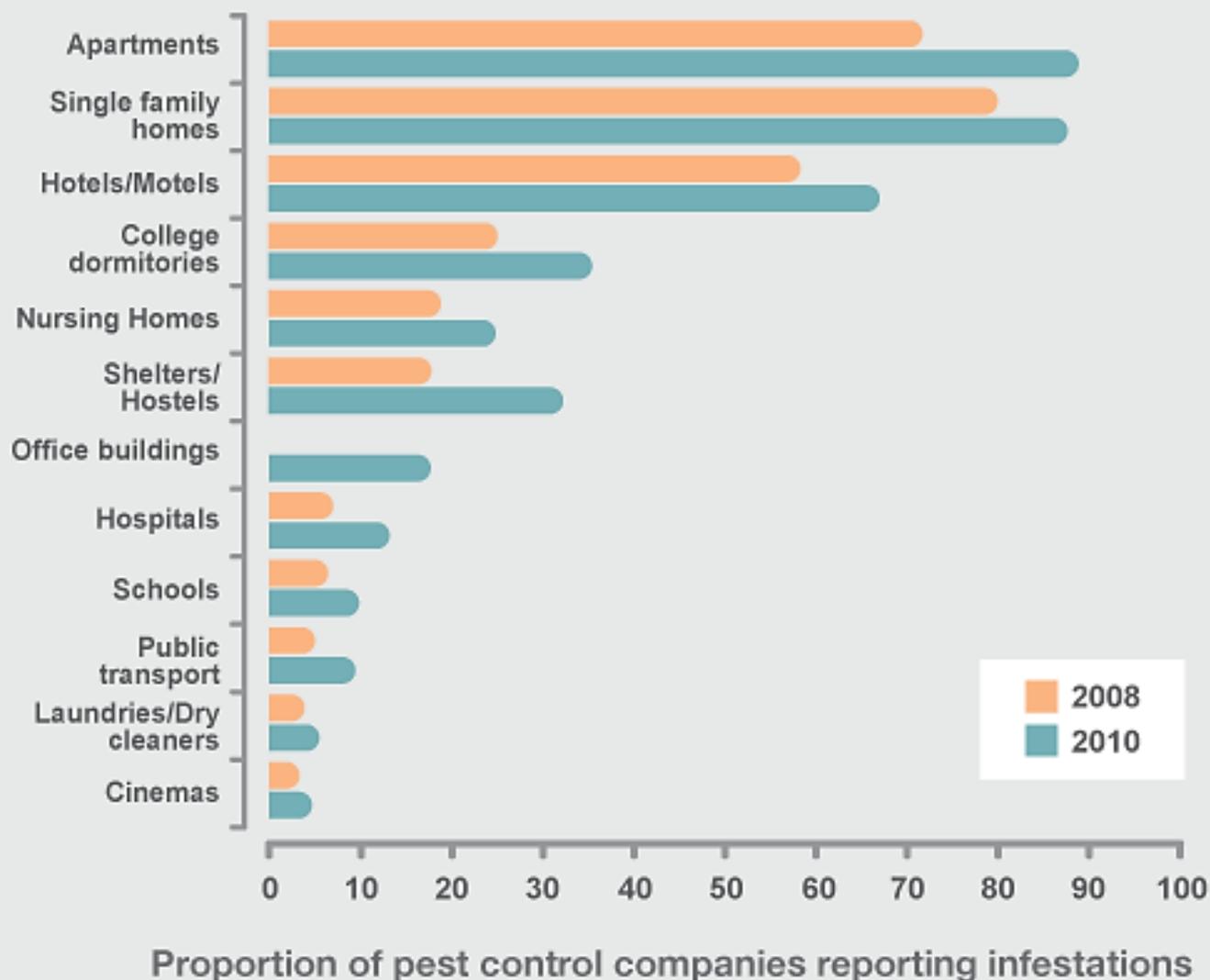


Figure 1: US Bed Bug Infestation Locations

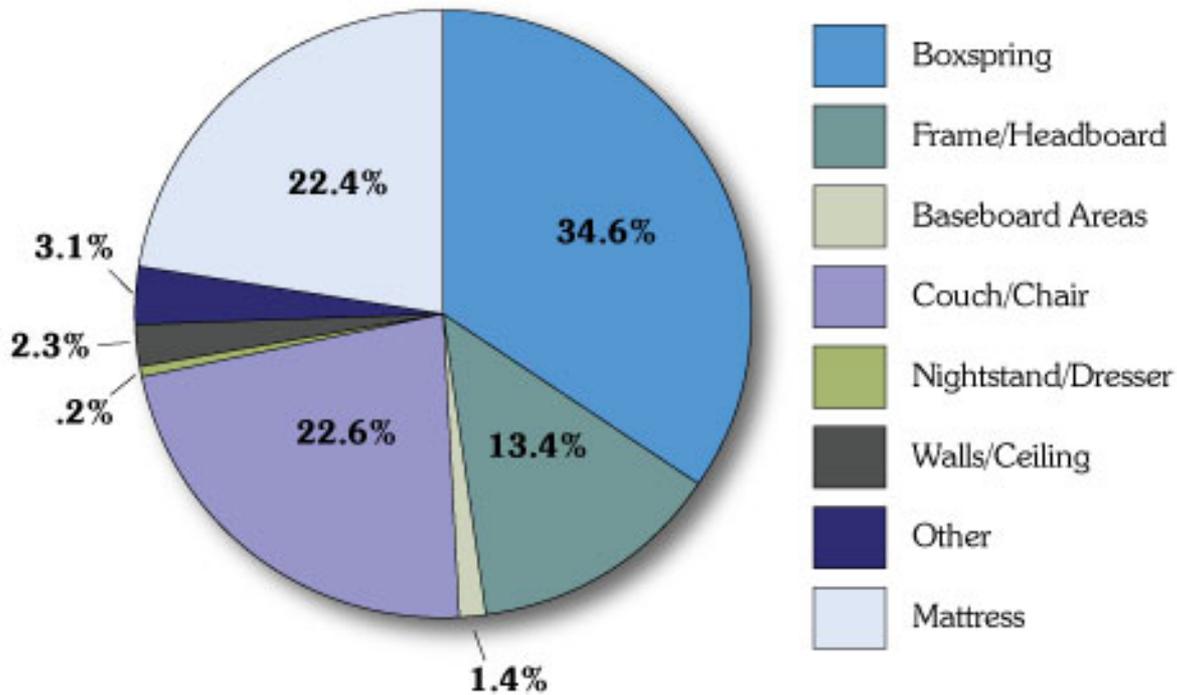


Source: University of Kentucky surveys of more than 500 US pest control companies in 2008 and 2010

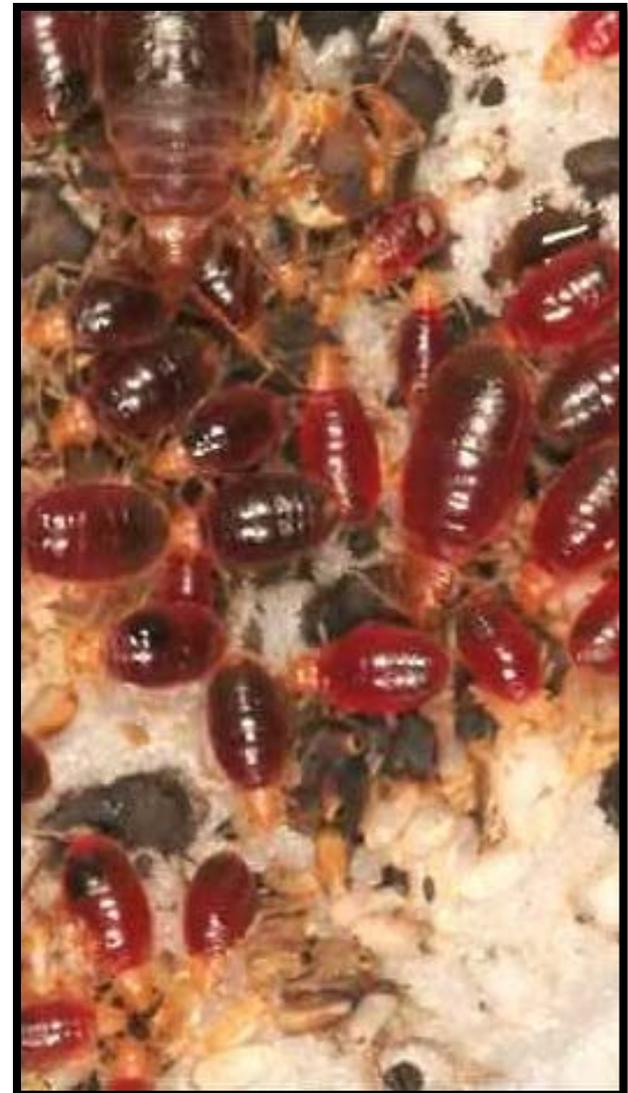
Gregarious species.



BED BUG HIDING SPOTS



Distribution of bed bugs found in 13 infested apartments
Source: University of Kentucky



Feeding

- Unlike other **sanguivores** both sexes feed.
- Feed on a variety of mammals and birds
- Hide away from person and at times on homeless.



Benoit Guenard



- Male uses distinct penis to provide sperm via organ Berlese.
- Via dramatic insemination



Suborders: Auchenorrhyncha, Sternorrhyncha

- Forewings are of uniform texture (membranous or leathery)
- Wings are held like a roof over the back
- Head deflected backwards
- Rostrum develops from the rear of the head



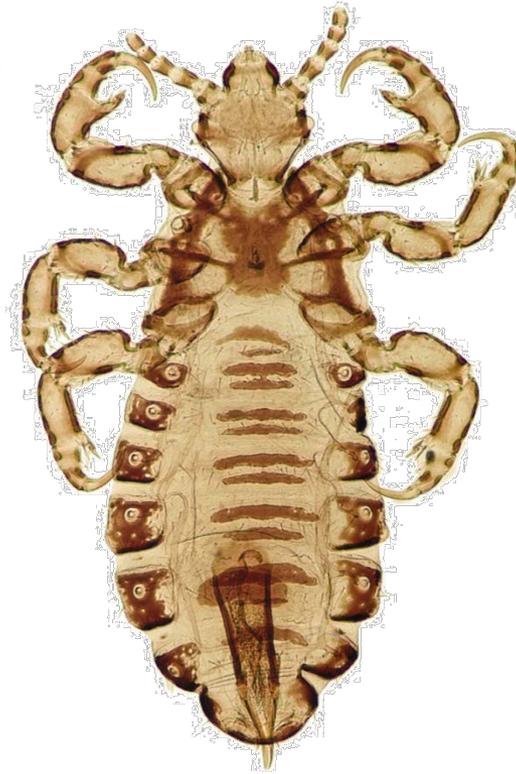
Order Psocoptera - Book lice, Bark lice, Dust lice, Psocids, Lice

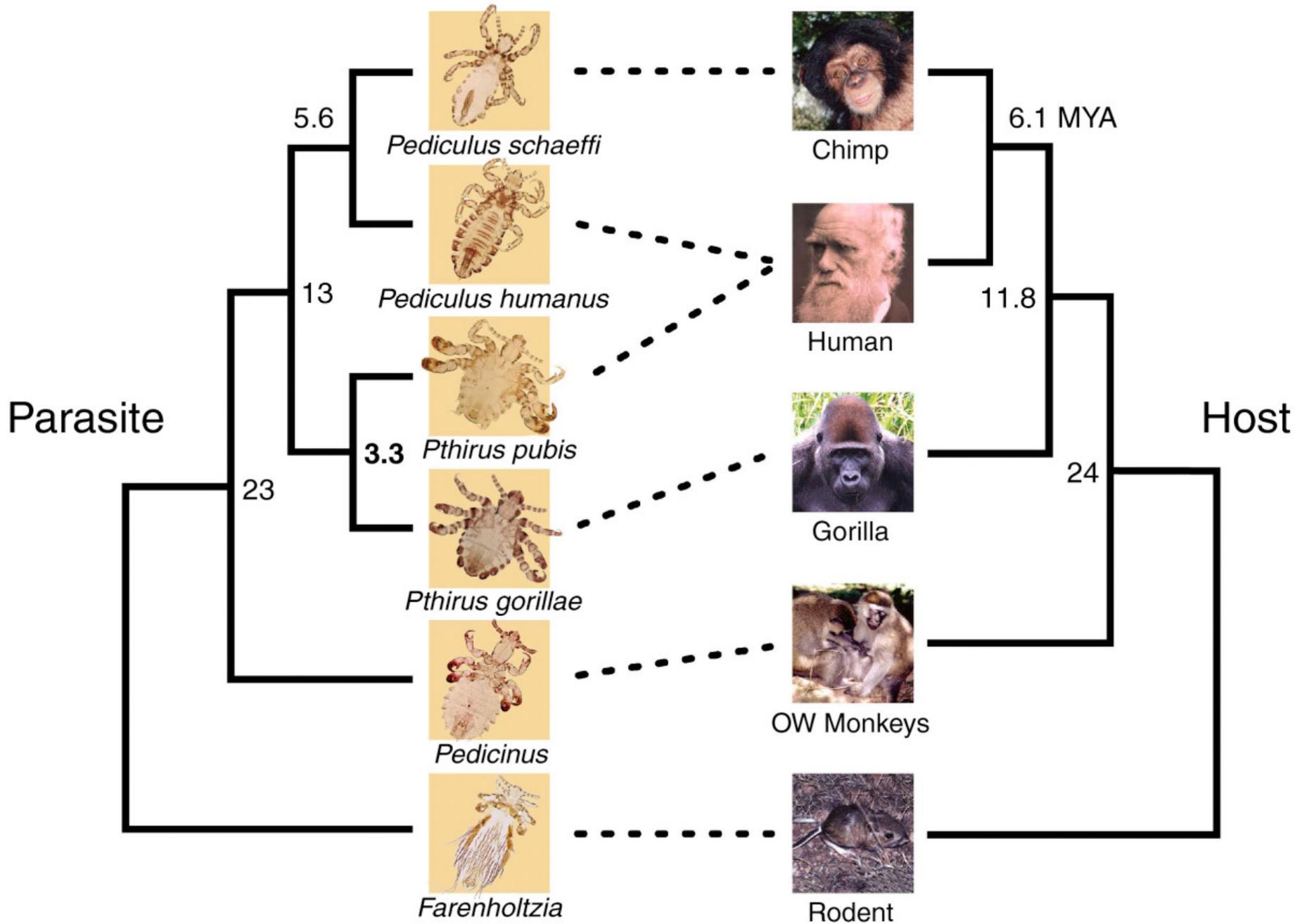
- Two pairs of membranous wings, or wingless
- 1-10 mm long
- Biting mouthparts
- Head broad, with bulbous postclypeus
- Small, stocky and soft-bodied
- 3000 species
- Mainly tropical
- Habitats: in vegetation and under bark, occasionally on books
- Feed on starchy substances, cereal plants, mould (on books)



Lice

- Wingless
- 0.35 - 10mm long
- Chewing mouthparts/sucking mouthparts
- Ecotoparasites
- Very small eyes





Understand the main differences between the three types of lice affecting humans

- Morphology and vector biology
- Disease risk
- Most effective treatments
- Prevention strategies



Sucking Lice

Three species utilize humans.

Body louse

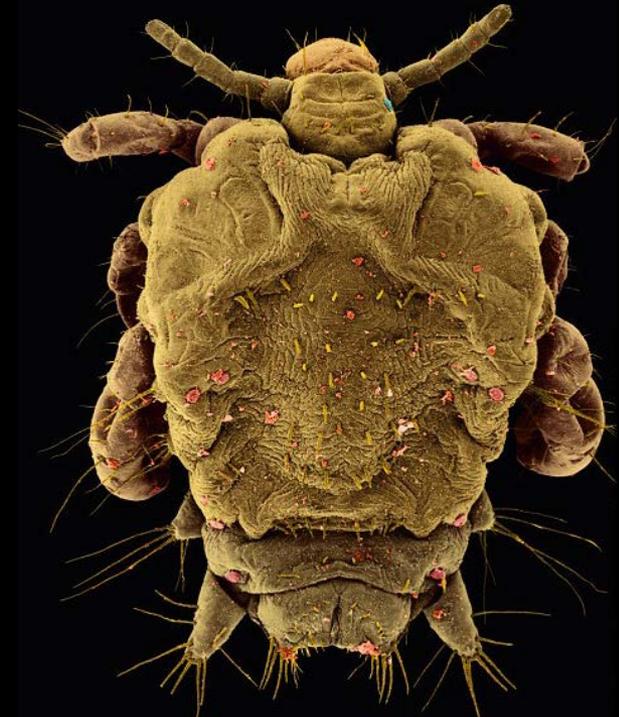
Pediculus humanus (var. *capitis*)

Head louse

Pediculus capitis (var. *corporis*)

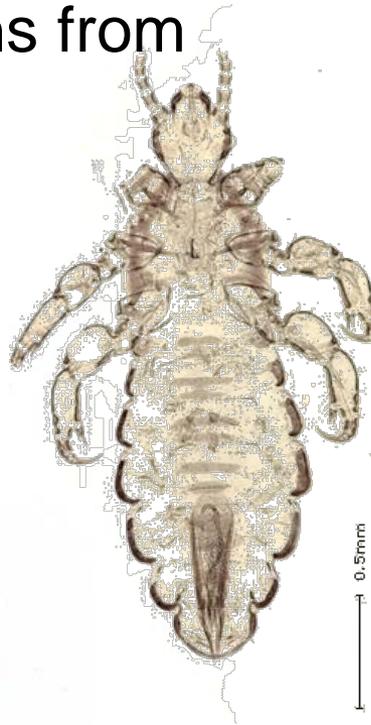
Pubic louse

Pthirus pubis



Head Lice

- Itching
- Difficulty sleeping
- Sores and secondary bacterial infections from scratching



Body lice

- Intense itching
- Skin discoloration/n thickening
- Secondary bacterial infection also possible from prolonged scratching
- Red rash

Pubic lice “crabs”

- Itching

Body Lice Diseases

Louse-Borne Relapsing Fever (*Borrelia recurrentis*)

- 1 Million cases observed in North Africa (WWII)
- Case fatality rate 10%
- Related to tick-borne relapsing fever (*B. duttonii*)

Trench Fever (*Bartonella quintana*)

- Less serious, rarely fatal
- Characteristic five-day fever

Epidemic typhus (*Rickettsia prowazekii*)

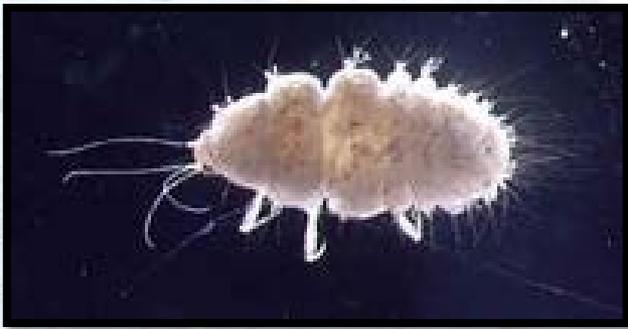


Neuroptera *sensu lato*- Lacewings, Snakeflies, Alderflies, Ant lions

- Two pairs of membranous wings
- Dense network of cross veins on wings
- Prominent vein forks at wing margins
- 3mm - 100mm long
- Chewing mouthparts
- 6,000 species
- World-wide, although families are more restricted
- Habitats: amongst vegetation and ground debris, in woodland
- Carnivores on smaller insects and pollen-eaters



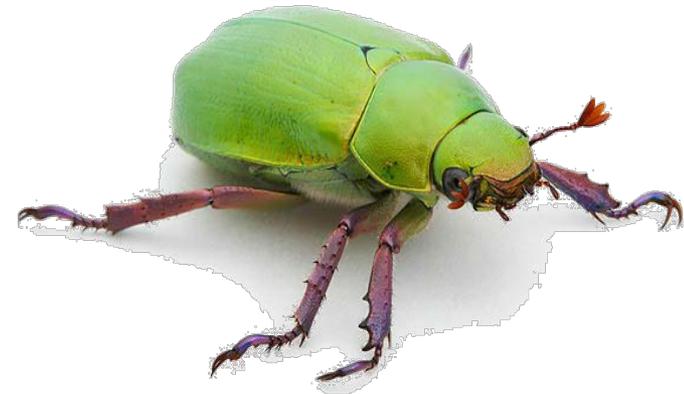
Freshwater sponges



- Freshwater sponges (Desomosponges)
- Range from freshwater to brackish
- Green from “zoochlorellae”
- Diapause (overwinter)
- Reproduction: gemmules
 - freezing/thawing
 - 3 years dried
 - anoxia conditions
- Nutrition mixotrophic with algal endosymbionts
- Sponge associations
- Caddisfly *Ceraclea fluva*
- Spongiflies

Order Coleoptera - Beetles

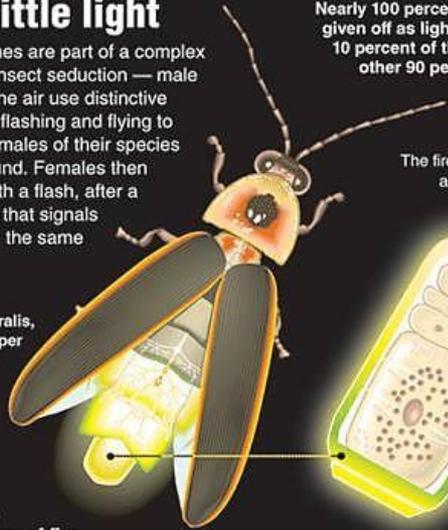
- Two pairs of wings
- Forewings (elytra) are veinless, toughened and horny, covering the entire abdomen and meeting at the midline
- Hindwings are membranous
- 0.5 - 190mm long
- Biting mouthparts
- Prothorax is large, and covered by the pronotum
- World-wide
- Habitats: from deserts to tropical regions, mainly ground dwelling and in vegetation, some aquatic
- Feed on most solids, including crops, timber, pepper and dry bone



This little light

Firefly flashes are part of a complex system of insect seduction — male fireflies in the air use distinctive patterns of flashing and flying to signal to females of their species on the ground. Females then respond with a flash, after a set interval that signals they are of the same species.

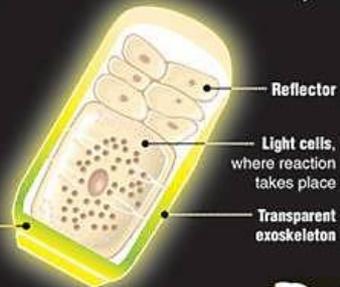
Photinus pyralis, the "Big Dipper Firefly"



Nearly 100 percent of the flash's energy is given off as light; in a standard lightbulb, 10 percent of the energy is light and the other 90 percent is given off as heat.

How it works

The firefly's light is produced during a chemical reaction. The light-emitting organ consists of three layers:



Distinctive flash patterns of five North American fireflies:

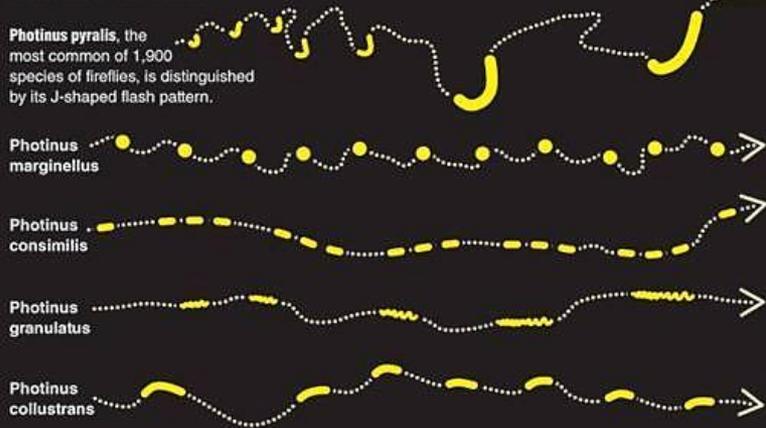
Photinus pyralis, the most common of 1,900 species of fireflies, is distinguished by its J-shaped flash pattern.

Photinus marginellus

Photinus consimilis

Photinus granulatus

Photinus collustrans



Order Strepsiptera - Stylopids, Twisted-wing Parasites

- Appearance of one pair of wings, females wingless
- Females are larviform and entirely endoparasitic
- Male forewings form small, stick-like balancers
- Male hindwings membranous, fan-shaped and used for flight
- Males are 1.5 to 4mm long
- Biting mouthparts are atrophied
- Male antennae are flabellate
- Male eyes are "raspberry-like"
- 560 species, World-wide
- Endoparasitic on insect hosts e.g. bugs, wasps and bees
- Mature adults do not feed, larvae and females are endoparasitic



Order Hymenoptera - Bees, Wasps, Ants, Ichneumons

- Two pairs of membranous wings
- Hind wings much smaller than forewings
- 0.21 - 67mm long
- Biting mouthparts
- World-wide
- Habitats: from woodland to desert
- Create own nests
- Feeding techniques vary from active predation to complete vegetarianism and nectar feeding
- Young are provisioned to varying degrees by parents / other adults



Eusociality

highest level of social organization in a hierarchical classification. Eusociality (sensu Batra and Wilson) is characterized by:

- cooperative brood care,
- overlapping adult generations and
- division of labor by reproductive and (partially) non-reproductive groups.



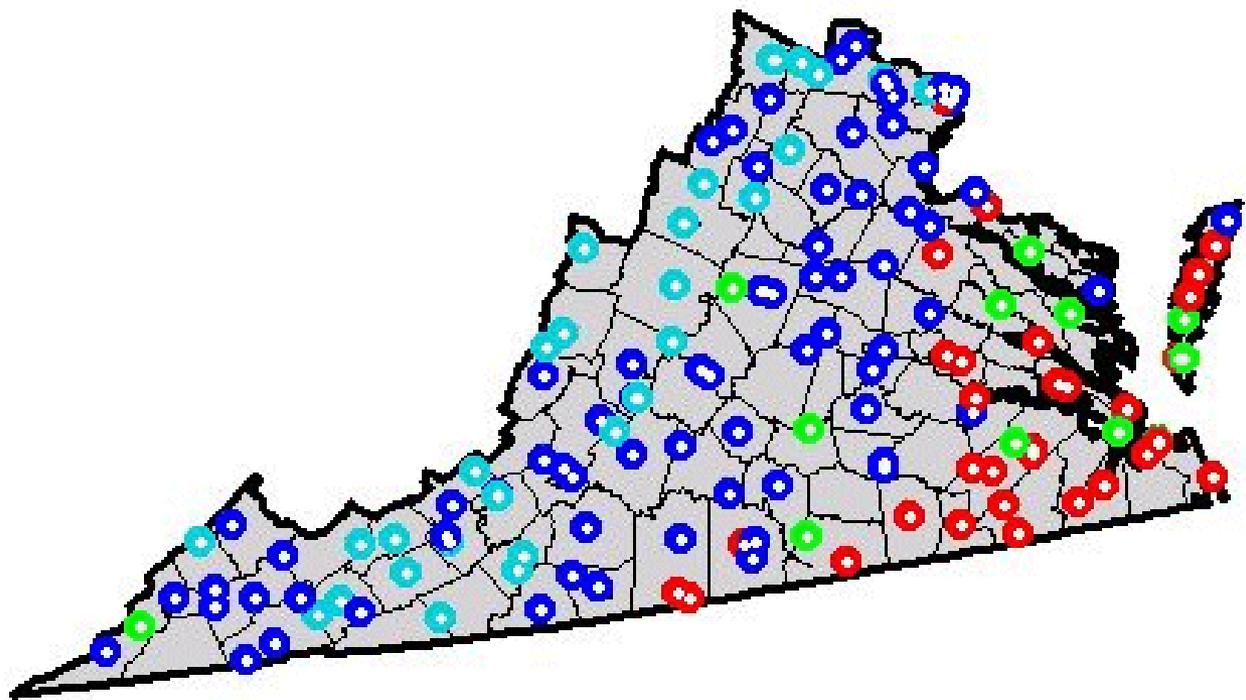




Potential Red Imported Fire Ant Range Expansion

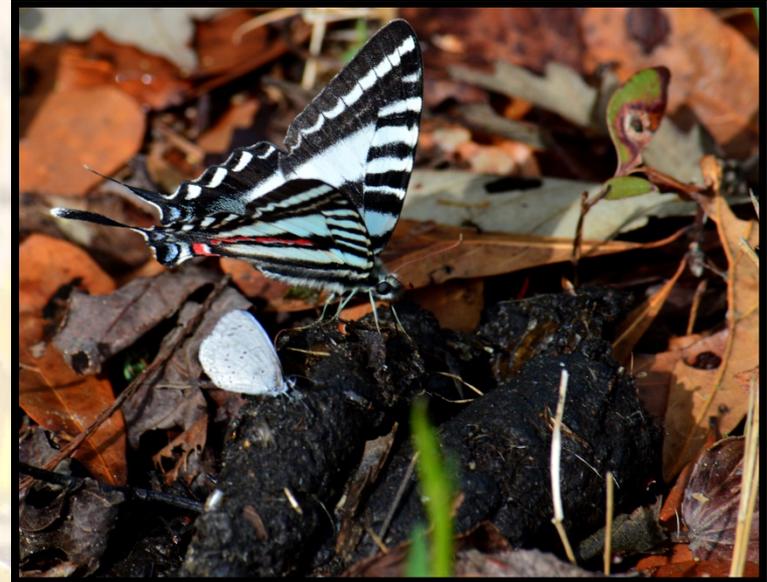
- RIFA Survival*
- Improbable
 - Undetermined
 - Possible
 - Certain

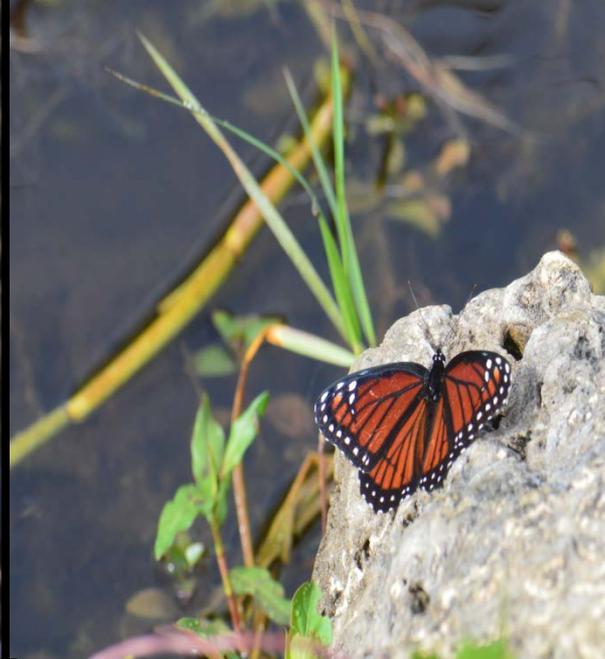
- Annual Rainfall*
- <Not enough
 - >Enough
- USDA Quarantine
(May 2000)



Order Lepidoptera - Butterflies, Moths

- Two pairs of membranous wings
- Both pairs covered in minute scales of various colours
- 3 - 280mm wing spans
- Mouthparts mainly suctorial, with proboscis
- World-wide
- Habitats: associated with higher plants, especially angiosperms
- Feed on liquids, usually nectar, the most primitive moths still eat pollen. Some drink tears, urine, and even blood





Butterflies-Psychophily

Flower Shape. Narrow tube with spur; wide landing pad

Opening. Day

Color. Bright red and purple

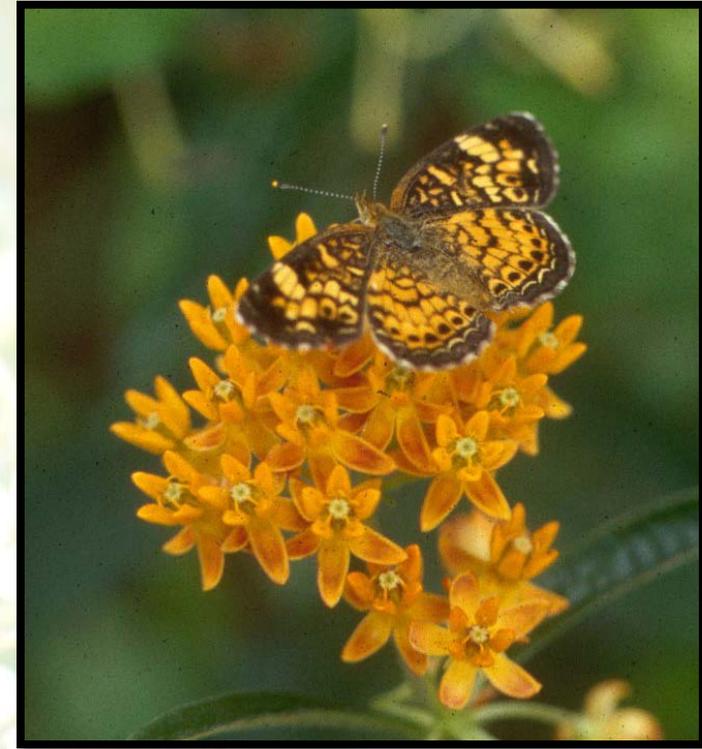
Nectar guides. Present

Odor. Faint but fresh

Nectar. Ample; deeply hidden

Nectar Comp. Sucrose-rich

Pollen. Limited



Moth-Phalaenophily



Flower Shape. Regular; tubular without a lip

Opening. Night

Color. Pale red, purple, pink or white

Nectar guides. None

Odor. Strong sweet; emitted at night

Nectar. Ample; deeply hidden

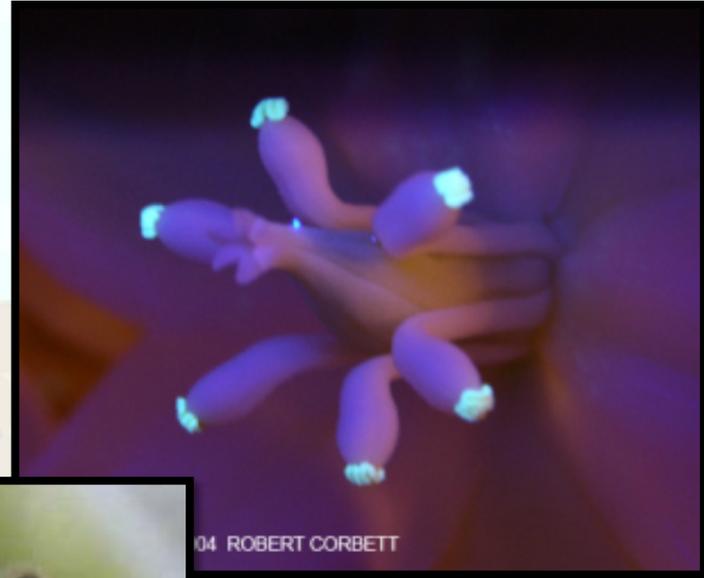
Nectar Comp. Sucrose-rich

Pollen. Limited



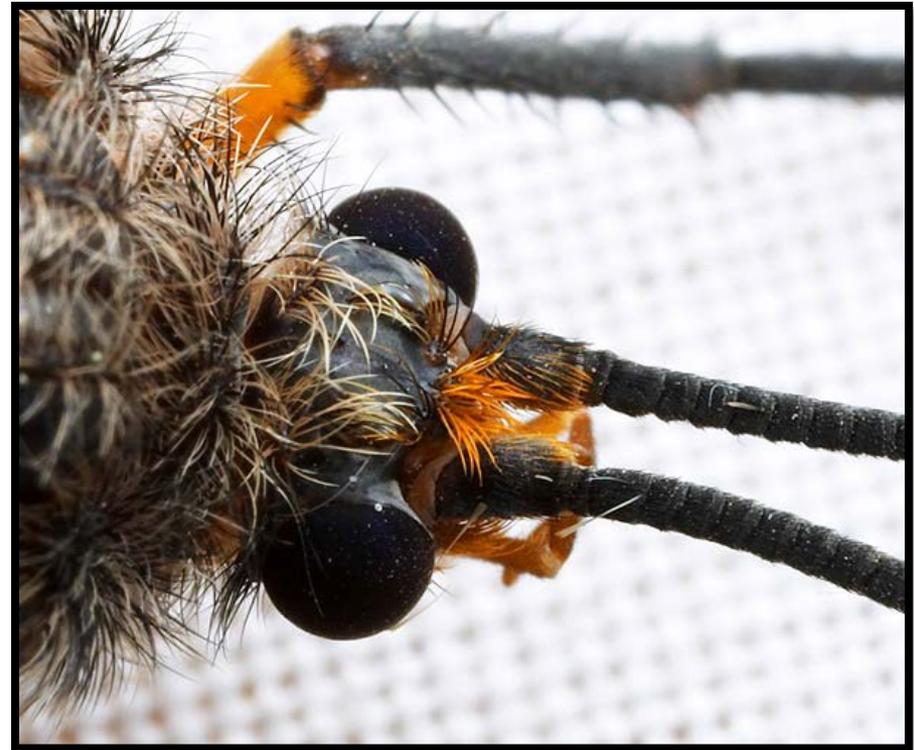
Yucca is a genus of perennial shrubs and trees in the family Asparagaceae a family of monocots.

Its 40-50 species are notable for their rosettes of evergreen, tough, sword-shaped leaves and large terminal panicles of white or whitish flowers.



Order Trichoptera - Caddisflies

- Two pairs of membranous, hair-covered wings
- Forewings are hairier and less transparent than hind wings
- Few cross veins on the wings
- Wings often have a whitish, hairless spot (thyridium) near the centre
- 1.4 - 40mm long
- Long, conspicuous palps
- No proboscis
- Habitats: in vegetation throughout the day, fly at night and attracted to lights,
- Adults generally do not feed, but may lap nectar



Order Mecoptera - Scorpion flies, Dance flies, Hanging flies



- Two pairs of membranous wings
- Body length: 10 - 20mm
Wingspan: up to 30mm
- Biting mouthparts
- Head extends downwards into "beak"
- Abdomen posterior upturned
- 500 species, 30 in Europe
- World-wide, more common in Northern Hemisphere
- Habitat: cool, shady locations, amongst low growing herbage, and hanging beneath vegetation
- Feed on dead animal and fruit, detected by olfaction. Prefer soft bodied arthropods, collect prey trapped on spiders' webs



© 2011 Werner Eigelsreiter

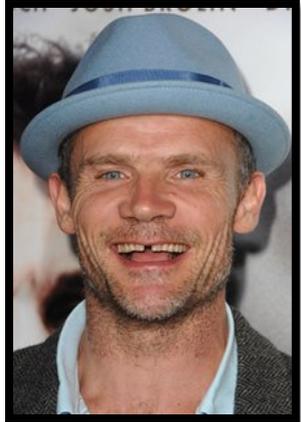


© - josef hlasek
www.hlasek.com
Boreus westwoodi bi8826

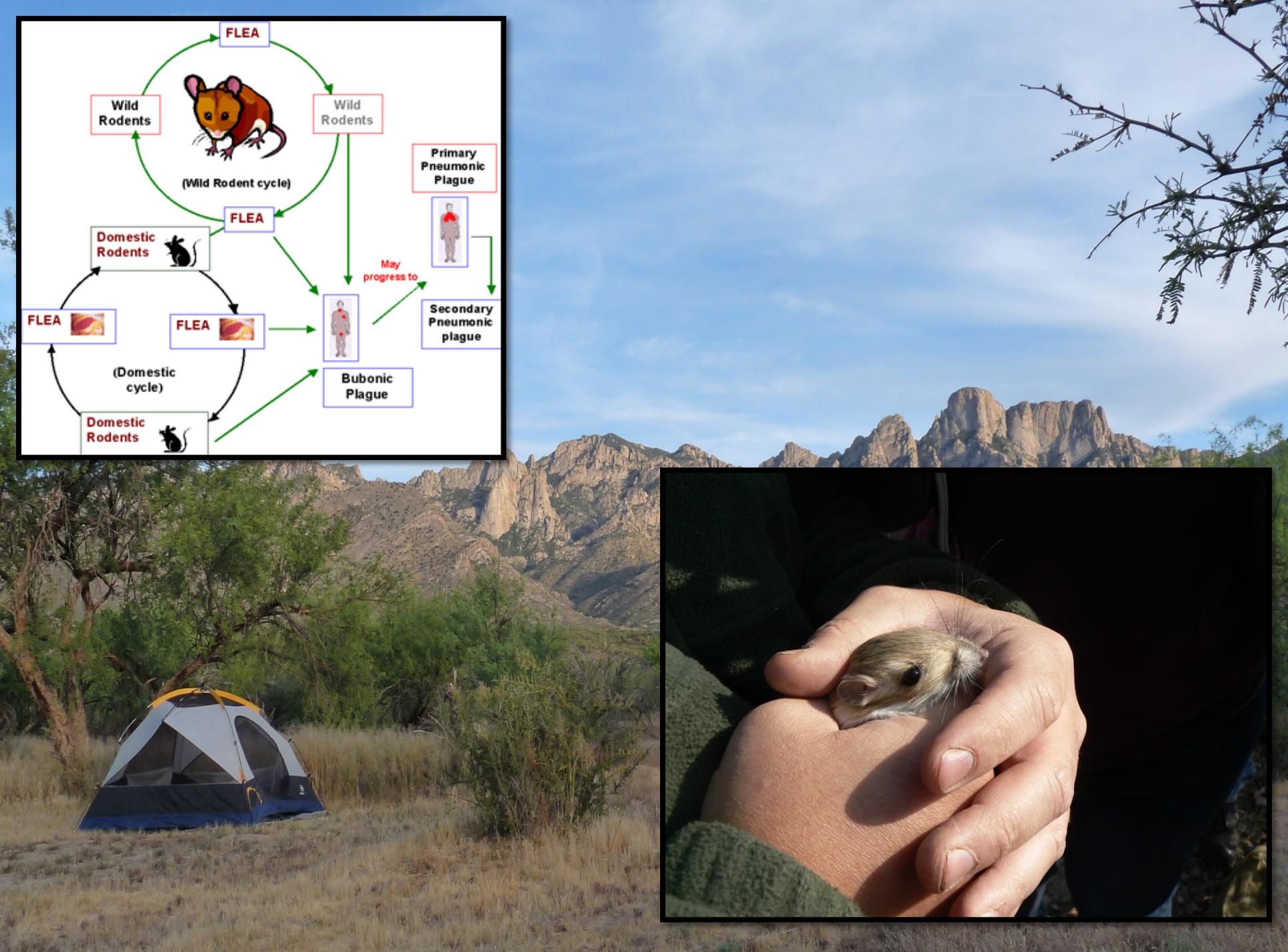
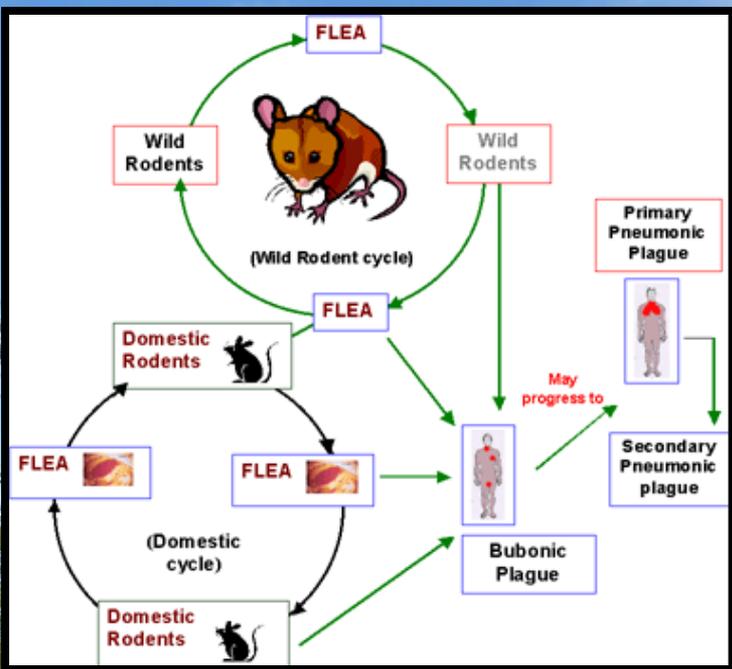


© 2006 Tom Murray

Order Siphonaptera - Fleas



- Wingless (adaptation to ectoparasitism)
- 1-10mm long
- Mouthparts are suctorial and piercing
- Hind legs are enlarged for jumping
- Laterally flattened
- Abdomen is heavily sclerotised
- Combs on head and thorax are important for identification
- Dark brown or black
- Antennae are short, and lie in grooves
- More than 2,000 species
- World-wide
- Ectoparasitic on mammals and birds, also found in hosts' nests and bedding
- Adults feed on blood, larvae feed on debris in host nest including adult flea faeces



Order Diptera - True Flies

- Appear to have one pair of wings
- Membranous forewings used for flight
- Hindwings form small stick-like halteres
- Body length: 1 - 60mm
Wingspan: few - 100mm
- Suctorial mouthparts
- No cerci on the abdomen
- Mainly associated with flowers and decaying organic matter
- Feed on vegetation and organic matter, some blood feeders and ectoparasites, some species do not feed at all as adults

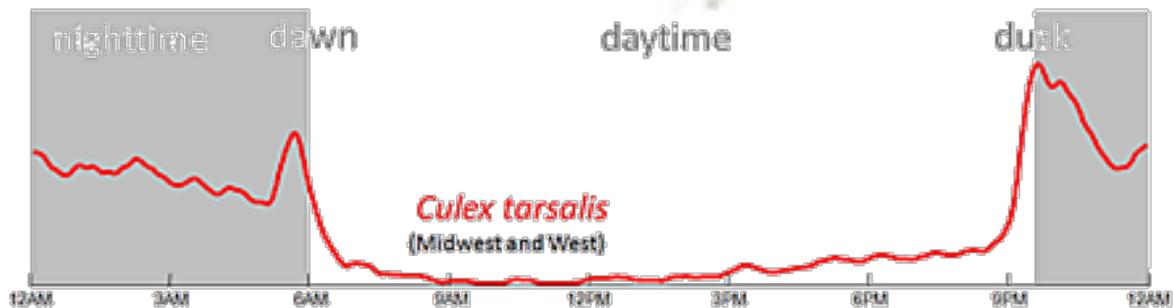
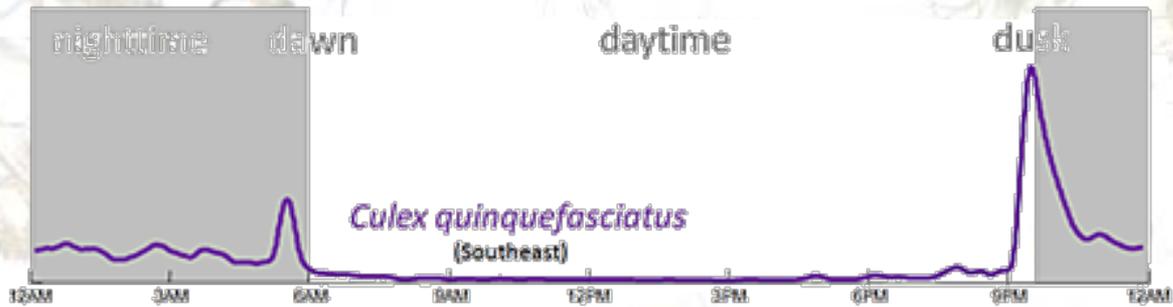


Behavior

Activity



Daily Activity Plots for two Mosquito Species that Transmit West Nile Virus



(c) Eamonn Keogh UCR

Behavior

Host Specificity

- Zoophilous
- Anthropophilous
- Ornithophilous

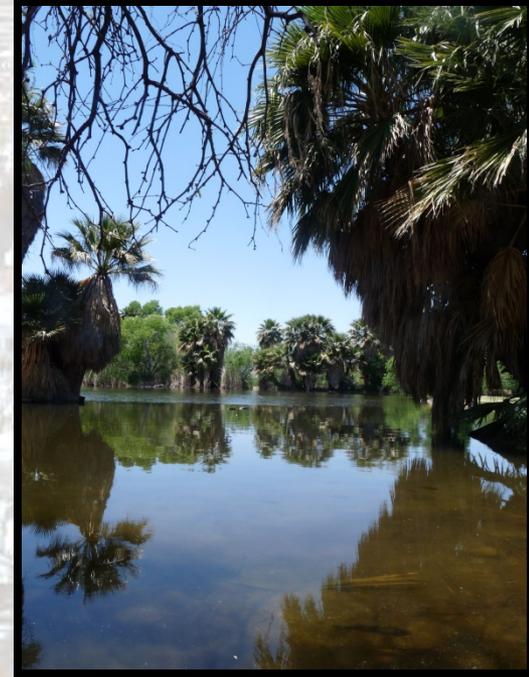




Mosquito Breeding Sites

Natural Vs. Man-made

- Tree holes
- Permanent water
- Vernal pools
- Swamps
- Salt Marshes
- Artificial Containers
- Tires
- Reflood areas
- Discarded Trash
- Landfills



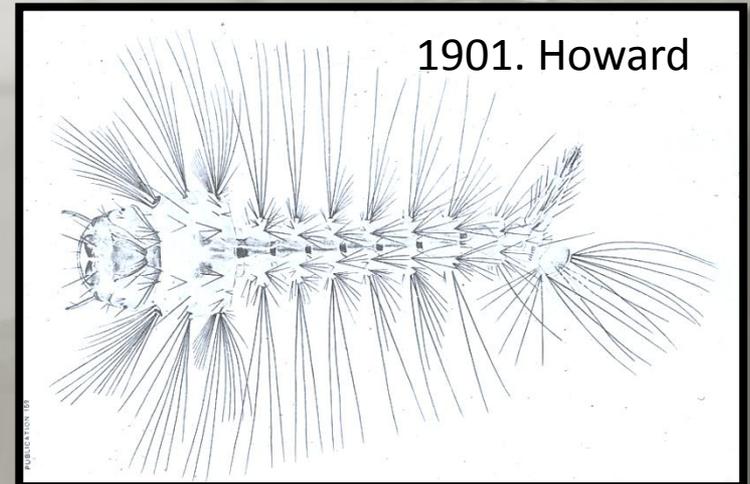
Carnivorous Plants

Something “new”

- *Wyeomyia smithii* live in phytotelma of *Sarracenia*.
- As do other mosquitoes (at times)
- Bacteria and protozoa diversity increases in presence of *W. smithii*.
- *not been observed since 1998 in Virginia*



Globe Staff Photo / Dina Rudick

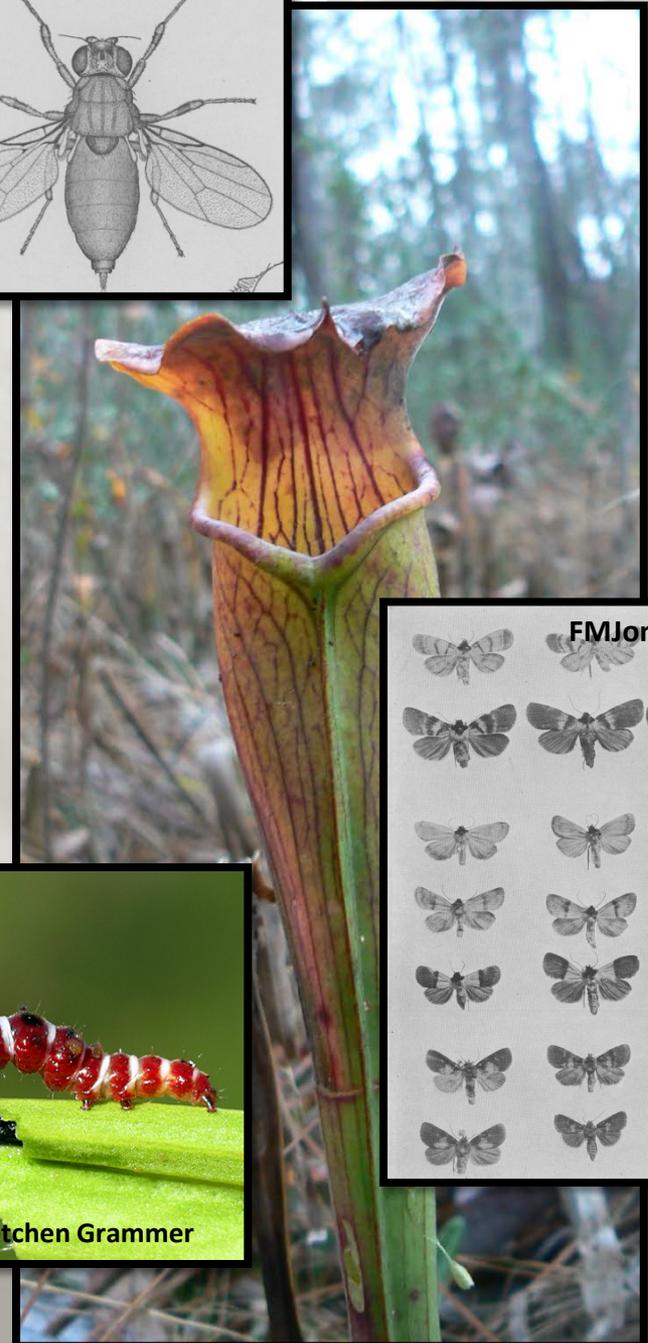
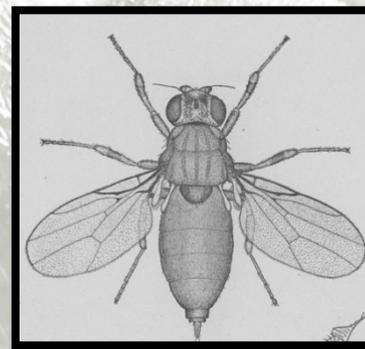


Carnivorous Plants

Something “new”

- Geometrid moth *Exyra* live on and pupate within pitcher plants.
- *Botanobia darlingtoniae* larvae feeding on upper leaves at orifice

Frank Morton Jones &
Carnivorous Plant Research



© 2006 Gretchen Grammer

Fly-Myophily



Flower Shape. Shallow; funnel-like or complex with trap

Opening. Day/night

Color. Pale, or dark brown, purple

Nectar guides. None

Odor. Putrid

Nectar. Usually absent

Nectar Comp. Amino acid-rich

Pollen. Limited



Thank you, for a wonderful night.