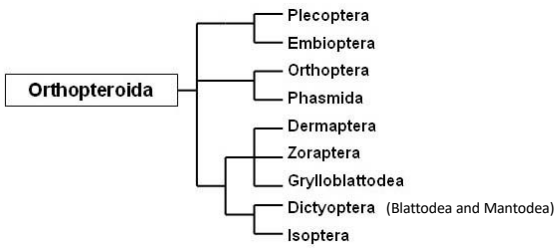
- Pterygota: Winged True Insects
  - Paleoptera: Ephemeroptera and Odonata
  - Neoptera: wings fold flat onto back
    - Exopterygota (simple metamorphosis)
      - Orthopteroida (mandibulate mouthparts, large anal lobe in the hind wing)



1

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ORDER: Plecoptera – Stoneflies

- aquatic larvae with thoracic gills and two caudal filaments (cerci)

2

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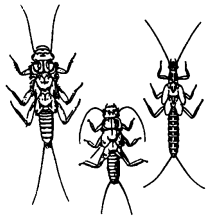
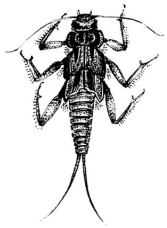
  - Paleoptera: Ephemeroptera and Odonata
  - Neoptera: wings fold flat onto back
    - Exopterygota (simple metamorphosis)
      - Orthopteroida (mandibulate mouthparts, large anal lobe in the hind wing)

ORDER: Plecoptera – Stoneflies

- aquatic larvae with thoracic gills and two caudal filaments (cerci)
  - nymphs feed on plants and algae; some are predaceous and / or omnivorous





3

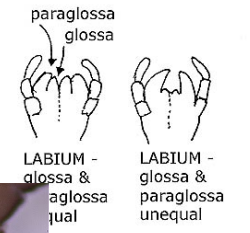
ORDER: Plecoptera – Stoneflies

- aquatic larvae with thoracic gills and two caudal filaments (cerci)
  - nymphs feed on plants and algae; some are predaceous and / or omnivorous
- many adults don't feed; they are soft-bodied and poor fliers. Wings are folded back over abdomen, and hind wing has a large anal lobe. Found near water.

4

ORDER: Plecoptera – Stoneflies

Two groups (by classification, not phylogenetically) distinguished by the relative sizes of glossae and paraglossae



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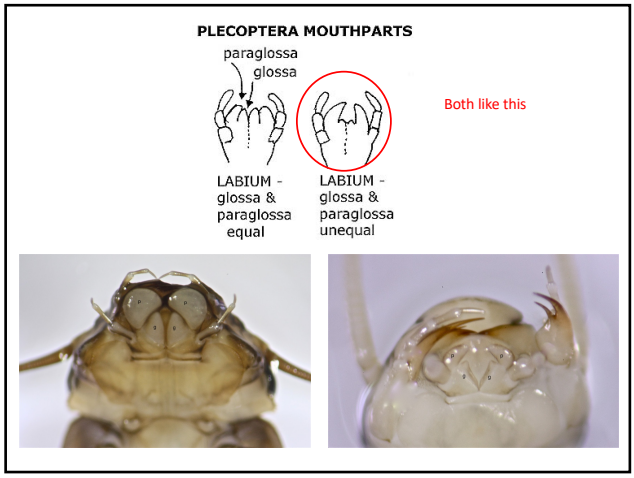


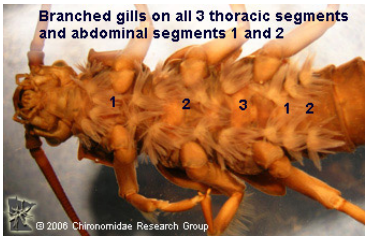
6

ORDER: Plecoptera – Stoneflies

Glossae and paraglossae about the same size:

1. Pteronarcyidae – Giant Stoneflies

- very large, may reach 55 mm in length!
- larvae with gill remnants on the first two abdominal segs.
- 3 ocelli; basal segment of tarsi shorter than 3rd (distal) segment



7

ORDER: Plecoptera – Stoneflies

Glossae and paraglossae about the same size:

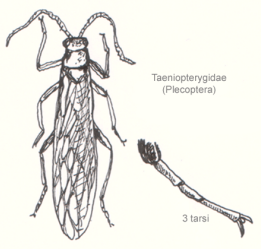
1. Pteronarcyidae – Giant Stoneflies
2. Peltoperlidae – Roach-like Stoneflies
   - glossae same size but no abdominal gills, 2 ocelli, basal tarsus shorter than 3rd

8

ORDER: Plecoptera – Stoneflies

Glossae and paraglossae about the same size:

1. Pteronarcyidae – Giant Stoneflies
2. Peltoperlidae – Roach-like Stoneflies
3. Taeniopterygidae – Winter stoneflies
   - glossae same size, tarsal segments are equal in length; in some the wingpads are highly divergent (though like this in other families, too).



9

ORDER: Plecoptera – Stoneflies

Glossae and paraglossae about the same size:

1. Pteronarcyidae – Giant Stoneflies
2. Peltoperlidae – Roach-like Stoneflies
3. Taeniopterygidae – Winter stoneflies
4. Nemouridae – Spring Stoneflies
   - glossae equal, tarsal length goes 2nd (shortest), third, basal (longest)
   - cerci short, wings flat at rest
   - larvae may have cervical gills

10

ORDER: Plecoptera – Stoneflies

Glossae and paraglossae about the same size:

1. Pteronarcyidae – Giant Stoneflies
2. Peltoperlidae – Roach-like Stoneflies
3. Taeniopterygidae – Winter stoneflies
4. Nemouridae – Spring Stoneflies
5. Leuctridae – Rolled-wing Stoneflies
   - short cerci in adult; wings roll around abdomen
   - glossae equal, tarsal length goes 2nd (shortest), third, basal (longest)

11

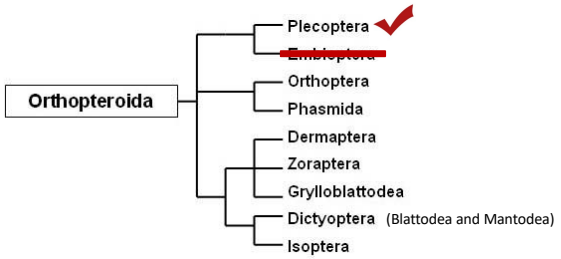
ORDER: Plecoptera – Stoneflies

Glossae and paraglossae about the same size:

1. Pteronarcyidae – Giant Stoneflies
2. Peltoperlidae – Roach-like Stoneflies
3. Taeniopterygidae – Winter stoneflies
4. Nemouridae – Spring Stoneflies
5. Leuctridae – Rolled-wing Stoneflies
6. Capniidae – Small winter stoneflies
   - glossae equal, tarsal length goes 2nd (shortest), third, basal (longest)
   - adults with long cerci

12

- Pterygota: Winged True Insects
  - Paleoptera: Ephemeroptera and Odonata
  - Neoptera: wings fold flat onto back
    - Exopterygota (simple metamorphosis)
      - Orthopteroida (mandibulate mouthparts, large anal lobe in the hind wing)

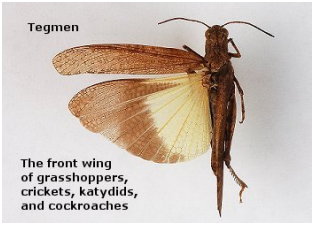


13

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

- most adults and nymphs feed on plant material, although some are predatory and some are scavengers.
- most are winged – with four wings in which the front wings are leathery **'tegmina' (singular is 'tegmen').** The wings fold fan-like over the back.

There are several families with exclusively western distributions… we'll forget about those!!

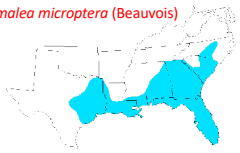


14

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

- Suborder Caelifera – "short-horned" grasshoppers (short antennae)

1. Romaleidae – Lubber Grasshoppers (1 in east) – *Romalea microptera* (Beauvois)



Huge (to 75mm) with reduced wings; hind wing red with black border.

15

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

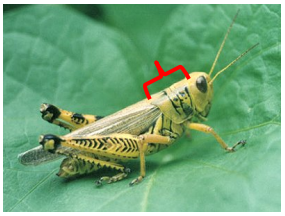
- Suborder Caelifera – "short-horned" grasshoppers (short antennae)

1. Romaleidae – Lubber Grasshoppers
2. Acrididae – Grasshoppers (>300 sp)
   - like other families in the suborder, antennae are short, tarsi are 3-segmented, auditory organ on first abdominal segment

16

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

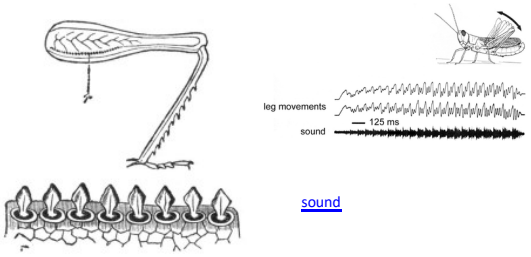
1. Romaleidae – Lubber Grasshoppers
2. Acrididae – Grasshoppers
   - like other families in the suborder, antennae are short, tarsi are 3-segmented, auditory organ on first abdominal segment
   - pronotum short – only covers thorax



17

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Romaleidae – Lubber Grasshoppers
2. Acrididae – Grasshoppers
   - like other families in the suborder, antennae are short, tarsi are 3-segmented, auditory organ on first abdominal segment- "call" two ways – some 'stridulate' by rubbing file on hind femur against the wing….



sound

Sounds and picture from: http://biology.nicerweb.com/Locked/media/ch01/Insects.html

18

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Romaleidae – Lubber Grasshoppers
2. Acrididae – Grasshoppers
   - like other families in the suborder, antennae are short, tarsi are 3-segmented, auditory organ on first abdominal segment
   - "call" two ways – some 'stridulate' by rubbing file on hind femur against the wing….

In North America, these are limited to the subfamily Gomphocerinae – the stridulating grasshoppers … they have a slanted face (but short antennae)

19

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Romaleidae – Lubber Grasshoppers
2. Acrididae – Grasshoppers
   - like other families in the suborder, antennae are short, tarsi are 3-segmented, auditory organ on first abdominal segment
   - "call" two ways – others in one subfamily (Oedinpodinae – "Banded-winged grasshoppers") clap wings in flight….

sound

Sounds and picture from: http://biology.nicerweb.com/Locked/media/ch01/Insects.html

20

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Romaleidae – Lubber Grasshoppers
2. Acrididae – Grasshoppers
   - like other families in the suborder, antennae are short, tarsi are 3-segmented, auditory organ on first abdominal segment
   - "call" two ways – some 'stridulate' by rubbing file on hind femur against the wing; others 'call' by clapping their wings in flight

   - extremely important as agricultural pets. From the locusts to the more speciose 'spur-throated grasshoppers', they can reach plague populations and devastate crop production.

video

21

22

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

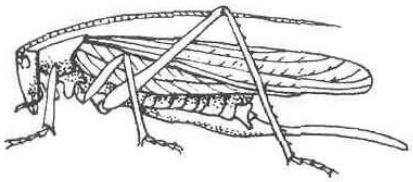
1. Romaleidae – Lubber Grasshoppers
2. Acrididae – Grasshoppers
3. Tetrigidae – Pygmy Grasshoppers
   - easy to distinguish because their pronotum is long and covers the abdomen

From: John R. Meyer, North Carolina State University. http://www.cals.ncsu.edu/course/ent425/spotID/Orthoptera/tetrigid.html

23

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

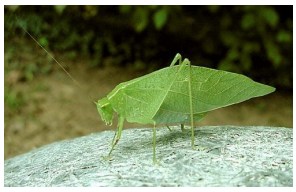
- **Suborder Ensifera**: the 'long-horned' grasshoppers, with antennae that are long and filametous, often longer than the body. The auditory organs are on the inside of the front tibia. Many with a long ovipositor.



24

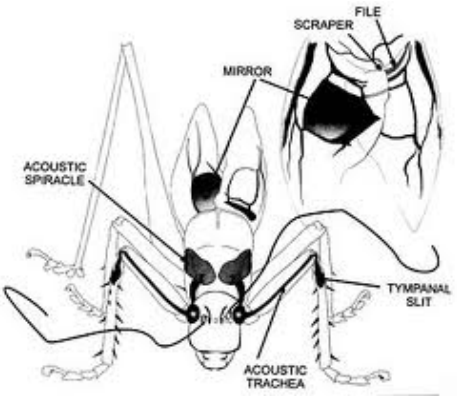
ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. **Tettigoniidae – Katydids**
   - long filamentous antennae, long ovipositors, tympani on front tibae, 4-seg tarsi.
   - most species stridulate by rubbing file on one wing against the other.



Songs at: http://entnemdept.ufl.edu/walker/buzz/141a.htm

25

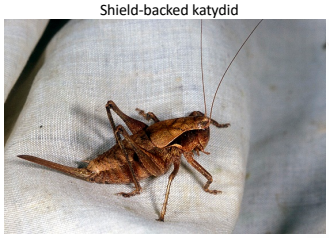


26

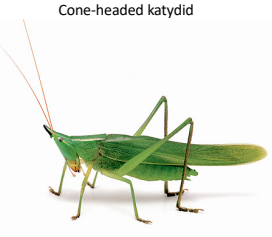
ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Tettigoniidae – Katydids
   - long filamentous antennae, long ovipositors, tympani on front tibae, 4-seg tarsi.
   - most species stridulate by rubbing file on one wing against the other.

Shield-backed katydid



Cone-headed katydid



27

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Tettigoniidae – Katydids
2. Rhaphidophoridae – Cave or Camel Crickets
   - brown, humpbacked, and living in dark places like caves, hollow trees, and crawlspaces.

28

New Zealand "Giant Weta's" – 11 species of giant 'crickets' (genus *Deinacrida*) – A good example of island gigantism – 4 inch bodies, up to 70 grams (heaviest insect recorded)

29

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Tettigoniidae – Katydids
2. Rhaphidophoridae – Cave or Camel Crickets
3. Gryllidae – Crickets
   - similar to tettigoniids, but tarsi are 3 segmented or less. Ovipositor is not flattened laterally, but is needle-like or cylindrical. They have tympani on fore tibia, and males stridulate with scraper and file like katydids. They are omnivorous.

Tree crickets

30

ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Tettigoniidae – Katydids
2. Rhaphidophoridae – Cave or Camel Crickets
3. Gryllidae – Crickets
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Ground cricket

House cricket

31

Bush cricket

32

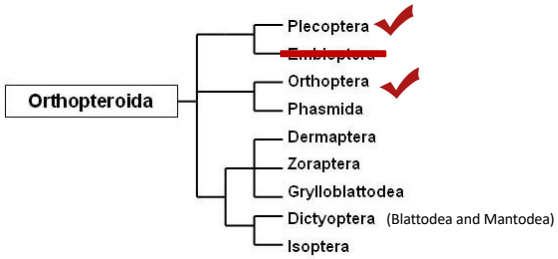
ORDER: Orthoptera – Grasshoppers, Katydids, and Crickets

1. Tettigoniidae – Katydids
2. Rhaphidophoridae – Cave or Camel Crickets
3. Gryllidae – Crickets
4. Gryllotalpidae - Mole Crickets

Rare but too cool to leave out… they burrow like moles, and have huge forelimbs modified for digging. The males stridulate. Can damage crops.

33

- Pterygota: Winged True Insects
  - Paleoptera: Ephemeroptera and Odonata
  - Neoptera: wings fold flat onto back
    - Exopterygota (simple metamorphosis)
      - Orthopteroida (mandibulate mouthparts, large anal lobe in the hind wing)



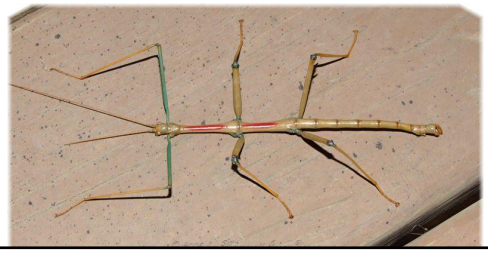
34

ORDER: Phasmida – Walking sticks

- sister group to the Orthoptera, they lack jumping legs, have 5-segmented tarsi (most), and elongate bodies with reduced or absent wings. Some species are apparently parthenogenetic, as no males have been found.

1. Heteronemiidae – Common Walking sticks

- uh, it's a walking stick! (mesothorax 4x length of prothorax)
- longest insect in U. S. : *Megaphasma denticrus* (Stal) – to 180mm



35

ORDER: Phasmida – Walkingsticks

1. Heteronemiidae – Common Walking sticks
2. Pseudophasmatidae – Striped Walking sticks

- first abdominal seg as long as metanotum
- there are several introduced species. Members of the genus *Anisomorpha* can spray a whitish chemical from a pronotal gland up to 40cm with great accuracy, aiming for the eyes.

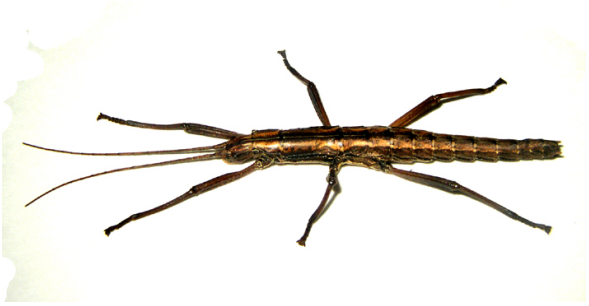
"Although Gray (1835) mentioned the defensive secretion of *A. buprestoides*, the first account of its effect on humans that could be located was by Stewart (1937), who wrote about an incident in Texas: "The victim was observing a pair of *Anisomorpha buprestoides* . . . with his face within two feet of the insects, when he received the discharge in his left eye. . . The pain in his left eye was immediately excruciating; being reported to be as severe as if it had been caused by molten lead. Quick, thorough drenching with cool water allayed the burning agony to a dull aching pain. The pain eased considerably within the course of a few hours. Upon awakening the next morning the entire cornea was almost a brilliant scarlet in color and the eye was so sensitive to light and pressure for the next forty-eight hours that the patient was incapacitated for work. Vision was impaired for about five days." Symptoms gradually disappeared and there were no lasting effects. Albert (1947) described a similar but less severe incident."
From: Thomas (2003).
http://entnemdept.ufl.edu/creatures/misc/walkingstick.htm

36

ORDER: Phasmida – Walkingsticks

1. Heteronemiidae – Common Walkingsticks
2. Pseudophasmatidae – Striped Walkingsticks

-Mesonotum at most 3x pronotum in length
- first abdominal seg as long as metanotum the eyes.



37

38

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  - Paleoptera: Ephemeroptera and Odonata
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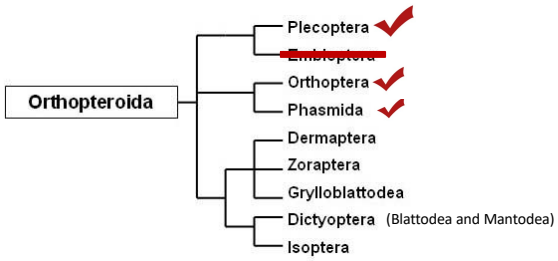
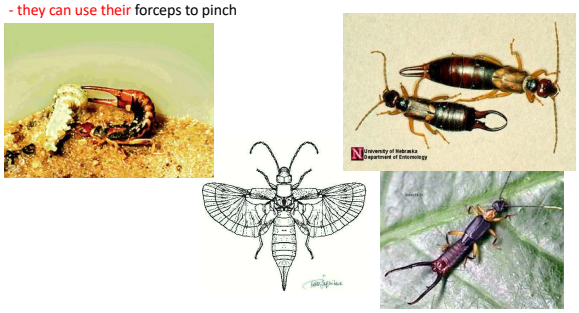
      - Orthopteroida (mandibulate mouthparts, large anal lobe in the hind wing)



39

ORDER: Dermaptera – Earwigs

- The order is distinguished by a pincer-like set of cerci called the forceps. They are winged or wingless insects; if winged, then the forewings are short and leathery and hide hind wings. Tarsi with three segments.
- Most are detritivores, some are herbivorous or predaceous
- some produce a foul-smelling fluid as a defensive secretion
- they can use their forceps to pinch



40

ORDER: Dermaptera – Earwigs

1. Forficulidae – European and Spine tailed Earwigs
 - second tarsal segment extends beyond the first (basal) segment, and it is expanded
 - antennae with 12-16 segments, yellow/brown

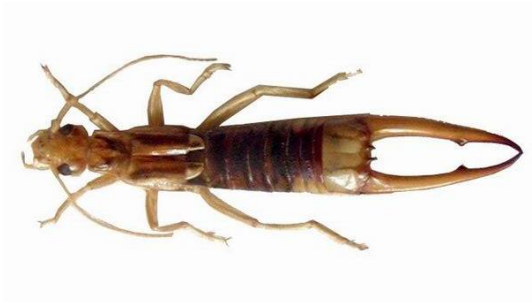
Spinetail (Genus *Doru*)

European earwig (male)

41

ORDER: Dermaptera – Earwigs

1. Forficulidae – European and Spinetailed Earwigs
2. Labiduridae – Striped Earwigs
 - Second tarsal segment normal
 - Antennae with 25-30 segments
 - pronotum often with stripes



42

ORDER: Dermaptera – Earwigs

1. Forficulidae – European and Spinetailed Earwigs
2. Labiduridae – Striped Earwigs
3. Anisolabididae – Seaside and Ring-legged Earwigs
 - second tarsal segment normal
 - male right forceps curves more than left
 - antennae 14-24 segments

43

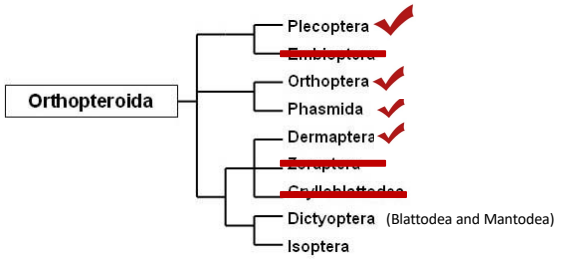
ORDER: Dermaptera – Earwigs

1. Forficulidae – European and Spinetailed Earwigs
2. Labiduridae – Striped Earwigs
3. Anisolabididae – Seaside and Ring-legged Earwigs
4. Labiidae – Little Earwigs
 - antennae 10-16 segments

Labia minor - 7mm, gold hairs

44

- Pterygota: Winged True Insects
  - Paleoptera: Ephemeroptera and Odonata
  - Neoptera: wings fold flat onto back
    - Exopterygota (simple metamorphosis)
      - Orthopteroida (mandibulate mouthparts, large anal lobe in the hind wing)



45

ORDER: Mantodea – Mantids

two families, but one is limited to Florida

1. Mantidae – Mantids

Stagomantis carolina

46

Gonatista grisea
Lichen mimic native to southeastern U.S.

Ootheca – egg case

47

Chinese mantis – *Tenodera aridifolia*

48

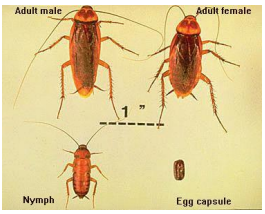
ORDER: Blattodea – Roaches

- head is concealed from above by an enlarged pronotum
- legs unmodified for jumping, grasping
- usually **no stridulating organs**
- tarsi 5-segmented
- wings generally present, but may be reduced
- eggs also in oothecae
- omnivorous

49

ORDER: Blattodea – Roaches

1. Blattidae
- ventroposterior margin of front femora with spines of equal length, or decreasing in length distally
- female subgenital plate divided lengthwise; male styli similar
- generally large (25mm)
- includes the Oriental cockroach (*Blatta orientalis* L.) and American cockroach (*Periplaneta americana* (L.)) . The American is large (2 in.) – "Palmetto Bugs" – (from Africa)



50

ORDER: Blattodea – Roaches (~50)

1. Blattidae
2. Blatellidae
- spines on front femora quite variable
- smaller
- subgenital plate of female entire (not divided)

Wood roach
Parcoblatta spp.

German cockroach
Blattella germanica (L.)

Brown-banded cockroach
Supella longipalpa (Fabricius)

51

ORDER: Blattodea – Roaches (~50)

1. Blattidae
2. Blatellidae
3. Blaberidae
- includes the largest roaches in U. S.
- spines on front femora just at tip, or also three on ventromedial margin
- no oothecae; they retain it in uterus and give live birth

Madiera cockroach
Rhyparobia maderae

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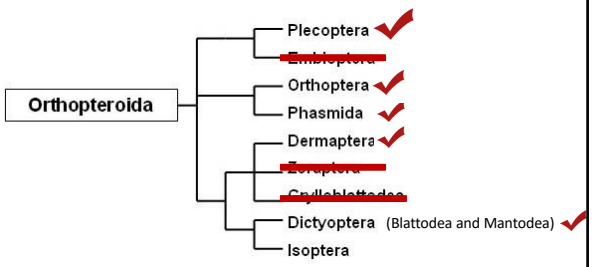
- Pterygota: Winged True Insects
  - Paleoptera: Ephemeroptera and Odonata
  - Neoptera: wings fold flat onto back
    - Exopterygota (simple metamorphosis)
      - Orthopteroida (mandibulate mouthparts, large anal lobe in the hind wing)

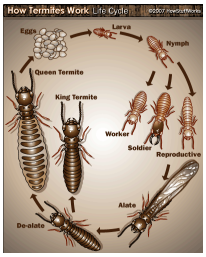


53

ORDER: Isoptera – Termites

- Hormones and inhibitory phernomes secreted by the reproductive and soldiers determine caste in male and female nymphs; they can develop into any caste.
- Wings are similar in size (isoptera) in the reproductive (the caste with wings)
- soft-bodied except for the king and queen.

Reproductives leave a colony in a mating swarm – pairing to establish new colonies. After the 'nuptual flight', the reproductives lose their wings.



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ORDER: Isoptera – Termites

- Hormones and inhibitory phernomes secreted by the reproductives and soldiers determine caste in male and female nymphs; they can develop into any caste.
- Wings are similar in size (isoptera) in the reproductives (the caste with wings)
- soft-bodied except for the king and queen.

Reproductives leave a colony in a mating swarm – pairing to establish new colonies. After the 'nuptual flight', the reproductives lose their wings.

Queens grow into an egg machine and live for 20 years

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ORDER: Isoptera – Termites

Soldiers and nasutes (in some colonies) product the colony. Soldiers have huge jaws and nasutes have a 'squirt-head'. In Cryptotermes, the soldiers have a block-head that blocks the termite burrow.

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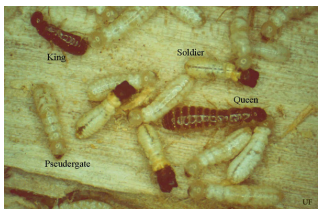
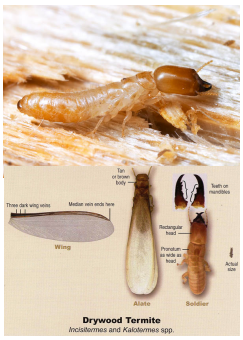
ORDER: Isoptera – Termites

1. Kalotermitidae - Drywood, Dampwood, and Powderpost termites
 - they do not construct earthen tubes, tending to only create cavities in the wood.
Reproductives have ocelli; soldiers have blunt, concave heads





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ORDER: Isoptera – Termites

1. Kalotermitidae - Drywood, Dampwood, and Powderpost termites
2. Rhinotermitidae – Subterranean termites
 - build earthen tubes and maintain contact with the ground
 - a fontanelle on the head
 - small

Reticulitermes flavipes – nest in soil, then colonize wood in a home.

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