Laboratory Identification of Arthropod Ectoparasites

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Faculty Disclosure

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“Nothing to disclose”.
Objectives

• Recognize common arthropod ectoparasites commonly submitted to diagnostic labs
• Understand the level of identification and reporting for various arthropods
Reporting Conundrums!

- http://www.extension.org/
- State Entomologist
- University with Entomology Program
What arthropods are of public health concern?

- Ectoparasites/visceral parasites of humans (hard ticks, scabies mites, lice, myiasis-causing flies, fleas, pentastomids).
- Casual blood-feeders (soft ticks, bed bugs, triatomine bugs, blood-sucking flies).
- Vectors of disease (mosquitoes, sand flies, black flies, triatomine bugs, ticks).
- Mechanical transmission of disease (e.g., house flies).
- Intermediate hosts for parasites (e.g., *Dipylidium*, *Hymenolepis*, *Paragonimus*, acanthocephalans).
- Stinging insects (bees, wasps, ants).
- Venomous spiders, scorpions, centipedes.
- Insects toxic to touch/ingest (blister beetles, stinging caterpillars).
- Allergic reactions (e.g., dust mites and their feces).
Ticks
Ticks

- Taxonomy: Acari: Ixodidae (hard ticks) and Argasidae (soft ticks).
- Obligate ectoparasites of terrestrial vertebrates.
- Possess eight legs; eyes present or absent; no wings and no antennae. Ixodid ticks have the mouthparts visible from above and possess a hardened dorsal shield (scutum). Argasid ticks have the mouthparts hidden from above and lack a scutum.
- In ixodid ticks, dorsal shield covers most of the body in the males and (approx.) anterior third in females.
- Vectors of many viral, bacterial, rickettsial, and parasitic diseases.
- Implicated in tick paralysis and tick toxicoses.
Hard (Ixodid) Tick - Anatomy

Note: some features such as festoons and anal groove may be difficult to discern in engorged specimens.
Hard Ticks-Life Cycle
**Dermacentor spp.**

- Commonly known as ‘American dog tick’.
- Vectors of agents of *Rickettsia rickettsii* (spotted fever rickettsiosis), Colorado tick fever virus, *Francisella tularensis* (tularemia), Central European tick-borne encephalitis virus, *Rickettsia sibirica* (Siberian tick typhus); implicated in tick paralysis.
- Ornate dorsal shield.
- Mouthparts short in relation to basis capituli.
- Eyes on dorsal shield.
- Festoons present.
- Species-level identification often requires examination of spiracular plate.
Dermacentor spp.
Dermacentor spp.
**Ixodes spp.**

- Commonly referred to as ‘deer ticks’ or ‘black-legged ticks’.
- Mouthparts long, in relation to basis capituli.
- Inornate dorsal shield.
- No festoons or eyes.
- Inverted U-shaped anal groove (may be difficult to see in engorged specimens).
- Depending on geographic location, it may be desirable to report gender, stage, and degree of engorgement.
Ixodes spp.
Ixodes spp.
Amblyomma spp.

- *A. americanum* is a vector of *Francisella tularensis* (tularemia), *Ehrlichia chaffeensis* (ehrlichiosis), *E. ewingii* (human granulocystic ehrlichiosis); *A. maculatum* is a vector of *Rickettsia parkeri* (tidewater spotted fever); *A. hebraeum* in Africa transmits boutonneuse fever (*Rickettsia conorii*).

- Mouthparts long in relation to basis capituli.
- Festoons and eyes present.
- Ornate dorsal shield.
- Round body that often keeps a round shape when engorged.
Amblyomma americanum
**Rhipicephalus sanguineus**

- Commonly known as the ‘brown dog tick’.
- Not an efficient vector of disease but there are reports/outbreaks of *Rickettsia rickettsii*.
- Laterally produced, angulate basis capituli.
- Mouthparts short in relation to basis capituli.
- Eyes and festoons present.
- Deeply-cleft front coxae.
Rhipicephalus sanguineus
# Hard Ticks - Review

<table>
<thead>
<tr>
<th>Genus</th>
<th>Dorsal Shield (ornate-with white maculae)</th>
<th>Mouthparts (palps and hypostome, length in relation to basis capituli)</th>
<th>Festoons</th>
<th>Eyes</th>
<th>Anal Groove</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Amblyomma</em></td>
<td>Ornate</td>
<td>Longer than basis capituli</td>
<td>Present</td>
<td>Present</td>
<td>Chalice-shaped</td>
</tr>
<tr>
<td><em>Dermacentor</em></td>
<td>Ornate</td>
<td>Subequal in length to basis capituli</td>
<td>Present</td>
<td>Present</td>
<td>Chalice-shaped</td>
</tr>
<tr>
<td><em>Ixodes</em></td>
<td>Inornate</td>
<td>Longer than basis capituli</td>
<td>Absent</td>
<td>Absent</td>
<td>Inverted, U-shaped</td>
</tr>
<tr>
<td><em>Rhipicephalus</em></td>
<td>Inornate</td>
<td>Subequal in length to basis capituli</td>
<td>Present</td>
<td>Present</td>
<td>Chalice-shaped</td>
</tr>
</tbody>
</table>
Ornithodoros spp.

- Soft ticks.
- *Ornithodoros* spp. in North America are vectors of tick-borne relapsing fever (TBRF) spirochetes; in Africa *O. moubata* vector of African TBRF spirochetes; in Panama and South America *Carios rudis* primary vector of TBRF spirochetes.
- No dorsal shield.
- Mouthparts hidden from above.
- Nymphs and adults do not reside on the host, but rather feed for short periods of time before returning to sheltered location.
Soft ticks-Life cycle

1. Eggs hatch into six-legged larvae.
2. Larvae attach to and feed on first host.
3. Larvae molt into the first nymphal stage after leaving the first host.
4. Nymphs feed on a second host.
5. Nymphs leave host and molt in shelter area.
6. Nymphs feed on a third host. This cycle is repeated for up to seven nymphal stages.
7. After 2-7 nymphal stages, nymphs leave the last host and molt into adults in the shelter area.
8. Adults may feed several times on host, returning to shelter area between meals.

⚠️ = Infective Stage
⚠️ = Diagnostic Stage
Soft Ticks
Scabies
Scabies

• Caused by the scabies or itch mite, *Sarcoptes scabiei*.
• Cutaneous parasites that usually reside in the stratum corneum.
• Like ticks, have larval, nymphal and adult stages.
• Causes severe itching, especially upon subsequent infections. Crusted form of disease known as ‘crusted’ or ‘Norwegian’ scabies.
• Highly-contagious, person-to-person contact.
• Adults are small, females 0.3-0.45 mm; males smaller.
• Legs highly-reduced.
• Mites (as well as their feces and eggs) usually found in skin scrapings.
Scabies
Scabies
Demodex spp.

- *Demodex folliculorum* and *D. brevis* reside in the pilosebaceous follicles on the forehead, face, nose and eyelids.
- Do not typically cause disease in humans, but their presence in skin biopsies may lead to confusion with scabies.
- Long and slender, 0.3 mm in length.
Avian mites

• Avian mites (i.e., *Ornithonyssus sylviarum*) may infest homes and bite people when their normal host is not available.
• Cannot survive on the human host and eventually die and fall off.
• Not vectors of disease in humans.
Pediculosis
Pediculosis (head and body lice)

- Caused by the human head (*Pediculus humanus capitis*) and body (*P. h. humanus*) lice.
- Typically asymptomatic, but may lead to severe itching, the scratching of which could lead to secondary bacterial infections.
- Transmission of *Rickettsia prowazekii* (epidemic typhus); *Bartonella quintana* (trench fever); *Borrelia recurrentis* (louse-borne relapsing fever).
- Highly-contagious, direct contact or fomites.
- Adults characterized by having six legs ending in raptorial claws, eyes present, one pair of antennae, wings absent.
- Incomplete metamorphosis; *P. h. humanus* resides on fomites, travels to humans to feed; *P. h. capitis* resides on human for all stages.
- Adult females 3-4 mm in length; males slightly smaller.
Lice - Anatomy
Pediculosis
Pediculosis
Phthiriasis (pubic lice)

- Caused by the pubic louse, *Phthirus pubis*.
- Usually reside in pubic region, but may be found anywhere hairy on the body, esp. coarse hair.
- Usually asymptomatic; itching can occur due to allergies to lice saliva.
- Contagious, direct sexual contact or fomites (rare).
- All stages occur on the human host.
- Adults are broader than long, have six legs with claw-like tarsi—claws larger on middle and hind legs; eyes and antennae present; wingless.
Phthiriasis

CDC
http://www.dpd.cdc.gov/dpdx

= Infective Stage
= Diagnostic Stage

Pthirus pubis

Egg → 1st nymph → 2nd nymph → 3rd nymph → Adult

Phthiriasis
Nits: *Pediculus* vs. *Phthirus*

*Pediculus humanus*  
*Phthirus pubis*

Images courtesy of Dr. Bobbi Pritt.
Myiasis
Myiasis

- Infestation or colonization by fly larvae (maggots).
- Usually caused by blow flies (Calliphoridae) or bot flies (Oestridae).
- *Dermatobia* (Neotropical); *Cochliomyia* (Neotropical); *Cordylobia* (Afrotropical); *Cuterebra* (Northern Hemisphere), *Oestrus* (sheep-raising areas); *Lucilia* (nearly cosmopolitan).
- Cutaneous, ocular, facultative, intestinal**, urinary**.
- In true myiasis, larvae will consume and damage healthy tissue; facultative myiasis usually results in consumption of dead/dying tissue (i.e., in wounds).
- Removal is curative; a species-level identification is not necessary for patient management.
Myiasis

1. adult
2. Eggs are laid on a blood-sucking vector
3. Larvae enter the host after the vector takes a blood meal
4. i = Infective Stage
5. d = Diagnostic Stage
6. pupa in soil
7. larva

http://www.dpd.cdc.gov/dpdx
Dermatobia hominis
Cochliomyia hominivorax
Oestrus ovis
Cordylobia anthropophaga
Cuterebra spp.
Fleas

• Obligate ectoparasites of the order Siphonaptera.
• Holometabolous life cycle (egg, larva, pupa, adult). Only adults parasitic, larvae are free-living and feed on organic material in bedding or nest of host.
• Adults are laterally compressed, wingless; mouthparts adapted for blood-feeding; specialized muscles in hind legs for jumping.
• Vectors of several bacterial and rickettsial diseases. Diseases may be transmitted by biting (plague) or by the rubbing of flea feces into wounds and cuts (typhus, other rickettsial diseases, *Bartonella*).
• Some are intermediate hosts of helminthic diseases.
• Tungiasis is condition caused by specialized species in the genus.
Fleas - Anatomy
Fleas

*Xenopsylla cheopis*  
*Ctenocephalides felis*
Tungiasis

- Infection with the chigoe fleas, *Tunga penetrans* and *T. trimammillata*.
- *Tunga penetrans* is circumtropical in distribution; *T. trimammillata* occurs in Peru, Ecuador, and Brazil.
- Females are cutaneous in the human host. Adults usually reside under and between the toes and other areas on the feet.
- Itching and tenderness can start as the gravid female becomes engorged; severe cases can lead to difficulty in walking. Secondary myiasis and bacterial infections are possible.
- Diagnosis is usually made by observing features of flea in biopsy specimens or examination of eggs liberated from lesion.
Tungiasis

1. Eggs hatch into larvae.
2. Eggs shed by female into environment.
3. Larvae form pupae.
4. Adults hatch from pupae.
5. Adult females burrow into the stratum granulosum.

= Infective Stage
= Diagnostic Stage

http://www.dpd.cdc.gov/dpdx
Tungiasis
Tungiasis
Bed Bugs
Bed Bugs

• Two species usually associated with humans: *Cimex lectularius* (cosmopolitan) and *C. hemipterus* (tropics).
• Not effective vectors of disease; symptoms are usually allergic reactions to components of their saliva.
• Casual feeders; do not reside on human host and hide in sheltered areas between feedings. Very reclusive.
• Body dorsoventrally flattened. Adults have six legs and one pair of antennae; wings reduced to shortened wing buds (not capable of flight); piercing-sucking mouthparts.
• Incomplete metamorphosis; all nymphal stages as well as adult feed on humans.
Bed bugs-Life Cycle
Bed Bugs
Questions ?