**Category C: Arthropods of Public Health Significance**

**Epidemiology**:study of disease distribution

**Vector-borne diseases**: infectious diseases in which pathogens are transmitted by insects or other arthropods. Zoonoses most common

**Epidemic**: unusually large number of cases of a disease in humans in a short period of time

**Epizootic**: an outbreak of a disease in animals

**Endemic**: a constant occurrence of a disease in an area (in humans)

**Enzootic**: a constant occurrence of a disease in an area (in animals)

**Anthroponosis**: infectious disease of humans that can be secondarily transmitted to animals (eg. TB, influenza)

**Zoonosis**: infectious disease of animals that can be secondarily transmitted to humans

**Lifecycle of a vector-borne disease**

Host

Pathogen

Environment

Vector

**Parasite**: an organism living on a host organism at expense of the host; inside a host (endoparasite) and living outside/on the host (ectoparasite)

**Pathogenicity**:

**Virulence**:

**Vector incrimination**: process of determining which species of arthropod vectors a particular disease.

**Vectorial capacity**: potential of a group of arthropods to transmit a disease/pathogen [total # of secondary infections]

**Vector competence**: ability of arthropods to acquire, maintain, and transmit a disease

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**Methods of disease transmission**

**1. Mechanical**: pathogen carried on legs, bodies, or via regurgitation or defecation

**2. Biological**: following changes happening inside vector

i. **Propagative**: pathogen multiply, but no change in form (eg. Plague and most viral diseases)

ii. **Cyclical**: pathogen undergo molt, but no multiplication (eg. filariasis)

iii. **Propagative & Cyclical**: both multiplication and form change (eg. protozoan parasites—malaria, leishmaniasis)

**3. Horizontal or Vertical (aka transovarial)**

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**Cockroaches** (know common names and indoor/outdoor or habitat preferences)

-Semi-social; egg case is called ootheca; 5-7 nymphal instars (wks to more than a year)

-Can mechanically transfer disease

-develop anywhere that has moderate temp and humidity and access to food and water

1. **German cockroach** (*Blatella germanica*):

-Most widespread and troublesome domestic cockroach in the US

-Exclusively Indoor species

-2 dark, longitudinal, parallel streaks on their pronotum (“head”)

-prefer dark, moist areas (~84 degree F) and close to food (eg. kitchen)

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1. **Brownbanded cockroach** (*Supella longipalpa*):

-Exclusively Indoors

-2 dark, transverse bands; pronotum mostly dark brown with light, yellowish edges

-Prefer temp >80 degree F, so found near ceilings or in the upper-story rooms

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1. **Oriental cockroach** (*Blatta orientalis*):

-Primarily Outdoors

-Females wingless; adults 1-1.25” long; also known as “water bug” or “water beetle”

-Like cool, moist, dark areas with vegetation::: can enter structures from there

-Cannot climb smooth surfaces unlike other spp.

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1. **American cockroach** (*Periplaneta americana*):

-Most common domestic sp. associated with sewer systems, subway tunnels::: from which they can access structures

-Large size (adults 1.5-2”); reddish brown wings and paler pronotum edges

-Long lived (may survive several years)

-Prefer dark, high humidity areas

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1. **Smokybrown cockroach** (*Periplaneta fuliginosa*):

-Primarily outdoors- in trees or dense vegetation

-Looks very similar to *P. americana*, but has uniform dark coloration

-When indoors, they are found in areas that are usually heated

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**Control of cockroaches**:

-Exclusion (preventing their entrance to the structures, especially where they have access to food. Eg. sealing openings- screen doors, windows, etc.)

-Improved sanitation (eg. clean garbage scraps, dirty dishes, throw garbage in containers with tight fitting lids)

-Vacuum with high velocity vacuum cleaners with HEPA filters (cockroaches aggregate)

-Sprays and powders for cracks and crevices (follow instruction on labels)

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**Lice** (know common names)

**-Two orders**: Mallophaga (biting/chewing lice- mostly found in bird nests) and Anoplura (sucking lice- humans and other mammals)

-3 nymphal instars

-Under optimal condition- one generation in a month

1. **Head louse** (*Pediculus humanus capitis*)

-no disease

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1. **Body louse** (*Pediculus humanus corporis*): mostly found in clothing

-Epidemic typhus (*Rickettsia prowzekii*): rapid fever, headache, malaise, blotchy rash on chest or addomen (10-14 days after exposure)

-Trench fever (*Bartonella quintana*): headache, myalgia, nausea, fever (can be asymptomatic, mild, or severe)

-Louse-borne (epidemic) Relapsing fever (*Borrelia recurrentis*): when infected lice are crushed or abraded into the skin. Not in N. America.

-Long term infestation can lead to “Vagabond’s disease”

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1. **Crab louse** (*Pthirus pubis*):

**-**Claws adapted to grab coarser hair (pubic hair, eyelashes, chest hair, beards)

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1. **Tropical rat louse** (*Hoplopleura pacifica*): infest domestic rats (*Rattus* spp.) throughout warm temp areas

**Control of lice**:

-Use of pediculicides “lice killer”

-Behavioral control: not sharing clothes, sheets, headphones, hats, combs, etc.

-Control of rats and their lice

-Ectoparasite control on pets

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**Kissing bugs** (know scientific names)

Order: Hemiptera (piercing-sucking mouthparts)

Family: Rediviidae (assassin bugs)

Subfamily: Triatominae (public health importance)

*- Triatoma protracta* most important vector in CA. Does not defecate while feeding unlike other spp.

- Chagas disease (*Trypanosoma cruzi*) prevalent in Mexico, Central and South America, but rare in the US (because the vector doesn’t defecate at bite site)

- Host: woodrats (*Neotoma* spp.)

- Chagas disease treatable with anti-parasitic drug (available from CDC). Fever, fatigue, anorexia, cardiac arrhythmia, heart failure, and possible death.

**Control of kissing bugs**:

-Prevention:

-screen doors, windows, or any other openings into buildings

-Reduce the intensity of outdoor lights (porch, door, etc.)

-Control woodrat population near dwellings

-Chemical spray: for the bugs indoors

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**Bedbugs** (know common names)

-No disease transmitted, just nuisance and saliva can cause allergic reactions and possible secondary infection in case of excessive itching/scratching.

In CA: 2 genera and 6 spp. of bedbugs. Most important is *Cimex lectularius*

**Types of bedbugs**

1. Swallow bugs: mostly feed on swallow birds, but can feed on humans in an absence of their bird host

2. Bat bugs: feed exclusively on bats, rarely on humans

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**Wasps, Hornets** (know scientific names), **Yellow jackets** (know scientific names)

(Know what sort of baits they respond to; where they nest/their habitat preferences)

**Yellow jackets** (*Vespula* spp.): 11 spp. in the Western US

- Nest underground in abandoned rodent burrows, holes, cracks, etc.

- Very territorial; only workers and queen can sting

- Normally feed on insects, spiders, plant nectars, and carrion

- Mate in fall, queen overwinter and in spring select nesting site, lay eggs, and nurture

1. *Vespula pensylvanica*:

- Most prevalent and widespread pest in the Western US

- Found in savannah, oak woodland habitats in use abandoned animal burrows, soil cracks and depressions

- Respond to both meat and chemical butyrate lures

2. *Vespula vulgaris*:

- Major pest of oak/madrone woodland habitats in Northern coast CA and Sierras

- Nest in ground cavities, hollow trees and logs, and wall voids

- Respond to meat bait, but NOT to chemical butyrate

3. *Vespula atropilosa*:

- Higher elevations; small nests

- Respond to both meat bait and chemical butyrate lures

4. *Vespula sulphurea*:

- Widespread in CA. often in riparian creeks

- Not considered pest

-Does NOT respond to either meat or chemical butyrate

5. *Vespula germanica*: can be confused with *V. vulgaris*

- Found in high mtns of Sierra Nevada and along the coast

- Nests often found in Italian cypress trees, palm trees, and inside buildings (attics, wall voids, and electrical boxes)

- Respond to meat bait, but NOT chemical butyrate

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**Hornets** (*Dolichovespula* spp.)

1. *Dolichovespula maculata*:

- Summertime pest; aerial nesting- oval shaped paper nest

- Occurs in wooded and forested areas

- Respond to meat, but NOT to chemical butyrate lures

2. *Dolichovespula arenaria*:

- NOT a pest species; northern CA in wooded and suburban areas; also aerial, oval nest

- Does NOT respond to either meat or chemical butyrate lures

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**Wasps**

1. **Paper wasps** (*Polistes* spp.):

-Beneficial insects (nest- single comb without outer covering; feed on soft bodied insects and fruits)

-Can cause painful sting (some can have anaphylactic shock)

-Similar to yellow jackets, but larger and tapered abdomen

-Queens overwinter in sheltered crevices and buildings

2. **Mud daubers** (*Sceliphron* and *Chalybion* spp.):

- Long narrow waist (widely distributed in CA)

**Control of Wasps**:

- If nest is accessible- Treat at Night; wear protective clothing

- If infestation is in small area- treat with correct bait

-If infestation is in a large area- conduct long term poison bait

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**Honeybees** (know common names)

~4000 spp. of bees globally and ~1600 spp. in CA. [globally 11 spp. of bees in genus *Apis*, only one in CA- *Apis mellifera* (honeybee)]. In CA, honeybees found everywhere except high mountains. Active only during the day when temp is 55 degree F, no rain, and wind <12mph.

**Order**: Hymenoptera

**Suborder**: Apocrita

**Family**: Apidae

**Queen**: Only 1 queen/ colony (live ~3yrs); can sting multiple times; doesn’t forage

**Worker**: All females; thousands/hive; short-lived; older worker bees forage for nectar/pollen and younger workers stay in hives for housekeeping chores; can sting (barbed sting)—when stinger is used, it releases pheromones to invite other bees to attack the ‘target’

**Drone**: Males; hundreds/hive; short-lived (~6wks); doesn’t forage (can’t feed themselves); die after mating or kicked out of the hive in winter; can’t sting

1. **Africanized honeybees** (“Killer bees”):

- Hybrid of European and central African bees

- Easily disturbed; follow a “marked” target up to ¼ mile from the hive

- Cannot control killer bees without harming European honeybees

2. **European honeybees**:

- Follow “target” 50-100ft from the hive

- Economically very important

**Control of bees**:

- **Prevention**: reduce/prohibit access to nesting sites

- Don’t destroy bee swarms; notify bee keepers. Bees in walls, chimneys, etc. should be removed by professional pest control operators

- Remove newly established colony before the increase in size/numbers

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**Ants** (know common names)

1. **Red imported fire ants**:

- Vicious stingers; prefer irrigated areas; create colony, dome-shaped “mounds”

- Worker castes of varying sizes

- Consume ground dwelling wildlife

-**Control**: two-step (1. Bait formulation with Insect Growth Regulators 2. Metabolic inhibitors)

2. **CA harvester ants**:

- One of the several spp. of red harvester ants; distinctly red in color; long hairs under the head “beard”

- Most painful sting; found in pastures, fields, yards. Forages for seeds

- Large, live in colonies, and can be pest of yards, but rarely invades homes

3. **Argentine ants**:

- Most important pest species; thrive in urban and suburban areas; difficult to control

- Multiple queens, so large colonies

- Light to dark brown, hairless except for the end of abdomen

- Omnivores indoors; feed on insects outdoors

- Out-compete other spp. - repeatedly attack other spp. nests until the spp. is gone

4. **Pharaoh ants**:

**-** Common indoor pest; they cannot sting

**-** attracted to food, especially meat

5. **Thief ants**:

-Tiny, yellowish ants; frequently nest indoors

- The usually live within or close to nests of larger ants and prey on larvae/pupae

- Majority house-infesting spp.

- Attracted to fatty/oily foods

6. **Southern fire ants**:

- 2 segmented waist; shiny red with blackish end of abdomen

- Defend nests with fiery sting that result in painful itching

- Attracted to sweets & fatty foods, but also prey on other insects

- Doesn’t usually occur in areas with Argentine ants

**-** Frequently nest indoors

7. **Odorous house ants**:

- Produce foul odor when crushed; usually ground nesting, but also can be found in structures (wall voids, especially around hot water pipes and heaters)

- Similar to Argentine ants, but darker in color

- Frequently nest indoors

8. **Velvety tree ants**:

- Found in oak woodlands from central CA to moderate elevations

- Produce foul odor when crushed

- Can be pest in picnic/BBQ settings

- Large colonies- in dead logs, stumps, soil, rock piles, dead tree limbs

9. **Carpenter ants**:

- Two types (nest in wood and nest in soil)

- Wood damaging are the largest ants

- Omnivores, but like sweets

- Workers can bite, but do not sting

- Frequently nest indoors

**Control of ants**:

-Species specific. Chemical control should be conducted at the nest site

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**Flies** (know common names, their biology)

**i. Primitive flies** (suborder: Nematocera) -- midges, gnats, mosquitoes, sandflies

In CA: only mosquitoes from this group transmit human diseases. But the insects can cause allergic reactions (“punkies” and black flies). This group has piercing mouthparts.

1. **Blackflies** (Simuliidae): “buffalo gnats;”

**-** Eggs, larvae in running water; adults emerge in spring/summer

- Vector of River blindness (“Onchocerciasis”) in Africa, but rare in the Americas.

2. **Punkies** (Ceratopogonidae): “no-see-ums”

- Painful biters. Genus *Leptoconops* and *Culicoides*

3. **Sandflies** (Psychodidae): Genus- *Lutzomyia* –New World.

- Hairy body and wings

- Old world sandflies (*Phlebotomus*) are vector of Leishmaniasis.

**Control of Primitive flies**:

Larval control: use of soil bacteria, *Bti*, or insect growth regulators such as methoprene

Environmental management: tilling of soil, controlling water level and flow and pH.

Exclusion: preventing access (habitat and host) such as screening doors, windows, etc. and changing light bulbs from white to yellow incandescent.

Public education:

Surveillance: to know the extent of the problem and inform control measures

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**ii. Advanced flies** (suborder: Brachycera-Orthorrhapha) -- horse flies, snipe flies

Found mostly in northern latitudes. Slicing mouthparts (slice the host capillaries, let the blood pool and lap the blood with labellum).

1. **Horse and deer flies** (Tabanidae):

**-** Males have “holoptic” eyes- compound eyes that converge at the top of the head, but females have “dichoptic” eyes- eyes separated.

- Aquatic to semiaquatic; larval development 1-3 years or 1-2 months depending on species; adults can survive several weeks

- Certain species can fly up to 40mph

-Can vector tularemia, anthrax, anaplasmosis

i. **The Western horse fly** (*Tabanus punctifer*):

CA: in cooler environments (foothill, montane habitats); eggs hatch in 5-7 days and larvae live at the bottom of mud; wings black with pronotum gray; cause painful bites to humans and wildlife.

ii. **Deer flies** (*Chrysops* spp.):

CA: wetlands and riparian environments in Central Valley and eastern Sierra. Species of greatest concern = *C. discalis* [breed in alkaline situations; transmit tularemia]

2. **Snipe fly** (Rhagionidae):

- Smaller than Tabanids, but noticeably elongated, thin legs, and wings clear, without dark markings

- Most spp. are aquatic; usually 1 generation per year; adults survive several wks.

- Blood feeding spp. uniformly colored gray to light brown

- *Symphoromyia atripes* most prevalent in CA (woodland and riparian habitats)

3. **Soldier fly** (Stratiomyiidae)

- Found worldwide; wasp-like appearance; adults brightly colored (yellow, green, red, brown and rarely blue and black)

- Larvae in aquatic to terrestrial ecosystems; from decaying fruits to organic substrates

- Eggs hatch 2-5 days; larval development +1-2 wks; adults live for about 1month

**Public health significance of this group**:

* Can cause **bite trauma** and allergic reactions
* Can lead to **enteric myiasis**: larvae (maggots) in gastrointestinal tract- no permanent damage

**Control of advanced flies**:

1. Source reduction

2. Exclusion

3. Repellents and other protective measures

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**iii. Higher flies** (suborder: Brachycera-Cyclorrhapha) -- house flies, blow flies

* **Myiasis** (infestation/invasion of living vertebrate body by maggots/fly larvae) — Obligate (specific): dependent to complete life cycle (eg. botflies, screw worm flies). Facultative (semi-specific): such as blow flies (opportunistic instead of programmed). Accidental: ingesting food or water with eggs/maggots

1. **Stable fly**: piercing mouthparts; larvae develop in moist mixture of straw, hay, and manure

2. **Horn fly**: late spring and summer in Central Valley- feed on cattle and horses; over-infestation can reduce milk production and decrease animal vigor.

3. **House fly**: annoyance to humans; develop in poorly maintained landfill, rotting fruits, and animal feces

4. **False stable fly**: near dairies and stables; does not bite; adults overwinter in woodpiles, structures

5. **Lesser housefly**: breeds in bird/animal droppings; unlike houseflies, lesser houseflies aggregate in swarms in shaded areas; males are territorial; fly at eye level

6. **Face fly**: very similar to houseflies, but larger; congregate on the faces of horses and cattle to feed on lacrimal secretions. Can cause “pinkeye” (*Moraxella bovis*).

7. **Green bottle fly**: most well-known and widely distributed blow fly in CA. Population peak in late spring.

8. **Common blow fly**: gray in color; breeds in garbage, carrion, carcasses of commensal rodents.

9. **Black blow fly**: deep metallic blue/ almost black in color; breeds in garbage and carrion

10. **Introduced blow fly (“latrine fly”)**: exaggerated large head and compound eyes

11. **Red-tailed flesh fly**: most abundant in lower altitudes (except deserts); distinct gray and black stripes on thorax; females deposit larvae not eggs; involved in intestinal and rectal myiasis.

12. **Red-tailed maggot (“drone fly”)**: mimic honeybees and likes flowers; humans pick parasites accidentally when foul water with larvae is ingested.

13. **Common horse bot fly**: resemble honeybees; intestinal parasite of equines.

14. **Screw worm flies**: larvae cause trauma (feeding in open sores); primary screw worm eradicated from the US (sterile insect technique), but secondary still present

15. **Warble fly**: resemble bumblebees; cutaneous parasite

16. **Sheep bot fly**: larvae are parasitic, growing in the nasal cavities of sheep/goats.

17. **Rodent and rabbit bots**: black with abdomen variegated in grays, blacks, and whites

**Control of higher flies**:

Balanced IPM (source reduction, exclusion, biological control, chemical control, public education)

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**Fleas** (know scientific names)

1. *Ctenocephalides felis* (Cat fleas):

- Not host specific, so will try to feed on any warm-blooded animals

- Murine typhus

- Intermediate host of dog tapeworm

2. *Pulex irritans* (human flea): No disease

- Found in bedding and furniture; also feed on domestic animals and large carnivores

- Lack both, genal and pronotal combs

3. *Xenopsylla cheopis* (Oriental rat flea):

-Primary vector of urban plague and murine typhus

4. *Oropsylla montana* (Ground squirrel flea):

-Primary vector of sylvatic (wild) plague in the Western US

-Main host of these fleas—CA ground squirrel; prefer cold weather

- Can/will bite humans

**Control of fleas**:

* Simultaneous treatment of pets and sylvatic animals
* Use pesticides
* Environmental management
* Avoid rodent burrows and dead, dying, or sick rodents as their fleas are looking for new hosts

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**Spiders** (know common names)

- ~3000 spp. in North America, but most not harmful to humans; most live outdoors, but sometimes found in dwellings

- Most spp. nocturnal; 4 pairs of legs; prey paralyzed with venom, digestive fluids added via maxillary glands then predigested fluids are consumed

- Eggs laid in sacs; incomplete metamorphosis; males don’t live for too long after maturity and mating

- Most spider bites occur accidentally; severity of bites depend on many factors (site of bite, amount of venom, age and fitness of the person)

**Class**: Arachnida

**Order**: Araneae

1. **Black widows** (Family: Theridiidae):

- Western US species = *Latrodectus hesperus*

- Females with red hour glass shape on the underside of their abdomen; males much smaller than females with brightly colored chevron-like bands

2. **Brown recluse, Brown, Violin spiders** (Family: Siciriidae – Loxoscelidae):

- Brown recluse- not found in CA; all bite cases imported incidences

- US: 13 spp. of *Loxosceles* spiders; all of these have venom that cause skin necrosis

- Six eyes; lack integumental patterns of spines; usually tawny brown color

3. **Tarantulas** (Family: Theraphosidae):

- Large, hairy spiders with stout legs and bodies

- Several spp. in arid regions of CA in burrows and under rocks

**Control of spiders**:

**- Remove shelter and food**: frequent house cleaning and control of other insect pests indoors

- Only use pesticides meant for spiders

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**Scorpions** (know scientific names)

~75 spp. recognized in the US- most occur in the Southwest.

- Lobster-like pincers and tail with a bulbous stinger; 4 pairs of legs; coloration varies by spp.;

- Nocturnal; use sensory vibrations for locating preys

- Give birth to live young (number depending on environmental conditions)

- Young carried on mother’s back; usually leave the mother after first molt

**Central valley & Desert areas**: genera- *Vaejovis, Paruroctonus, Serradigitus, Anuroctonus, Hadrurus,* and *Superstitionia*.

**Moist areas of Sierra Nevada & Coastal CA**: genus- *Uroctonus*

1. **Bark scorpion** (*Centruroides exilicauda*):

- **Medically important** (lethal venom) — (found in western NM, AZ, Mexico, and along Colorado River in CA

- Can crawl up into RVs, boats, trailers, beddings, etc—how they are transported to urban areas

- Thin, long pincers; no first-aid measures to treat scorpion stings

**Control of scorpions**:

- Prevent sources before and during spring

- Shake out gloves, shoes, etc. when in the areas with scorpions

- Outdoors: clear out rock piles, garbage, firewood piles

- Indoors: sealing cracks and crevices; install smooth walls because scorpions cannot climb on smooth surfaces

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**Mites** (know common names)

Class: Arachnida (4 pair of legs)

- Most mites are plant-feeders, only few predators and fewer parasites

- 6 stages of development (prelarva, larva, protonymph, deutonymph, tritonymph, adult)

1. **Demodicidae** (Suborder: Acariformes):

- 2 important spp. = *Demodex folliculorum* and *D. brevis*

- Worm-like bodies; live on the surface of the skin (scalp, forehead, eyelids, etc.)

- Conflicting info on if these cause skin diseases

2. **Trombiculidae “Chigger mites”** (Suborder: Actinedida)

- 2 important spp. in CA = *Eutrombicula belkini* (North, Central, South CA—coastal sage and chaparral plant areas) and *E. batatas* (Central CA—moist conditions with herbaceous grasses)

- Larvae = small, red, grasping/piercing mouthparts

- Adults = predators of small arthropods and their eggs (ground litter and soil)

- **Control**: prevent mites from getting on to humans; pesticide use not feasible

3. **Sarcoptidae “Scabies mites”** (Suborder: Acaridida)

- Spp. of *Sarcoptes* genus found on humans globally; microscopic

- *Sarcoptes scabiei hominis*: broadly oval, translucent to brownish in color

- **Cause scabies**, an extremely itchy skin condition

- Mostly occur in the skin between fingers, on elbows, but frequently on skin of scrotum, penis, breasts, knees, and buttocks

- Close person-to-person contact transmission

4. **Pyroglyphidae “House dust mites”** (Suborder: Acaridida):

- Genus *Dermatophagoides* includes spp. of medical importance = *D. pteronyssinus* (European house dust mite) and *D. farina*e (American house dust mite)

- 5 life stages (egg, larva, protonymph, tritonymph, adult)

- Live in mammal/bird burrows & nests or in dust and debris of buildings

- **Control**: regular, good housekeeping

5. **Macronyssidae** (Suborder: Gamasida; Order: Parasitiformes):

- Blood-feeding spp.

- Medically important spp.: *Ornithonyssus bacoti* (Tropical rat mite- roof rats, Norway rats), *O. sylviarum* (Northern fowl mite), and *O. bursa* (Tropical fowl mite)

- *O. bacoti* could potentially cause murine typhus, tularemia, and plague

- O. sylviarum – Western equine and Newcastle disease viruses isolated

6. **Dermanyssidae “Chicken mites”** (Suborder: Gamasida, Order: Parasitiformes):

- *Dermanyssus gallinae*- medically important; blood-feeding

- **Causes painful skin irritation**, associated with farms, ranches, poultry houses, and live-chicken markets

- **Control**: removal of bird nests, maintenance of chicken coups, acaricidal pesticide application

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**Ticks** (know scientific names)

Just like mites, tick larvae have 6 legs and nymphs and adults have 8 legs. Most of hard-ticks (>90%) are three-host ticks (each life stage feed on different hosts).

- Otocacariasis: ticks invading the auditory canal of humans

- Some ticks can cause tick paralysis

1. **Hard ticks (Ixodidae)**: each stage one blood meal (2-5 days); live around 2 years

i. **American dog tick** (*Dermacentor variabilis*):

- Rocky Mountain Spotted Fever “RMSF” (*Rickettsia rickettsii*). Primary hosts: rodents and lagomorphs

- Tularemia (*Francisella tularensis*). Primary hosts: rodents, deer, lagomorphs

ii. **Brown dog tick** (*Rhipicephalus sanguineus*): can complete entire life cycle indoors; mostly feed on dogs, but can feed on various mammals

- Rocky Mountain Spotted Fever “RMSF” (*Rickettsia rickettsii*)

iii. **Pacific coast tick** (*D. occidentalis*):

- Rocky Mountain Spotted Fever “RMSF” (*Rickettsia rickettsii*). Primary hosts: rodents and lagomorphs

- Colorado tick fever (Coltivirus). Primary hosts: rodents and lagomorphs

iv. **Western Black-legged tick** (*Ixodes pacificus*):

- Lyme disease (*Borrelia burgdorferi*) - primary hosts: rodents (deer mice, woodrats, squirrels. In Ca primary reservoir is dusky-footed woodrat (*Neotoma fuscipes*)), deer, lizards, and lagomorphs

- Human granulocytic anaplasmosis (*Anaplasma phagocytophilum*) – primary hosts are same as *B. burgdorferi*.

- *I. pacificus* are found in open grass or chaparral, along trails, and some suburban areas when there are deer and other wildlife present (especially in coastal counties and foothills of Sierra Nevada mtns)

v. **Rocky mountain wood tick** (*D. andersoni*):

- Tularemia (*Francisella tularensis*). Primary hosts: rodents, deer, lagomorphs

- Rocky Mountain Spotted Fever “RMSF” (*Rickettsia rickettsii*). Primary hosts: rodents and lagomorphs

- Colorado tick fever (Coltivirus). Primary hosts: rodents and lagomorphs

2. **Soft ticks (Argasidae**): multiple blood meal (15-20 mins); can live up to 10 years; cause tick-borne relapsing fever; host rodents and lagomorphs

i. *Ornithodoros hermsi*: tick-borne relapsing fever (*Borrelia hermsii*)—found mostly in rodent nests

ii. *O. coriaceus* (Pajahuello tick): epizootic bovine abortion to cattle—found in fields

iii. *O. turicata*: tick-borne relapsing fever (*B. turicatae*)

iv. *O. parkeri*: tick-borne relapsing fever (*B. parkeri*)

**Control of ticks**:

- Control strategies dependent on spp. of ticks, life stage, season, distribution of its hosts

- Environmental modification or Landscape management to prevent ticks and tick hosts

- Chemical control: Acaricide applications on a wider area

- Personal protection: staying on trail; tucking socks in boots and shirts in pants; wear light colored clothing (easy to see ticks); use repellents; TICK CHECK

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**Field Safety**

Safety program for vector control personnel under **Title 8** include:

-Active supervision

- Written safety protocols on avoiding vector and vector-borne diseases: type of possible exposures and consequences, proper use of safety equipment, proper use of surveillance and lab equipment, emergency procedures for accidental exposure

- Effective use of PPE

- Safe methods of transporting samples: avoid direct contact between samples and occupants of the vehicle, proper containment of samples and labeling sample containers with “Biohazard” labels

- Continued education to train on safety procedures

----------------------------------------------- *The End* ----------------------------------------------------------