



**Biomedical Parasitology**

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**Ticks**






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1

**General morphology**

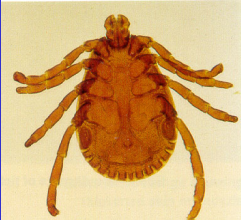
- Ticks are large, blood-sucking arachnids
- Two body segments:
  - Capitulum: mouthparts & sensory palps
  - Idiosoma: abdomen, legs, eyes, anus, etc
- No wings
- Adults & nymphs have 4 pairs of legs
- Larvae have 3 pairs of legs

4


**ARACHNIDS**  
(two main assemblages)

**TICKS**



macroscopic in size  
toothed, exposed hypostome

**MITES**




microscopic in size  
unarmed, hidden hypostome

2


**Ticks are super-mites!**

- Body size - 10-100 times bigger
- Life span - up to 11 years vs 9 months
- Why?
- Mites have the smallest genome (75 Mb, *Tetranychus urticae*) know to date whereas ticks have the largest genomes (6400 Mb, *Rhipicephalus (Boophilus) microplus*)


*Ixodes ricinus*:  
live 1-6 years




*Argas reflexus*:  
live 7-11 years



*Ornithonyssus bursa*:  
live 1 week



*Sarcoptes scabiei*:  
live 10-17 days



5



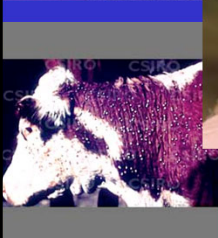

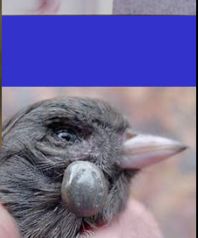
**TICKS**

Over 800 species described

Blood-sucking ectoparasites that may cause:

- anaemia (mild-severe blood loss)
- dermatosis (inflammation, ulceration, itching)
- toxicosis (serum exudation)
- ascending paralysis (due to toxins)
- otoacariasis (infestation of ear canal)
- other infections (viral, bacterial, rickettsial, spirochaete, protozoal or helminth infections)  
e.g. Lyme disease, tick fever (babesiosis), East Coast fever (theileriosis), Rocky Mt spotted fever

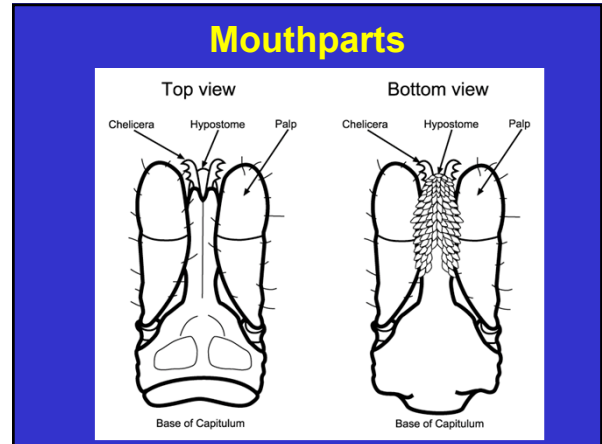
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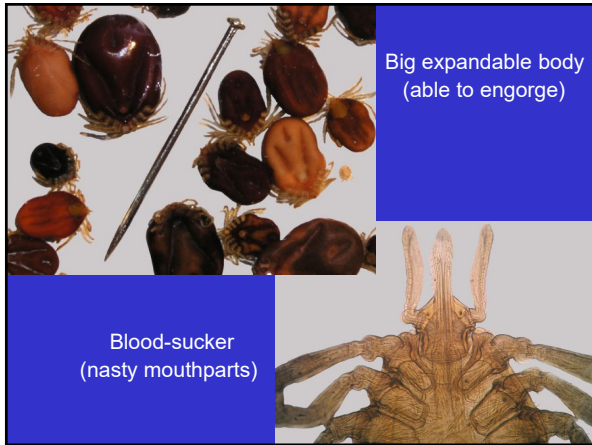
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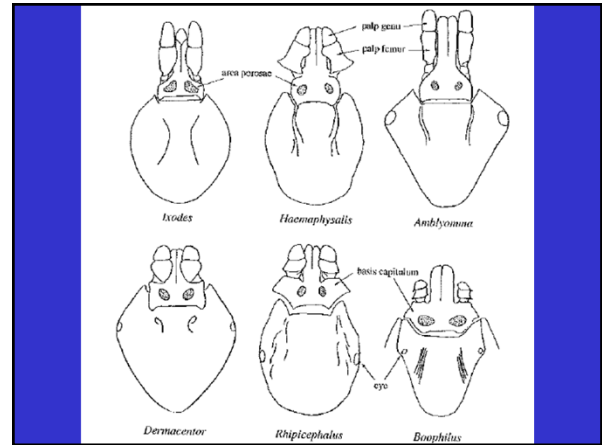
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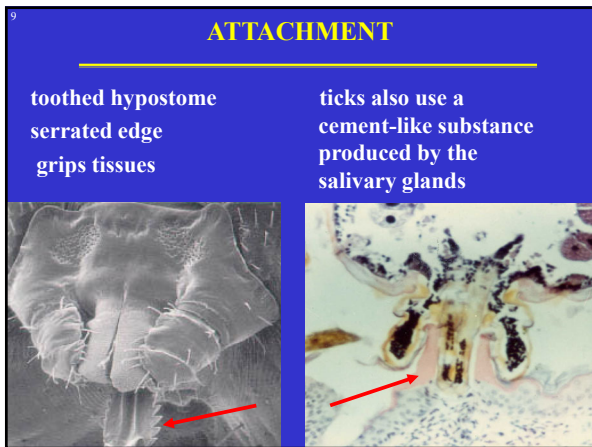
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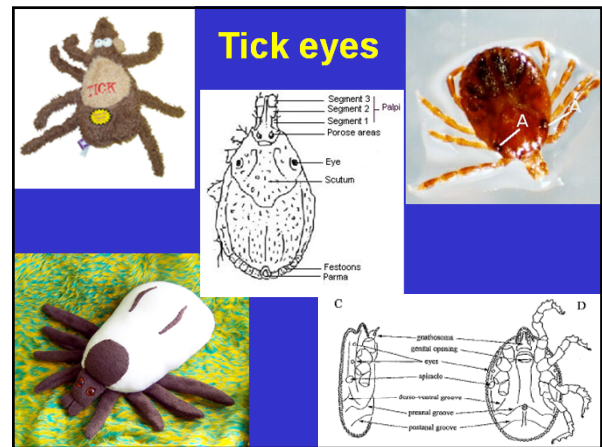
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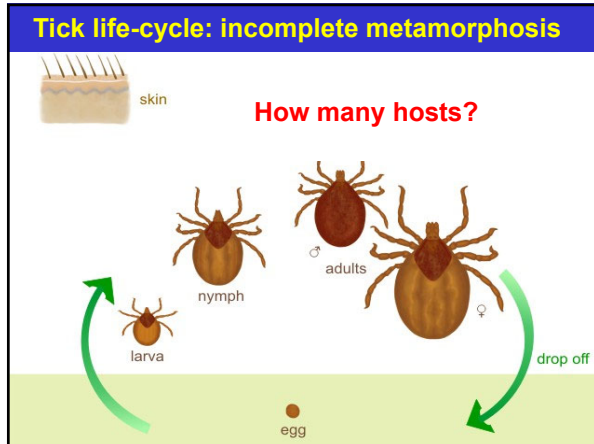
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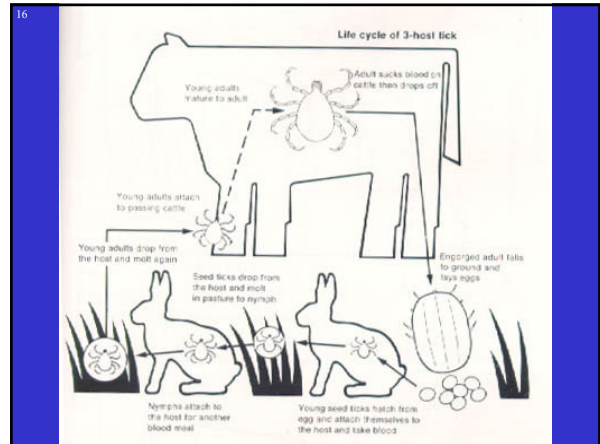
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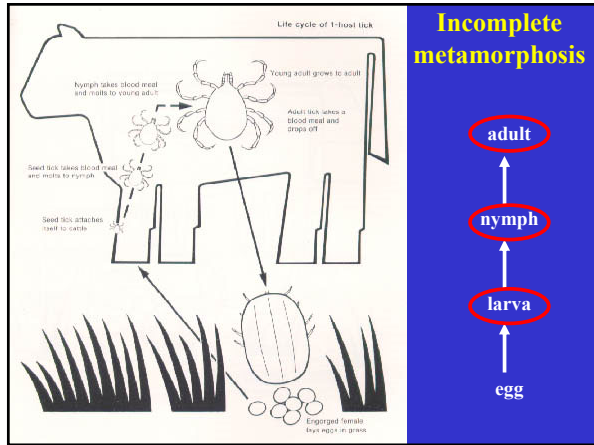
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13



16



### Incomplete metamorphosis



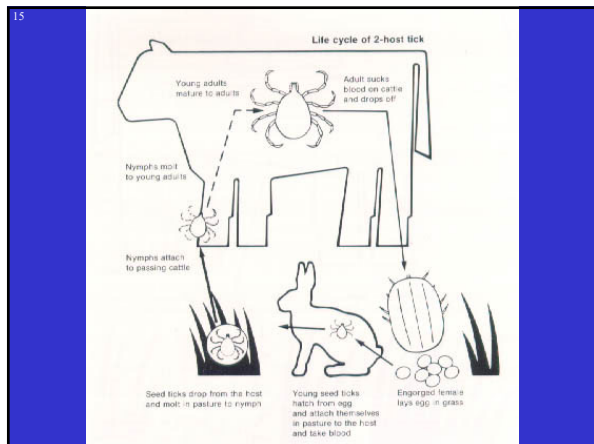
14

### Developmental stages

All stages feed on host blood. Adults engorge!

larvae (seed ticks)	nymphs	adults

17



15

### Proliferative potential

Females lay 100-18,000 eggs in soil or humus

18

## Feeding & life cycle

- Obligate blood suckers; with elaborate mouth parts for penetrating host skin and holding on
- Many ticks secrete cement to aid attachment during feeding
- Multiple feeding stages
- 1, 2 & 3 host ticks

19

## Ticks as vectors

### Bacteria

- *Rickettsia* spp.
  - Rocky Mountain Fever, vectored by *Dermacentor andersoni* and *D. variabilis*
  - Queensland Tick Typhus, vectored by *Ixodes holocyclus* & *I. tasmani*
  - Canine rickettsiosis, vectored by *Rhipicephalus* spp
- *Ehrlichia* spp. and *Anaplasma*
  - Ehrlichiosis in humans and cattle, vectored by hard ticks
- *Borellia* spp.
  - Relapsing fever, vectored by both hard and soft ticks
  - Lyme disease, vectored by *Ixodes* spp.

### Viruses

- West Nile virus vectored by *Hyalomma marginatum*
- Colorado tick fever virus vectored by *Dermacentor* spp.



22

## Effects of tick feeding

- Dermatitis (itching, inflammation, ulceration)
- Toxicosis (potent chemicals in saliva & cement)
  - Rash
  - Blisters (serosanguineous)
  - Paralysis (neurotoxins enter bloodstream)
- Heavy infestation can cause:
  - Severe blood loss, death (often seen in birds)
  - Damaged hides
  - Reduced production (meat, milk, or wool)
- Predispose to secondary infection
- Transmit infectious diseases

20

## Diversity of tick fauna

- Subclass Acari (mites & ticks)
- Order Parasitiformes
- Suborder Ixodida
- 900 species
- Infest mammals, birds, reptiles & amphibians
- 3 families:
  - Ixodidae - hard ticks
  - Argasidae - soft ticks
  - Nuttalliellidae - intermediates

23

## Ticks as vectors

- Strong vector capability due to low host-specificity and long life span (often longer than their hosts) - second only to mosquitoes
- Protozoans
  - *Babesia* spp. (babesiosis)
    - Tick Fever vectored by *Rhipicephalus (Boophilus)* spp.
    - Dog malignant jaundice, vectored by *Rhipicephalus* spp.
  - *Theileria* spp. (theileriosis)
    - East Coast fever, vectored by *Rhipicephalus* spp.
  - Both diseases cause considerable economic loss for animal industry; may also affect humans
  - *Hepatozoon canis*
    - Canine hepatozoonosis, vectored by *Rhipicephalus* spp.

21

## TICKS

### IXODIDAE (hard ticks)



hard cuticle  
scutum present  
capitulum terminal

### ARGASIDAE (soft ticks)



leathery cuticle  
scutum absent  
capitulum subterminal

24


### Nuttalliellidae

- Single species, *Nuttalliella namaqua*
- Possesses a pseudo-scutum and apical gnathostoma as observed for hard ticks
- Leathery outer "skin" similar to soft ticks
- Feed on lizards
- Mouth parts visible from dorsal view (like hard ticks)
- Rare - only 51 specimens ever collected
- Rapid feeder - like soft ticks

25

### Ornithodoros spp. (tampans)

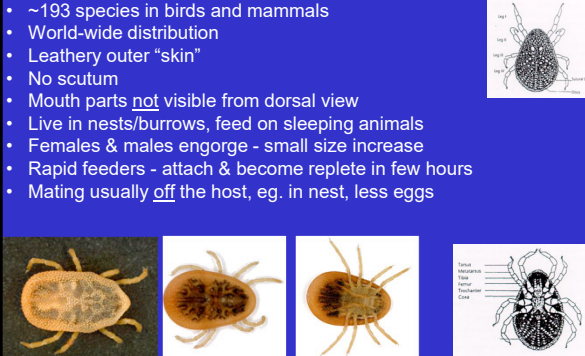
- cosmopolitan (except Australia)
- found in native huts and sand under trees
- cause irritation, restlessness
- heavy infestations may cause anaemia, death
- thought to transmit epidemic bovine abortion



28

### Soft ticks (Argasidae)

- ~193 species in birds and mammals
- World-wide distribution
- Leathery outer "skin"
- No scutum
- Mouth parts not visible from dorsal view
- Live in nests/burrows, feed on sleeping animals
- Females & males engorge - small size increase
- Rapid feeders - attach & become replete in few hours
- Mating usually off the host, eg. in nest, less eggs




26

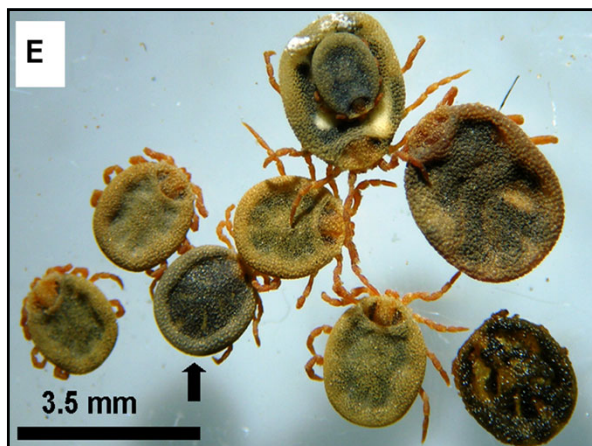
### Ornithodoros

- over 100 species
- infest mammals
- *O. capensis* normally parasitic on bats

tick bite	20 mins later erythema	60 mins later wheal
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29



27

### TOXICOSIS

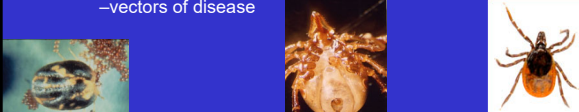
sensitization to tick bites causes intra-epidermal sero-sanguinous blisters (sweating sickness of cattle due to profuse serum exudation)



30

### Hard ticks (Ixodidae)

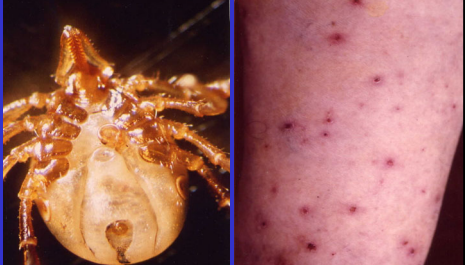
- 702 species, in 14 genera
- Infest mammals, birds & reptiles
- Hard scutum on dorsal surface
- Mouth parts visible from dorsal view
- Only female engorges with blood - huge size increase
- 1, 2 or 3 host life-cycles
- Relatively "slow" feeders - attach & imbibe blood over days
- Mating usually on the host
- Marked sexual dimorphism (size & color)
- Many species of medical and veterinary importance as:
  - disease agents or
  - vectors of disease



31

### *Ixodes* spp.

- some 200 species of 3-host ticks on small mammals
- scrub tick *Ixodes holocyclus* found on native animals
- bite may cause scrub itch



34

### INFESTATIONS

heavy infestations may cause:

- damaged hides (rough thickened skin)
- morbidity (anaemia, distress, paralysis)
- production losses (meat/milk/fibre)
- mortality

cow udder



dog ear




32



35

### IXODIDAE


PROSTRIATA  
(anal groove anterior)



*Ixodes*


METASTRIATA  
(anal groove posterior)

Brevirostrata  
(short mouthparts)



*Boophilus*  
*Haemaphysalis*  
*Rhipicephalus*  
*Dermacentor*

Longirostrata  
(long mouthparts)

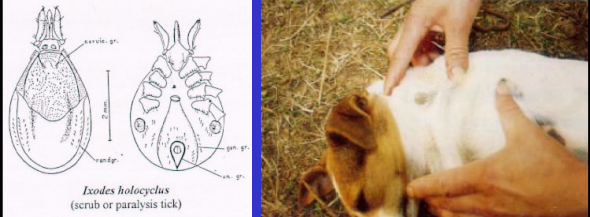


*Amblyomma*  
*Aponomma*  
*Hyalomma*

33

### *Ixodes holocyclus*

- infestation of domestic animals and humans can result in ascending motor paralysis
- due to neurotoxic anticoagulants released by engorging females
- one tick can kill dog or infant



*Ixodes holocyclus*  
(scrub or paralysis tick)

36

### Tick paralysis

- Caused by neurotoxins produced in tick's salivary
- Toxins enter bloodstream when engorged females feed
- Symptoms appear in 2–7 days: weakness in legs initially, then ascending paralysis from legs to trunk, arms, & head in hours; may lead to respiratory failure & death
- Mainly by *Ixodes holocyclus* in Australia, *Dermacentor andersoni* & *D. variabilis* in Nth America, but many other hard tick species (>40) can also cause paralysis
- Occur in domestic animals & humans (often children <10y)
- A single tick can kill a dog or an infant
- Symptom diminishes rapidly after ticks are removed

37

### How to remove ticks

40

*Ixodes holocyclus*

38

### Differential diagnosis

<p><i>Rhipicephalus sanguineus</i> brown dog tick legs spaced apart no anal groove</p>	<p><i>Ixodes holocyclus</i> paralysis tick, scrub tick legs grouped anal groove</p>
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41

### *Ixodes holocyclus* (paralysis tick)

<p>left facial paralysis (following local paralysis of seventh cranial nerve)</p>	<p>Bell's phenomenon</p>
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39

### VECTORS FOR DISEASE

- *Ixodes* spp. transmit Lyme disease caused by spirochaete *Borrelia burgdorfi*
- *Boophilus* spp. transmit tick fevers caused by *Babesia* spp.
- *Rhipicephalus* spp. transmit canine rickettsiosis (*Rickettsia canis*), malignant jaundice (*Babesia canis*), hepatozoonosis (*Hepatozoon canis*), East Coast fever (*Theileria parva*)
- *Dermacentor* spp. transmit Rocky Mountain spotted fever and Colorado tick fever virus

42

## Control

- Remove tick (taking care to remove mouthparts)
- Chemical - acaricides
  - large animal - amitraz/diazinon (dip)
    - cypermethrin/chlorfenvinphos (dip/spray)
    - ivermectin
  - small animal - propoxur/flumethrin (collar)
    - pyrethrin/S-methoprene (spray)
    - fipronil/imidacloprid/lufenuron (pour-ons)
- Emergence of resistance to chemicals
- Animal management (pasture rotation)
- Control stock movement (quarantine)
- Breed for develop genetic resistance
- Vaccination
  - salivary gland antigens
  - tick gut antigens



43

## SUMMARY

### Ticks

- 1-, 2-, 3-host life cycles

### Soft ticks (argasids)

- blood loss
- serosanguinous blisters

### Hard ticks (ixodids)

- blood loss, anaemia
- dermatosis
- paralysis
- transmit diseases

44