

Wombat ticks:





Identifying the presence of tick-borne pathogens in ticks from bare-nosed wombats (*Vombatus ursinus*)

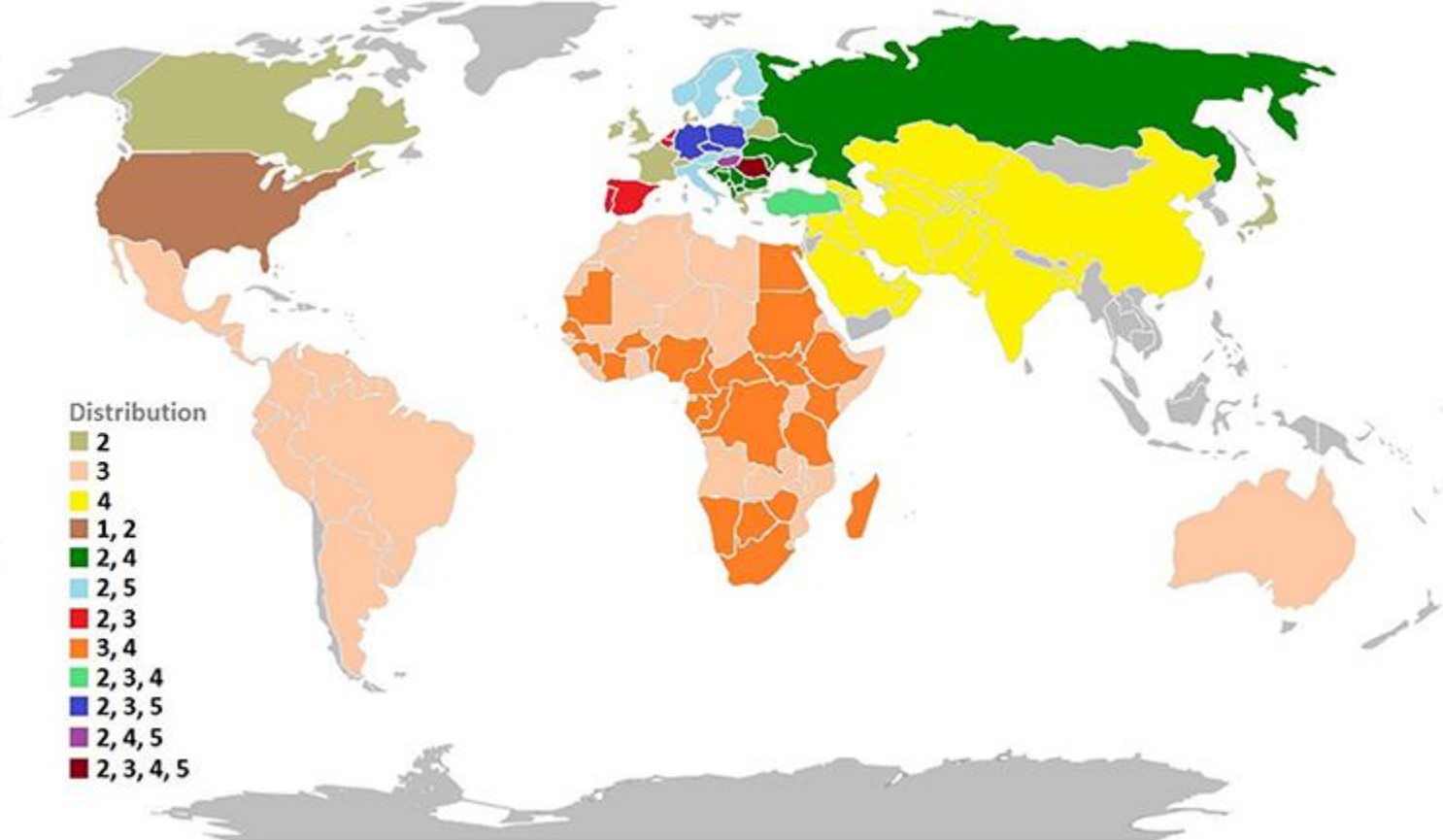
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Diseases	Pathogens	Main tick vector
1 Human granulocytic anaplasmosis	 <i>Anaplasma phagocytophilum</i>	 <i>Ixodes</i>
2 Lyme disease	 <i>Borrelia burgdorferi</i>	 <i>Ixodes</i>
3 Babesiosis	 <i>Babesia</i> spp.	 <i>Rhipicephalus</i>  <i>Ixodes</i>
4 Crimean-congo hemorrhagic fever	 CCHFV	 <i>Hyalomma</i>
5 Tick-borne encephalitis	 TBEV	 <i>Ixodes</i>

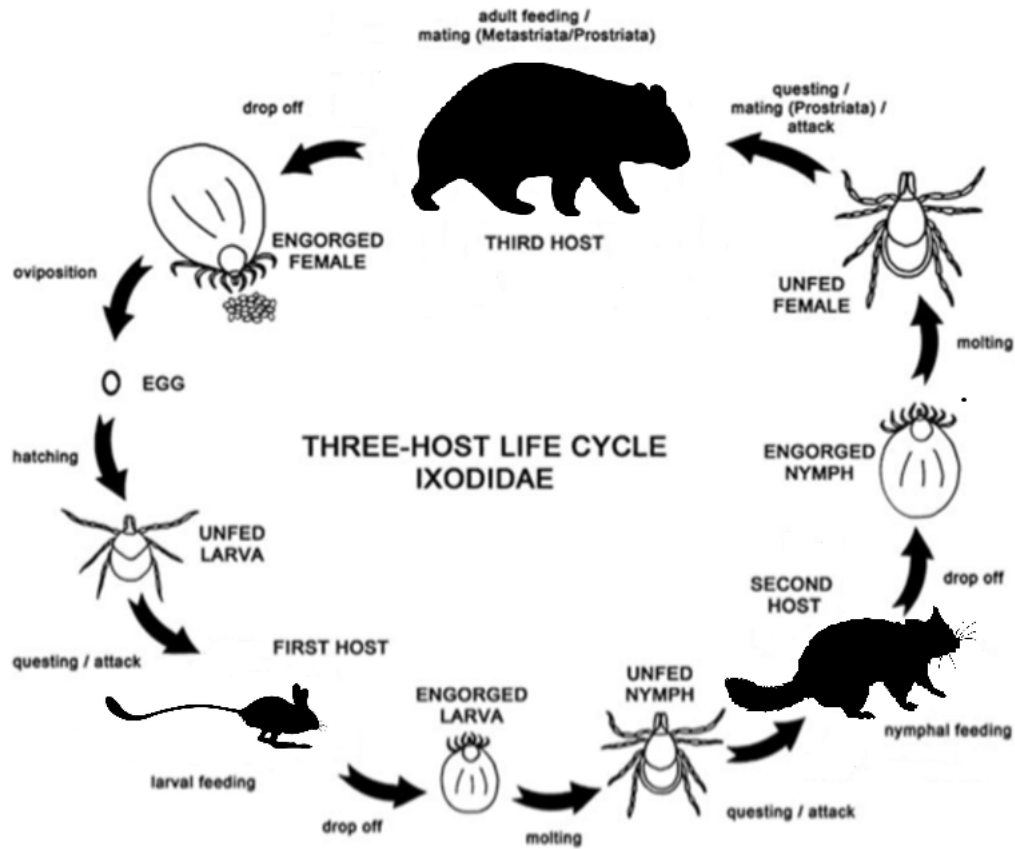


- Infectious:**
- Anaplasmosis
 - Babesiosis
 - Ehrlichiosis
 - Lyme borreliosis
 - Q-fever
 - Relapsing fever
 - Rickettsiosis
 - Spotted fever
 - Typhus

- Non-infectious:**
- Dermatopathies
 - Paralysis
 - Mammalian meat allergy

de La Fuente et al. 2017

Zoonotic Tick-borne Diseases



Ixodidae:

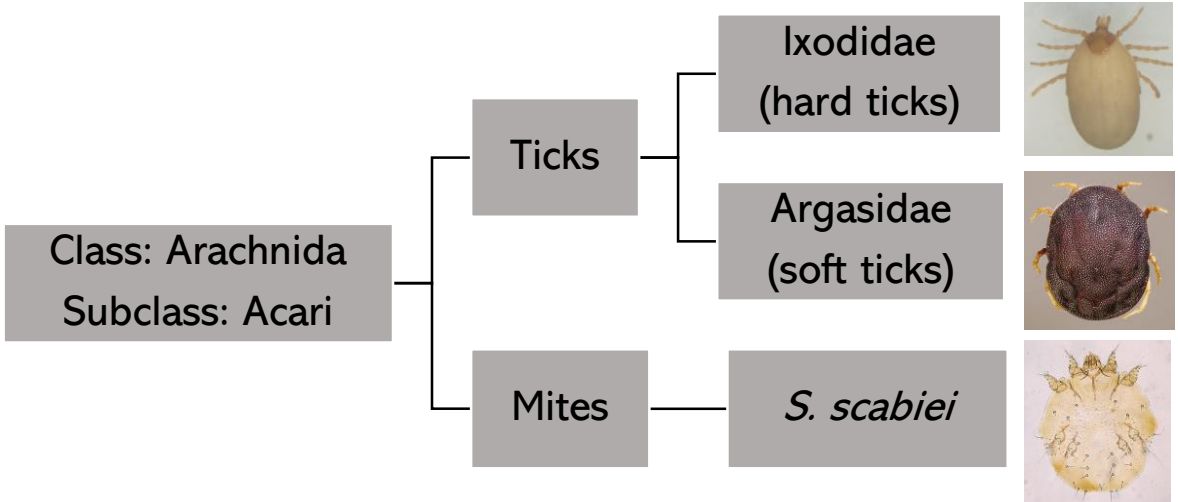
One-host ticks - e.g. *Boophilus*

Two-host ticks - larvae and nymphs feed and develop on the same host

Three-host ticks - most ticks of public health importance e.g. *Ixodes*

Argasidae: 14 spp.

Multiple hosts



Australian ticks (Acari: Ixodida)



Photo: Christine Rand



Photo: Leoni K Arthur-Weston



Photo: Leoni K Arthur-Weston

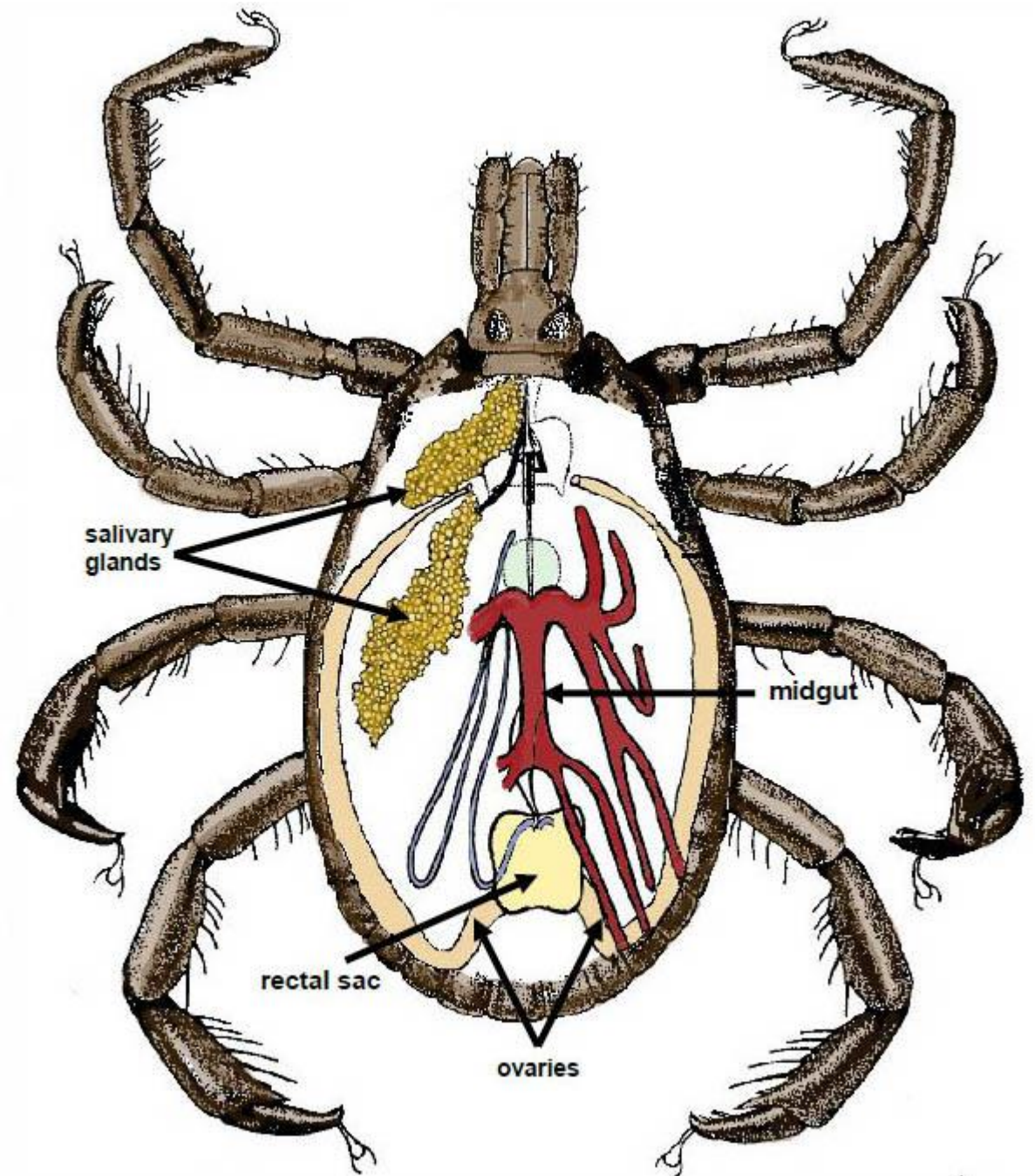


Photo: Belinda Goldsworthy



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Pathogen transmission



Australian tick-borne pathogens (TBPs)

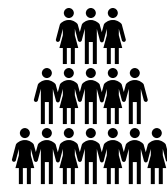
Tick-borne Bacterial Pathogens

Class: Alphaproteobacteria
Order: Rickettsiales
Family: Anaplasmatoceae
Genera: Anaplasma
Ehrlichia
Cryptoplasma
Neoehrlichia
Borrelia
Wolbachia

Class: Alphaproteobacteria
Order: Rickettsiales
Family: Rickettsiaceae
Genus: Rickettsia

Class: Gammaproteobacteria
Order: Legionellales
Family: Coxiellaceae
Genus: Coxiella

Class: Alphaproteobacteria
Order: Rhizobiales
Family: Bartonellaceae
Genus: Bartonella



Queensland tick typhus (*Rickettsia australis*)

Spotted fever (*Rickettsia honei*)

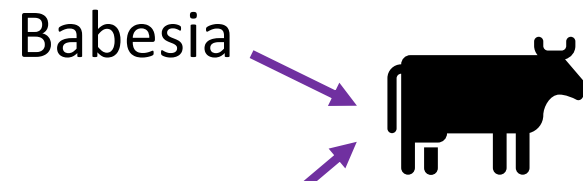
Q fever (*Coxiella burnetii*)



A. auruginans > Coxiella and Rickettsia

Australian tick-borne pathogens (TBPs)

PROTOZOA



Theileria →



Toxoplasmosis?

VIRUS

Flaviviruses →



Many novel species require further research (Harvey et al. 2019)

Methodology

IDENTIFICATION

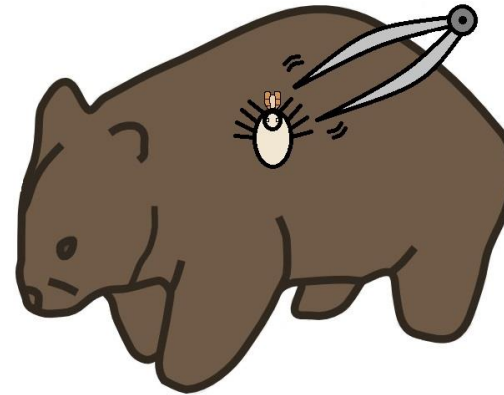
Barker & Walker 2014

Roberts 1970

MOLECULAR METHODS

Schabereiter-Gurtner et al. 2003

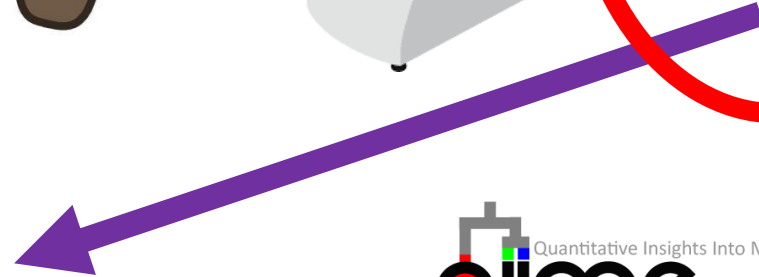
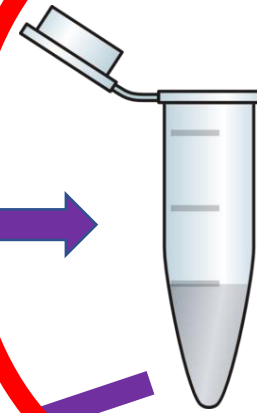
Collection



Identification



DNA Extraction



Next generation Sequencing (NGS)



Bioinformatics

Next Generation Sequencing

Microscopy and culture

- Low sensitivity

PCR

- One sequence from one sample
- Long amplicons

NGS

- High-throughput
- Millions of sequences from many samples
- Short amplicons

Where next?

Tick collection

- February 2020

Finalise

- Molecular methods
- Bioinformatics

Further research

- Wombat pathogens vs. tick pathogens
- *Sarcoptes scabiei* pathogens
- Native Australian tick microbiomes

Questions?

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- Wildlife Rescue Far South Coast
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- Bonorong Wildlife Sanctuary
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- SMWS
- WIRES
- Port Stephens Koalas
- Wildlife In Need of Care
- Friends of the Koala
- Koala Conservation Australia
- ...And all individual tick collectors

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