



THE  
**MENTOR**  
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& **SUFFERING IN HUMANITARIAN CRISES**



# Ticks as Vectors and African Tick Bite Fever

Alex Heaney

3/9/12



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# Lesson Summary

1. Ticks as Disease Vectors

2. African Tick Bite Fever



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# Ticks

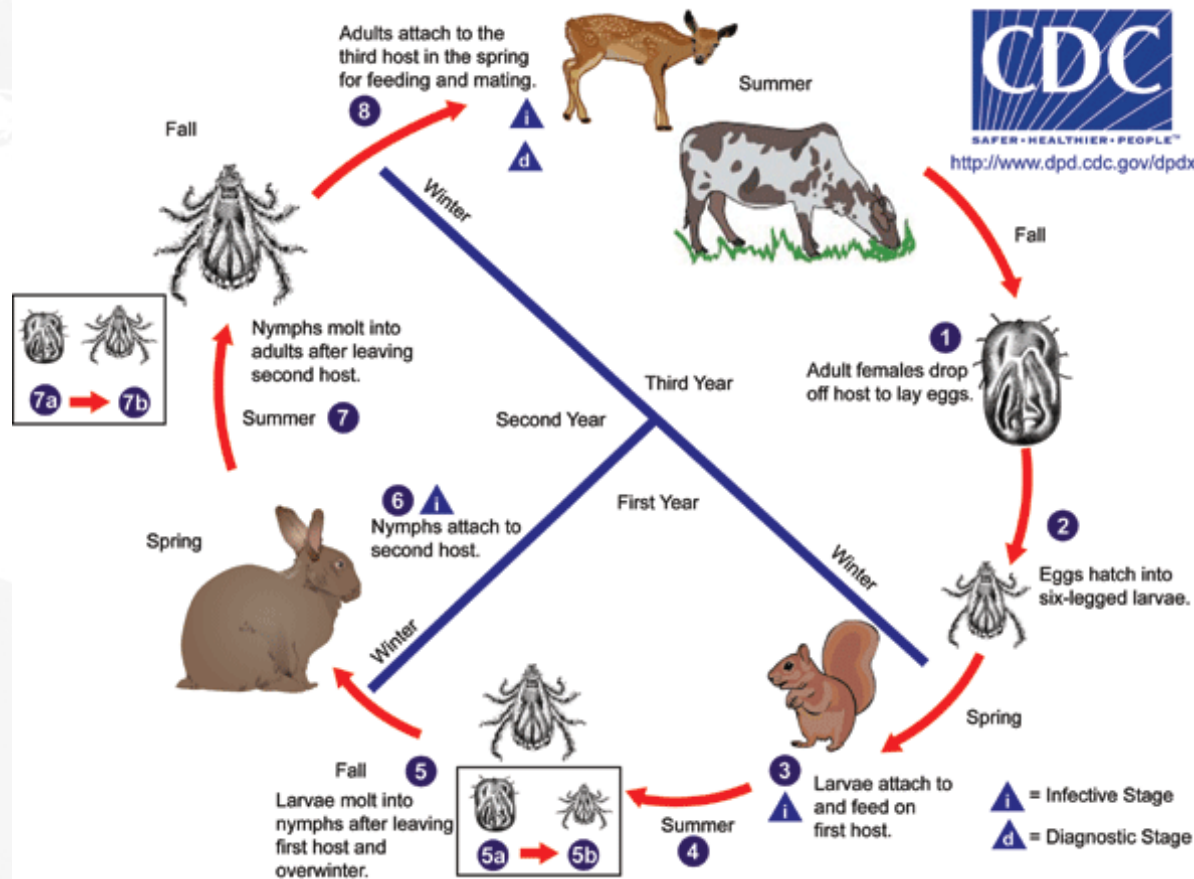
- Arthropoda
  - 2 types of ticks that are vectors for human disease
    - Hard ticks (Ixodidae class)
    - soft ticks (Argasidae class)



Picture Credit: [www.floridahealth.com](http://www.floridahealth.com)



# Life Cycle of a Hard Tick





# Connecting to a Host

- Questing: ticks feed by perching in low vegetation and waiting for a mammal to walk by



Photo Credit: Local Public Health Institute of Massachusetts  
<http://www.masslocalinstitute.org>



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# Connecting to a Host

- Questing
- Ticks use chemical stimuli, airborne vibrations, and body temperatures to locate mammals



Photo Credit: Local Public Health Institute of Massachusetts  
<http://www.masslocalinstitute.org>



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# Ticks as Disease Vectors

- transmit a greater variety of pathogenic microorganisms than any other arthropod vector group
- Bacteria/virus/protozoa in saliva of tick
  - Injected during a blood meal

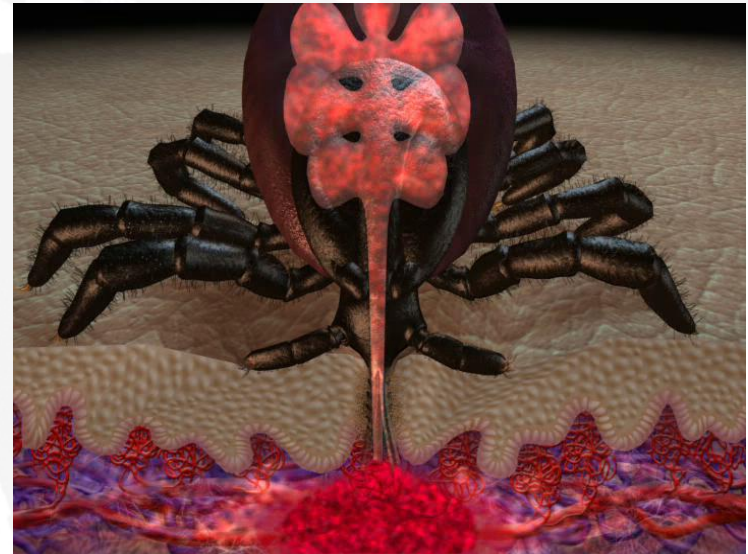


Photo Credit: Lyme Disease Action  
<http://www.lymediseaseaction.org.uk/about-ticks/tick-animation/>



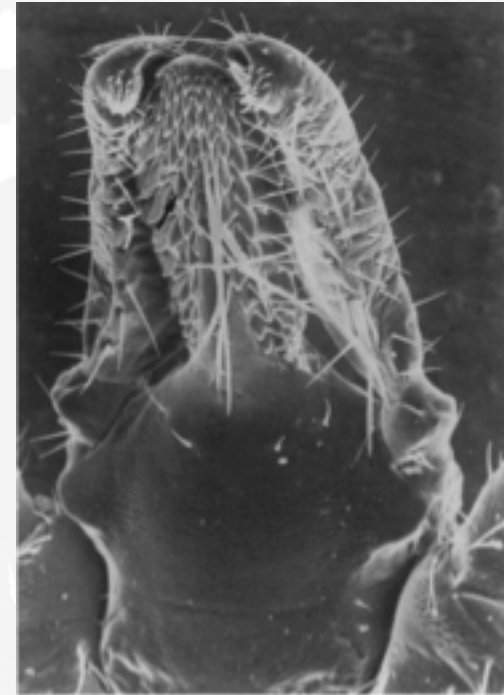


# Ticks as Disease Vectors

- Hypostoma attaches to the host's skin using hooks



Photo by Larisa Vredevoe, UC. Davis



Picture from (Parola, 2001)



# Ticks as Disease Vectors

## Substances secreted into skin

- Cementing substance
  - Glues the hypostoma in place
- Immunosuppressive, Anti-inflammatory chemicals
  - Helps the tick go unnoticed by the host
- Anticoagulant
  - Allows blood to go where it needs to go in the body

All help the pathogen to establish a foothold in the host



# Epidemiology of Tick Borne Diseases

Ticks are second only to mosquitoes as vectors of human infectious disease throughout the world

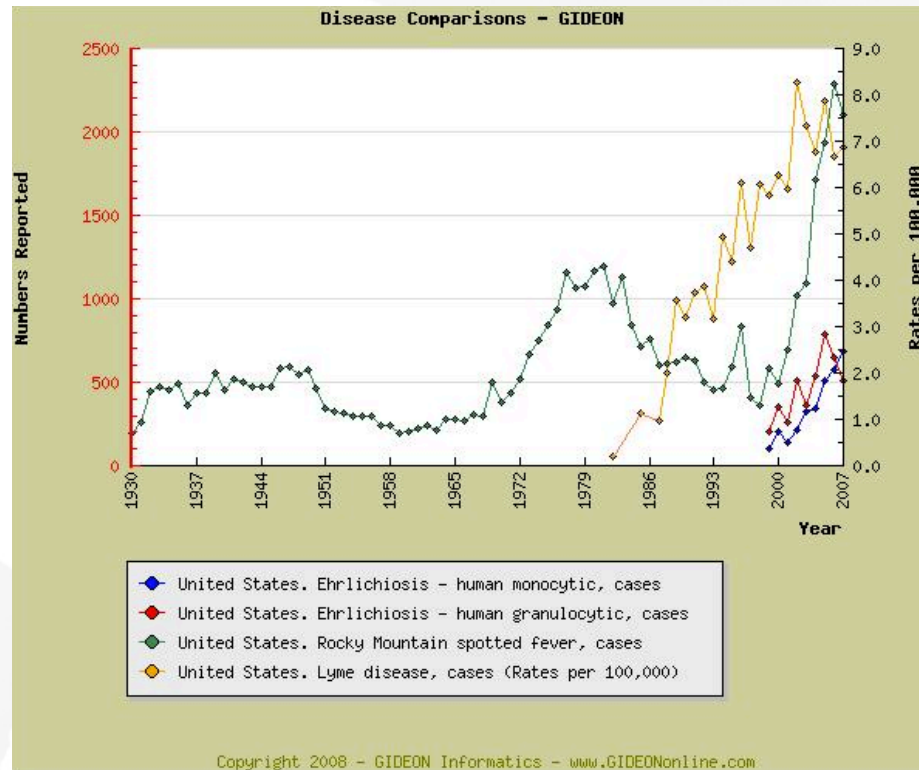


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# Epidemiology of Tick Borne Diseases in US

- Recent dramatic increase in prevalence



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# Epidemiology of Tick Borne Diseases in US

- Recent dramatic increase in prevalence
- Prevalence varies within differing populations

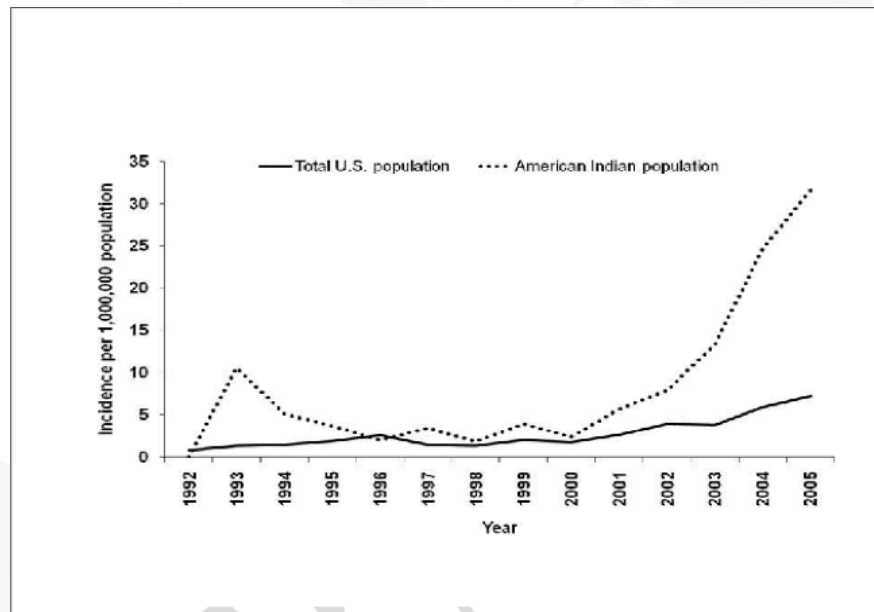


FIGURE 3 Annual incidence rates of Rocky Mountain spotted fever, per 1 million population, among American Indians, and the total U.S. population, 1992-2005 (Holman et al., 2009).



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# Epidemiology of Tick Borne Diseases in US

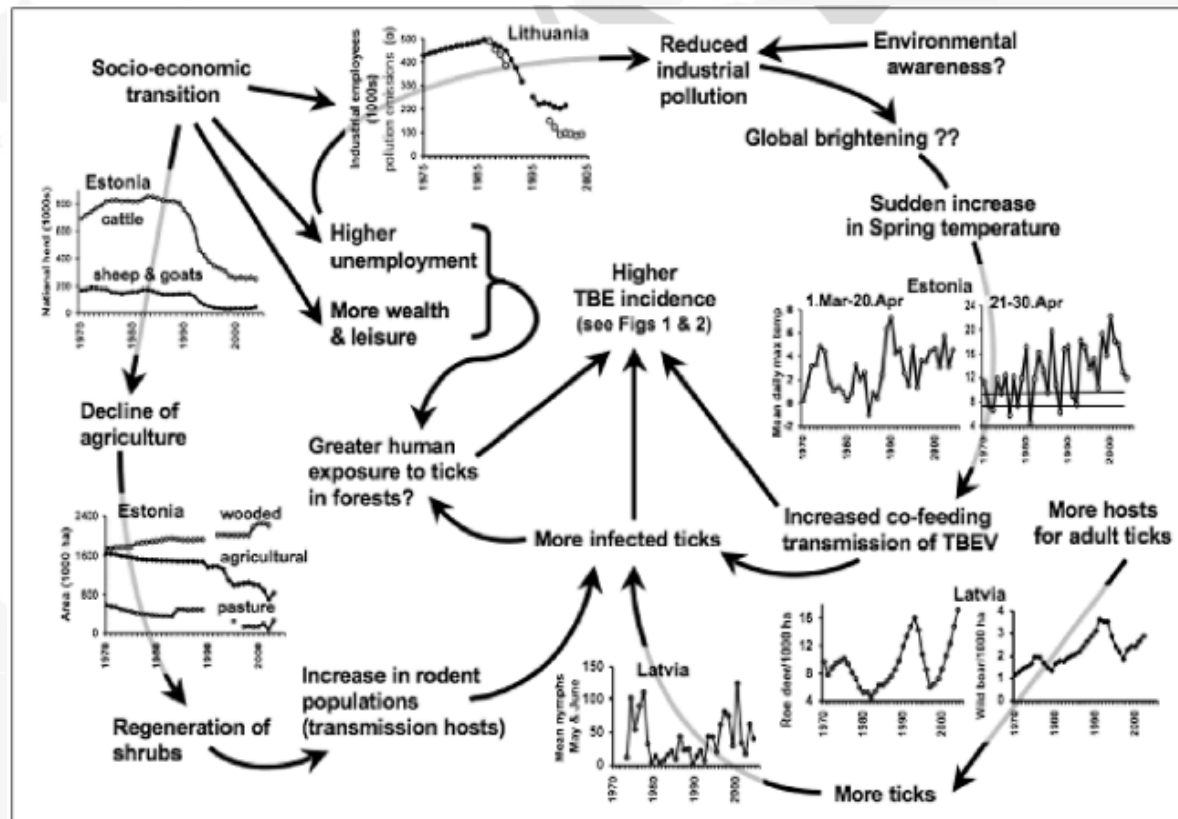
- Possible explanations of increase in prevalence:
  - warming temperatures/increasing humidity
  - residential development in preferred tick ecosystems
  - Increased contact between ticks and humans
  - more competent tick vectors
  - international trade and travel distributing tick vectors and their preferred animal hosts



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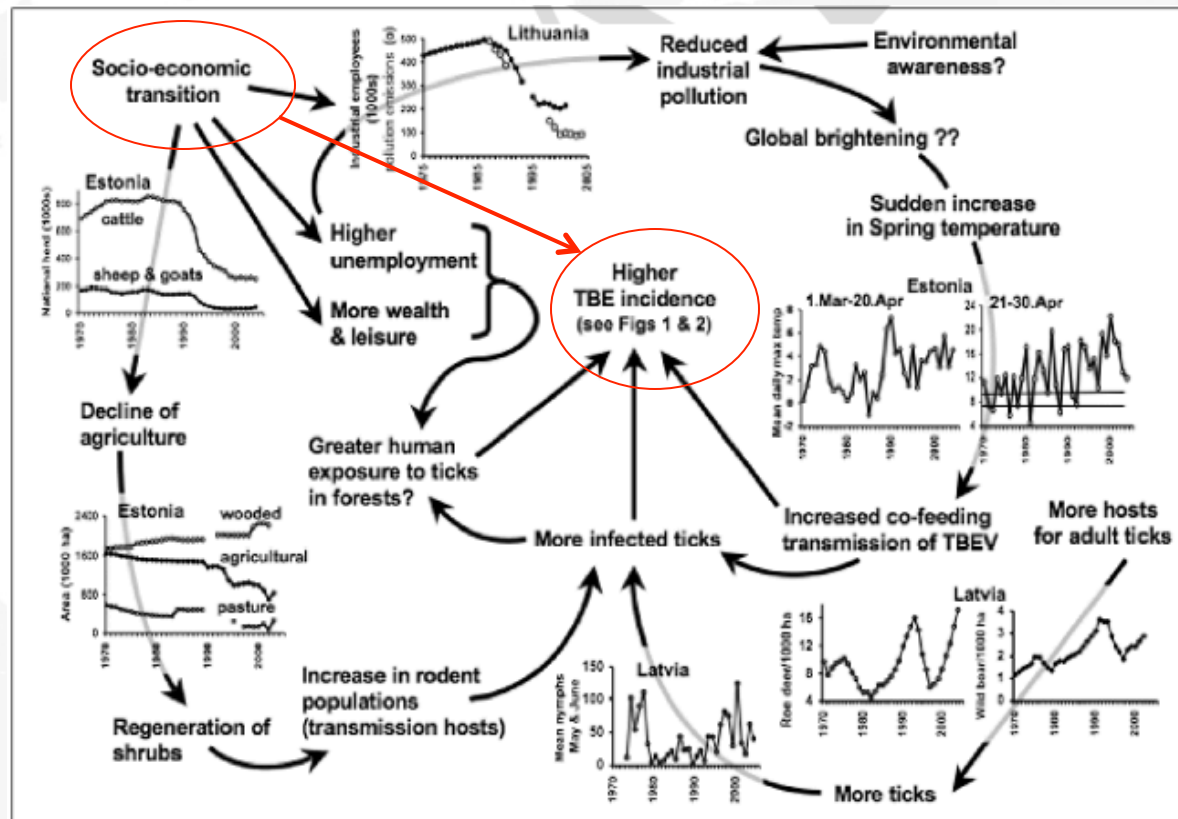
# Epidemiology of Tick Borne Diseases in Lithuania



**FIGURE 6** Hypothetical explanation for the surge in cases of tick-borne encephalitis in Estonia, Latvia, and Lithuania, following the end of Soviet rule (Šumilo et al., 2007)



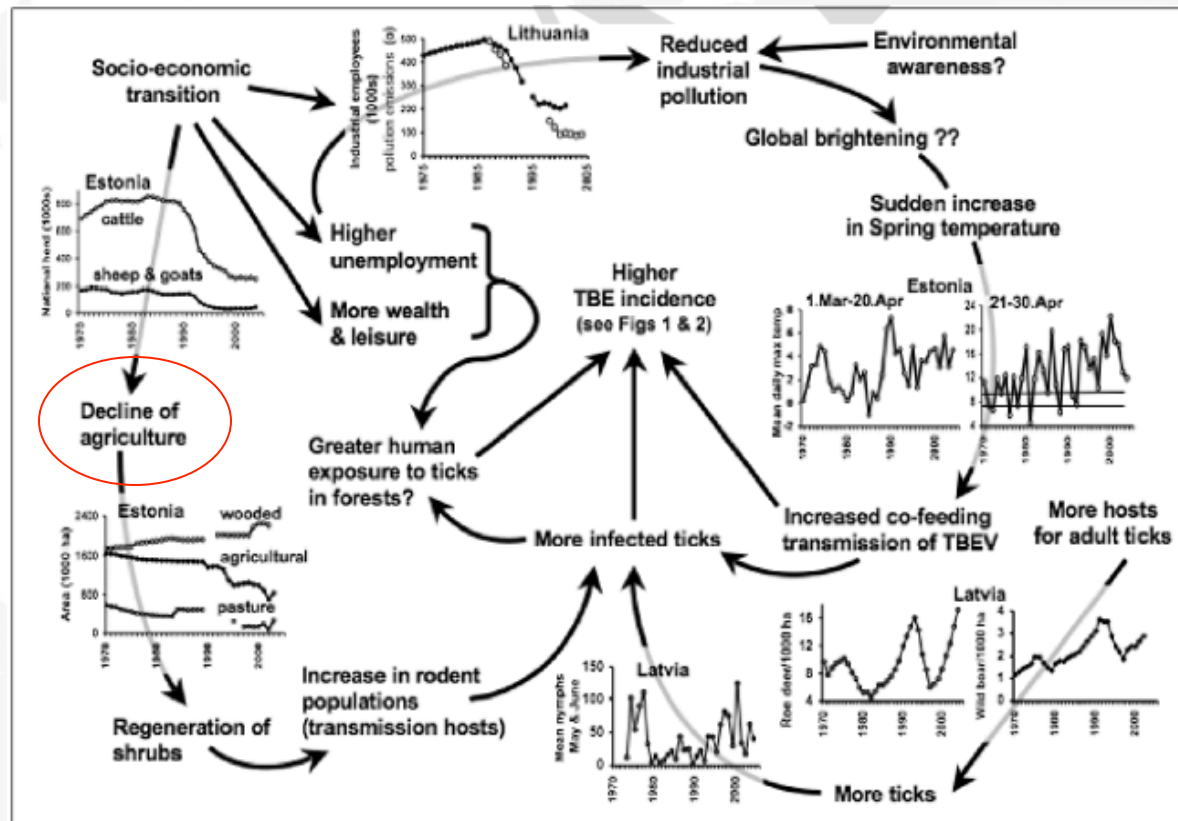
# Epidemiology of Tick Borne Diseases in Lithuania



**FIGURE 6** Hypothetical explanation for the surge in cases of tick-borne encephalitis in Estonia, Latvia, and Lithuania, following the end of Soviet rule (Šumilo et al., 2007)



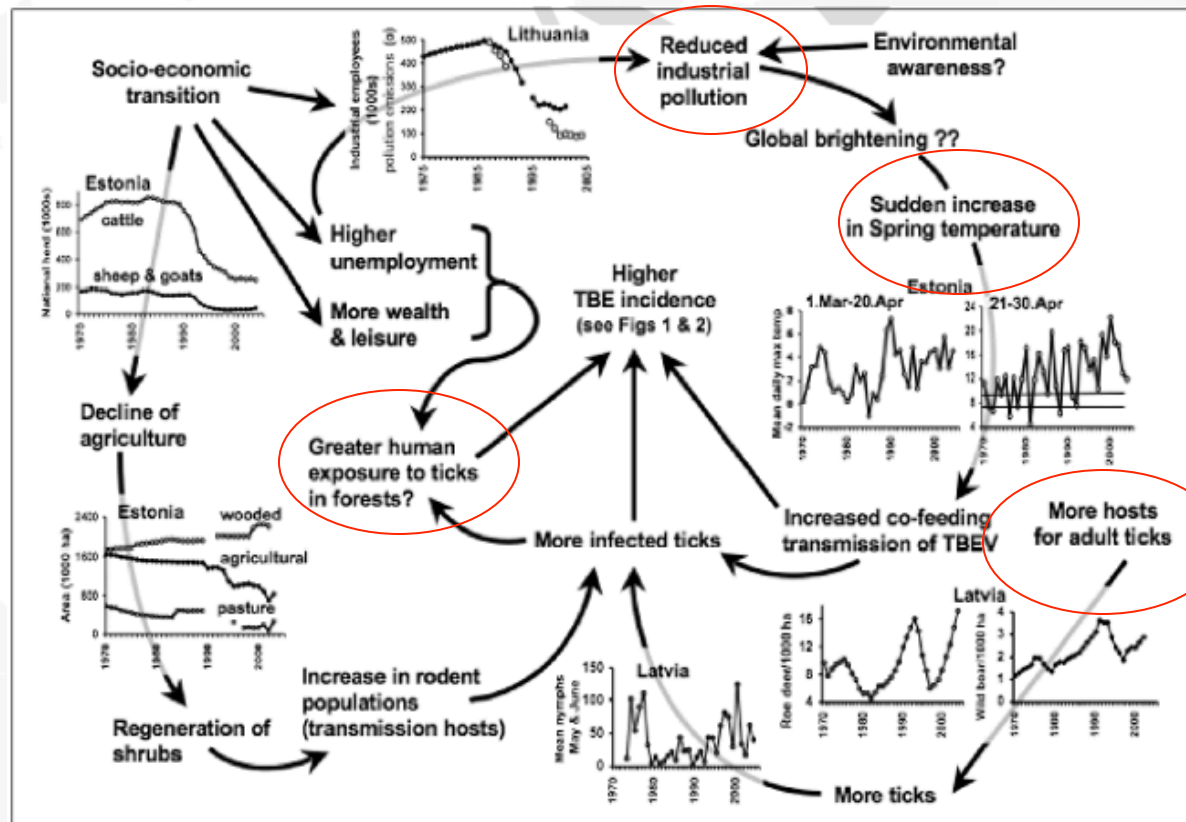
# Epidemiology of Tick Borne Diseases in Lithuania



**FIGURE 6** Hypothetical explanation for the surge in cases of tick-borne encephalitis in Estonia, Latvia, and Lithuania, following the end of Soviet rule (Šumilo et al., 2007)



# Epidemiology of Tick Borne Diseases in Lithuania



**FIGURE 6** Hypothetical explanation for the upsurge in cases of tick-borne encephalitis in Estonia, Latvia, and Lithuania, following the end of Soviet rule (Šumilo et al., 2007)





# Diseases Carried by Ticks

## Diseases:

Anaplasmosis  
Ehrlichiosis  
Lyme Disease  
Rickettsiosis  
Rocky Mountain Spotted Fever  
Southern Tick-Associated Rash Illness  
Tickborne relapsing fever  
Tularemia  
African Tick Bite Fever  
364D Rickettsiosis  
Meningoencephalitis  
Colorado tick fever  
Crimean  
Congo hemorrhagic fever  
Babesiosis  
Cytauxzoonosis

## Bacteria

*Anaplasma phagocytophilum*  
*Ehrlichia*  
*Borrelia burgdorferi*  
*Rickettsiae*  
*Borellia*  
*spirochetes*  
*Francisella tularensis*

## Virus

*TBEV virus*  
*CTF virus*  
*CCHF virus*

## Protozoa

*Babesia microti*  
*C. Felis*



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# Diseases Carried by Ticks

## Diseases:

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Ehrlichiosis

Lyme Disease

**Rickettsiosis**

**Rocky Mountain Spotted Fever**

Southern Tick-Associated Rash Illness

Tickborne relapsing fever

Tularemia

**African Tick Bite Fever** ←

**364D Rickettsiosis**

Meningoencephalitis

Colorado tick fever

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Congo hemorrhagic fever

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## Bacteria

*Anaplasma phagocytophilum*

*Ehrlichia*

*Borrelia burgdorferi*

***Rickettsiae***

*Borellia*

*spirochetes*

*Francisella tularensis*

## Virus

*TBEV virus*

*CTF virus*

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## Protozoa

*Babesia microti*

*C. Felis*



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# African Tick Bite Fever

- Vector: *Amblyomma hebraeum* and *A. variegatum* ticks
- Bacteria: *Rickettsia africae* and *Rickettsia parkeri*
  - Thrive in tick salivary glands
  - Multiply in tick salivary glands and ovaries of tick
  - Once injected in host, initially spread via lymphatics, then travels to vascular endothelial lining cells of CNS, lungs, and myocardium



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# Epidemiology *Amblyomma hebraeum*

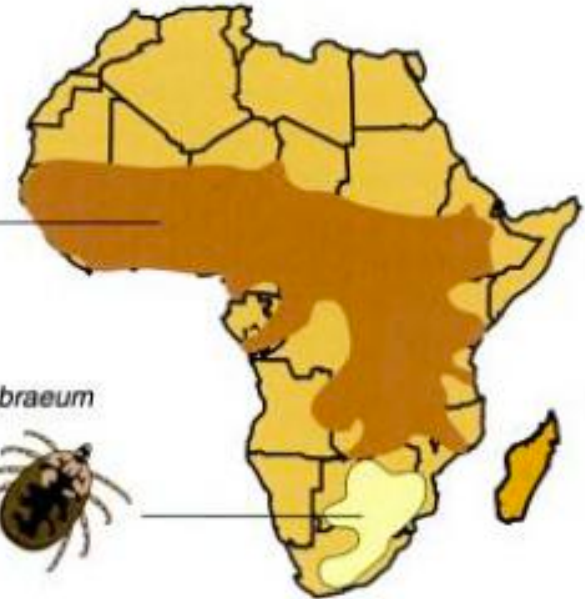


Endemic African Countries

*A. variegatum*



*A. hebraeum*



Prevalence of *A. hebraeum* Tick



# Epidemiology

- Not many cases reported within endemic countries
  - People in endemic countries are infected at a younger age
    - At this age, disease is not serious enough to warrant medical attention
  - Misdiagnosed as malaria

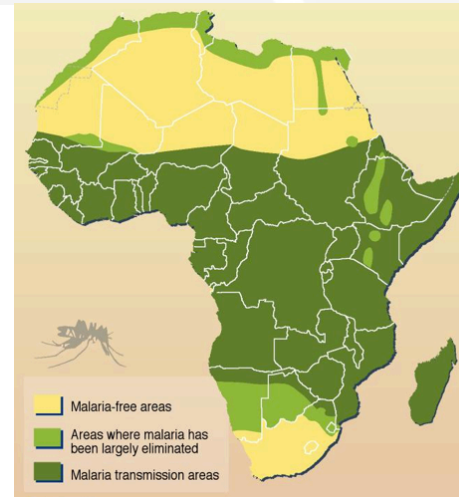


Photo credit: <http://www.grida.no/publications/vg/africa/page/3119.aspx>



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## A Case Study (France)

- Patient: 69 year old white man
- History: had just returned from a 6 day trip to **Zimbabwe**
  - Had visited farms and other rural areas
- Admitted with a **fever**
- Signs/Symptoms:
  - multiple eschars on the right leg
  - headaches, dry cough, nausea, chills, back pain, dysphagia
  - lymphangitis and edema of the right leg



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# Clinical Presentation

- Symptoms start 1-2 weeks after infection
- rash and/or eschar at site of tick bite
  - Rash starts on wrists/ankles and spreads to the limbs
- Enlarged lymph nodes near eschar



Photo by Mark Wise, Travel Clinic



# Clinical Presentation

- fever, headache, nausea, malaise, vomiting, abdominal pain
- Severe problems
  - Vascular epithelial cell damage by microbial replication
  - Vascular inflammation
  - Pulmonary edema
  - Distal, digital skin necrosis



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# Diagnostic Challenges

- Clinical Presentation similar for many different *rickettsiae* infections
  - tick bites, eschars, rash, painful regional lymphadenopathy
- Antibody-based laboratory techniques are not sufficient
  - *Rickettsiae* bacteria all cause similar immune responses in humans
- Can be misdiagnosed as Malaria



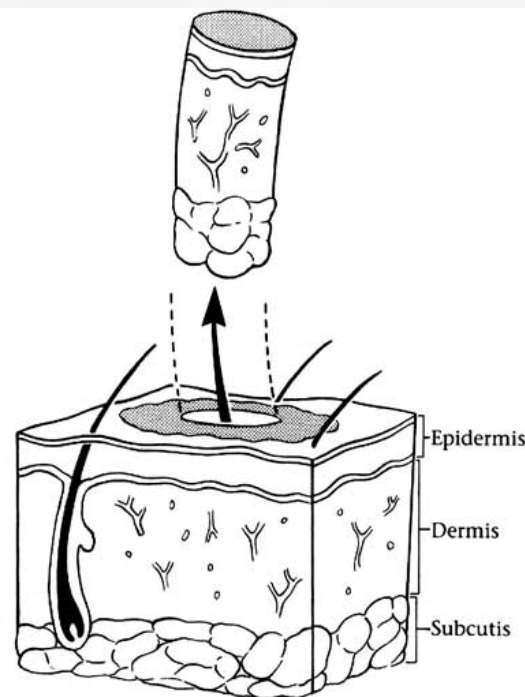
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# Preferred Diagnostic Techniques

**Sample: Swab or skin biopsy from rash or eschar**

- PCR test
  - Also possible with blood sample
- Immunohistochemical detection
- Culture isolation



Skin Biopsy





# Treatment

- Doxycycline
  - 200 mg/day
  - 3-14 days



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# Personal Methods of Prevention

- Body be checked every few hours for ticks
- diethyl-3-methylbenzamide (DEET) and KBR 3023 lotions



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# Large Scale Preventative Strategies

- Deforestation or agricultural activities disrupt tick lifecycle
- Insecticides
  - Negative impact on environment
  - Ex. Amitraz, Decamethrin
- Tail tags



Picture credits: UC Davis Veterinary School (top) and [http://www.agric.wa.gov.au/PC\\_93608.html](http://www.agric.wa.gov.au/PC_93608.html) (bottom)



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# Ticks as Disease Vectors Summary

- Anthropoda phyla of animal parasites
  - hard ticks and soft ticks transmit human diseases
- Hard tick life cycles can include 1-3 feeding hosts, and humans are at risk of becoming an "accidental host" during feeding periods in the lifecycle
- Ticks use methods such as questing, chemical stimuli, and summoning signals to find a hosts
- Ticks transmit Bacteria/virus/protozoa during blood meals by secreting saliva (containing the pathogen) into the host
- Increasing reports of occurrence in tick borne diseases are due to changing environmental factors and growing disease recognition



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# African Tick Bite Fever Summary (1 of 2)

- Vector: *Amblyomma hebraeum* and *A. variegatum* ticks
- Bacteria: *Rickettsia africae* and *Rickettsia parkeri*
- Epidemiology
  - Mainly endemic to Sub-Saharan Africa, but some endemicity in Caribbean and Americas
  - Mainly a "traveler disease" - few reported cases in endemic countries
- Clinical Presentation
  - rash, eschar, lymphangitis, fever, rare severe complications
- Diagnosis
  - Challenges in distinguishing it from other Rickettsial and febrile diseases
  - Use PCR, Immunohistochemical detection, culture isolation on skin biopsy



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# African Tick Bite Fever Summary (2 of 2)

- Treatment
  - Doxycycline
- Control Methods
  - Mainly personal prevention like DEET/KBR lotions
  - Some larger interventions like deforestation, insecticides, and tail tags
- If epidemic were to occur, obstacles for control would be lack of diagnostic tools and lack of large scale control methods



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Questions??



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