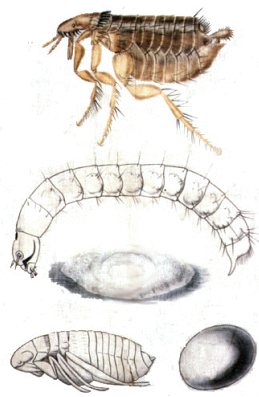


Siphonaptera: fleas

- o Endopterygota
- o 1° mammalian ectoparasites
- o Annoy, bite, cause allergies
- o Hind legs adapted for jumping
- o Adults: blood suckers
- o Unfed adults live a long time
- o Somewhat host specific



<http://bugguide.net/magm/aw/BRLQBRRQNRHQARHQF/RHQV3K0Q8CQW3K0RMR0RGR00Q0Q07FRKQJ0Q0Q0G0CQ0R3K1R40DQ.jpg>



Flea Vectors

- o Can live off host for months
- o Many species are vectors
- o *Oropsylla montana*
 - Rock and California ground squirrels, prairie dogs
 - Most important flea vector in US
- o *Xenopsylla cheopis* (oriental rat flea)
 - 1° vector in epidemics in Asia, Africa, S.A.
 - Male engorged with blood



Fig. 9.11 Flea larvae. The gut contains semi-digested blood provided by the adult flea.



Actual size

Plague

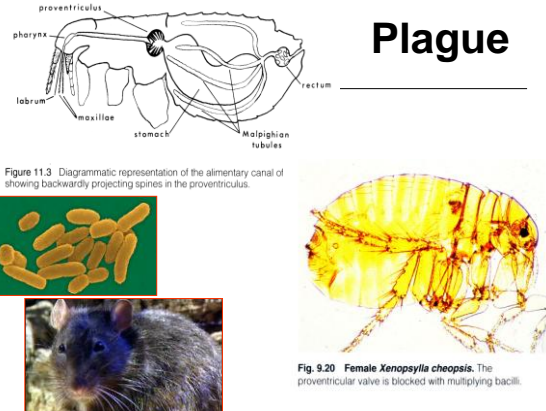


Figure 11.3 Diagrammatic representation of the alimentary canal of showing backwardly projecting spines in the proventriculus.

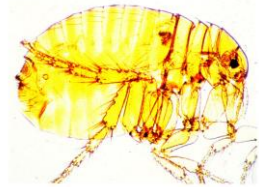


Fig. 9.20 Female *Xenopsylla cheopis*. The proventricular valve is blocked with multiplying bacilli.

Plague transmission

- o Flea bite (78%)
- o Direct animal contact (20%)
 - Tissues, body fluids, scratches, bites
 - Enters through break in skin
- o Aerosol (2%)
- o Human cases
 - April–November (93%)
 - Increased activity of fleas and hosts

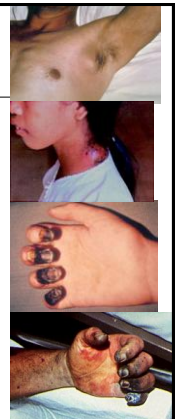
Flea Transmission

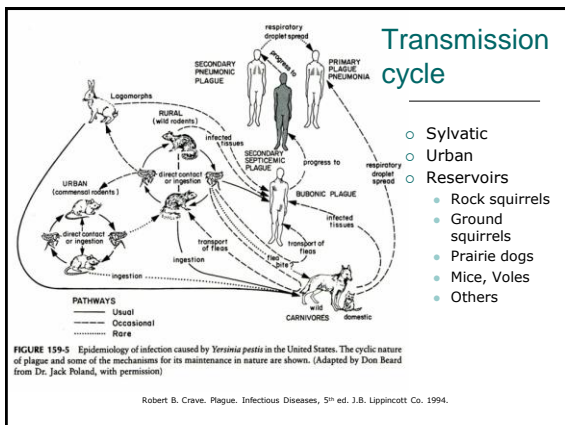
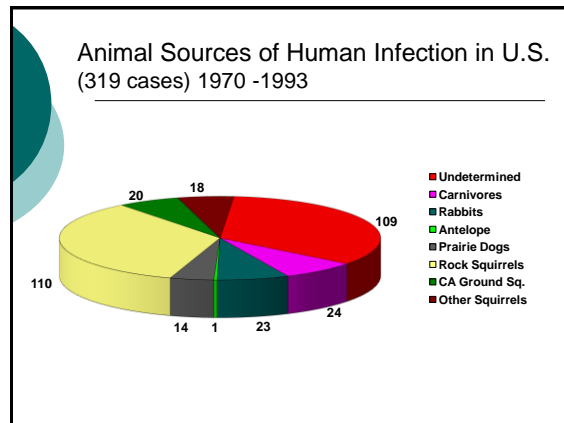
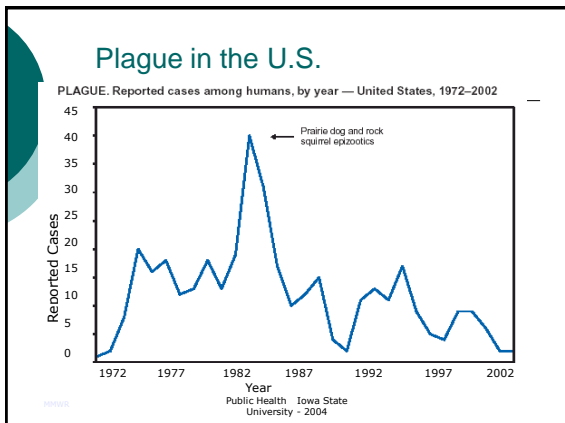
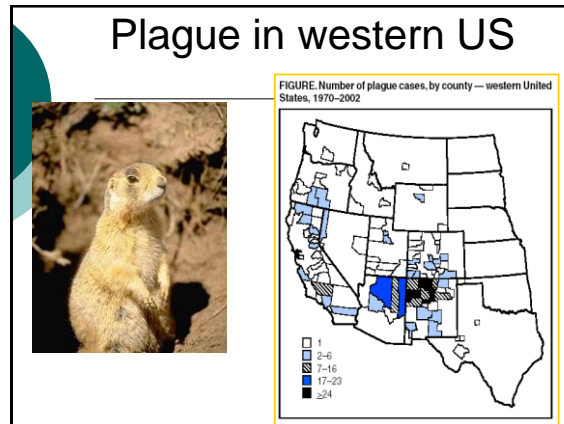
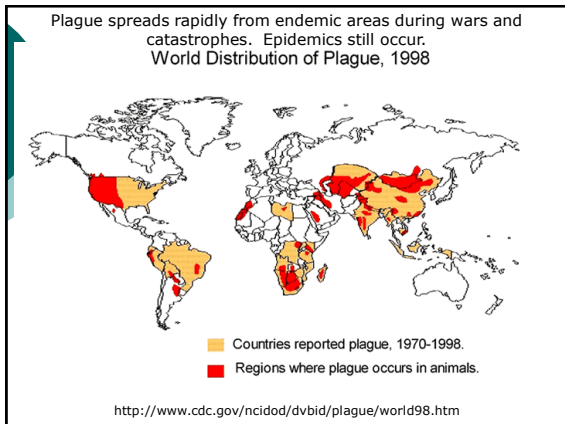
- o $\leq 27^{\circ}\text{C}$ (80°F)
 - Blood clots in gut of flea
 - *Y. pestis* trapped
 - Transmission occurs more readily
- o $\geq 27^{\circ}\text{C}$
 - Blood clot in gut of flea dissolves
 - Organism passes through
 - Transmission less likely



Types of plague

- o Bubonic (80–90% of cases)
 - Bubo: swollen, painful lymph node
 - Mortality (untreated): 50–60%
- o Septicemic
 - Similar to bubonic, + septicemia, organ failure, hemorrhage, necrosis
 - Mortality (untreated): 100%
- o Pneumonic
 - 1° - *Y. pestis* inhaled
 - 2° - septicemic form spreads
 - Respiratory distress, hemoptysis





Sylvatic and urban plague

- Enzootic
 - Steady level in rodent populations
 - Low death rates
- Epizootic
 - Large die-offs → fleas change hosts (e.g., rats)
 - Amplifying hosts
 - Prairie dog, ground squirrels, rock squirrels, woodrats, chipmunks
 - Expansion into human areas
 - Facilitated by poverty, homelessness

History

- Importance
 - 1 of 3 WHO quarantinable diseases
 - Estimated 200 million deaths recorded
- Three pandemics
 - Justinian 541 AD
 - Black Death 1346
 - China 1855

From where did the black death come?

- Black Plague came to shore of Black Sea
- Italian sailors infected
- It arrived in Europe October of 1347

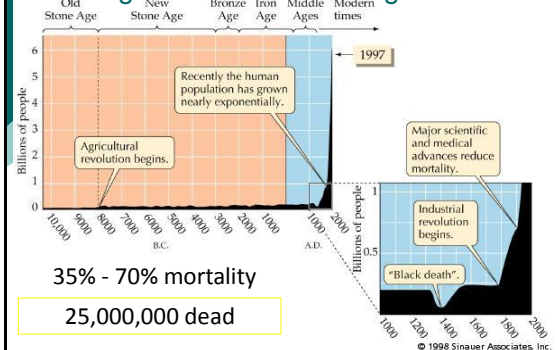


Medieval cures

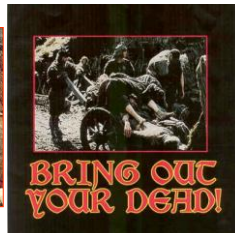


- The swellings should be softened with figs and cooked onions. Mix onions with yeast and butter. Then open the swellings with a knife.
- Take a live frog and put its belly on the plague sore. The frog will swell up and burst. Keep doing this with further frogs until they stop bursting. Can use a dried toad, too.

Plague and the Middle Ages



Medieval and contemporary art & the plague



"Ring Around The Rosy
A Pocket Full Of Posies
Ashes, Ashes
All Fall Down"

<http://www.youtube.com/watch?v=TwsKg6LwAuY>

Plague as a Biological Weapon

- One of top 6 agents identified by CDC
- Known attempted uses
 - Japanese in WWII; infected fleas released over China
 - A microbiologist with suspect motives obtained sample thru mail
- 1970 WHO simulation of 50 kg in city of 5 million
 - 80,000-100,000 hospitalized
 - 500,000 secondary cases
 - Up to 100,000 deaths
- Weapons programs
 - U.S. terminated 1970
 - Russia – prior program's status unknown

Prevention and Control

- Education/awareness
- Isolate infected animals
 - Limit contact
 - Personal protection
- Flea control
 - Spring to fall
- Prevent roaming or hunting of pets
- Rodent control
 - Eliminate rodent habitat around home
- Insect repellents for skin & clothes
- Insecticide in epizootic areas

Tick Classification

- P. Arthropoda, sP Chelicerata, C. Arachnida, sC. Acari,
 - Order Ixodida
 - 860 spp. in 22 genera and 3 families
 - F. Ixodidae: the hard ticks
- Can transmit protozoans, viruses, and bacteria

Dorsal view of mouthparts of hard tick

Ticks, Lyme disease, and ecology

- Ticks are ectoparasites and vectors
- Spirochete bacterium is the pathogen
- What are the ecological drivers of disease emergence?

Ticks that cause Lyme disease

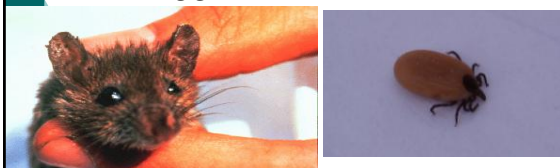
Black-legged Tick
Rocky Mountain Tick
Lone Star Tick

Black-legged Ticks (Deer Ticks)

Nymph
Larva
Adult (female)

Three life stages

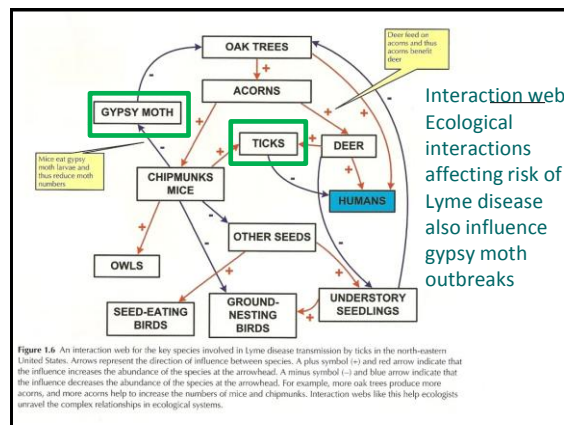
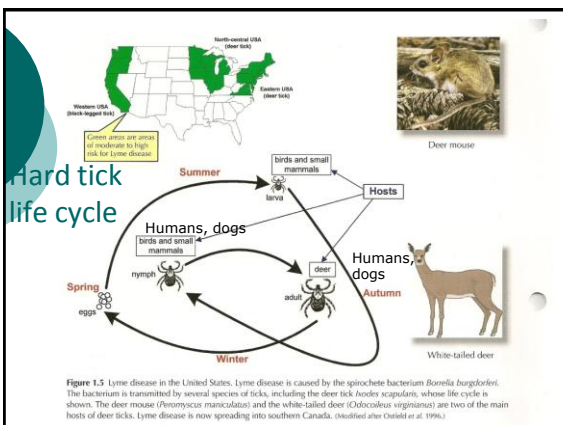
Natural host for immature black-legged ticks



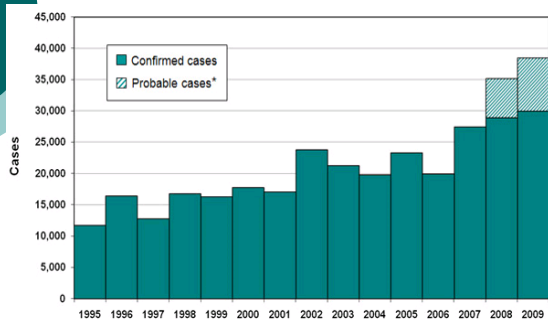
Immature blacklegged ticks can be infected by feeding on mice that are carrying Lyme disease bacteria.

Transmission can also occur from the ticks to mice.

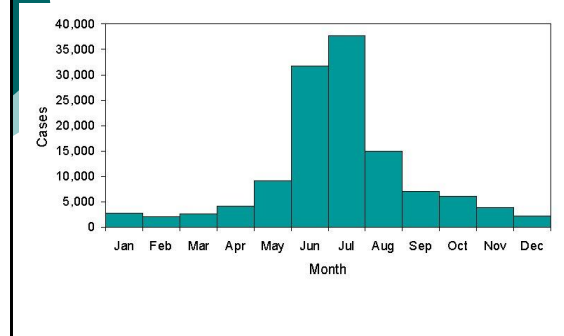
Black-legged tick habitat and questing



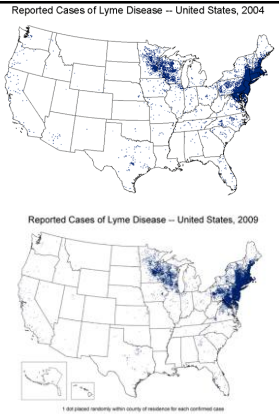
Reported Cases of Lyme Disease by Year, United States, 1992-2009 (CDC data)



Reported Cases of Lyme Disease by Month of Illness Onset United States, 1992-2004 (CDC)



Lyme disease in 48 states. The number of cases reported to the CDC in 2004 and 2009



Symptoms and Treatment of Lyme Disease

Can lead to cardiac; musculoskeletal; neurological problems

- Headaches; fatigue; pain; insomnia; loss of memory
- An imitator of other conditions
 - Confused with flu; MS; seizure; arthritis; Gulf war syndrome; ADHD; fibromyalgia; other neurologic conditions
- Treated with antibiotics
 - Prompt treatment is most effective
 - No known cure for chronic Lyme disease

