Dog Tick Invasion of Alaska

Implications for risks of tick-borne diseases

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Photo by Dr. M. Dryden, KSU

Outline

1. Epidemic rise of TBDs in USA
2. Alaska's tick fauna & SOA surveillance
3. Documented introductions & probable establishment of dog ticks into Alaska
4. Tick biology & life cycles
5. AK's Tick-borne diseases
6. Final thoughts and considerations

Photo by Dr. M. Dryden, KSU

Tick-borne Diseases of Humans in the US

- Steadily increasing human cases of TBDs reported annually

Table 1. Tick-borne diseases reported to the CDC, United Stated, and 2002-2011 [Source: CDC]

Disease	Year									
	2002	2003	2004	2005	2006	2007	2008	2009§	2010	2011
Lyme	23,763	21,273	19,859	21,304	19,931	27,444	35,198	38,468	30,158	33,097
RMSF	1,104	1,091	1,738	2,029	2,288	2,221	2,563	1,815	1,985	2,802
Eh/An (total)*	750	727	934	1,404	1,455	1,999	2,107	2,267	2,615	3,562
Babesiosis‡										1,128

§Reporting criteria revised in 2009

*Includes human granulocytic anaplasmosis and human monocytic ehrlichiosis

‡Babesiosis became nationally notifiable in 2010

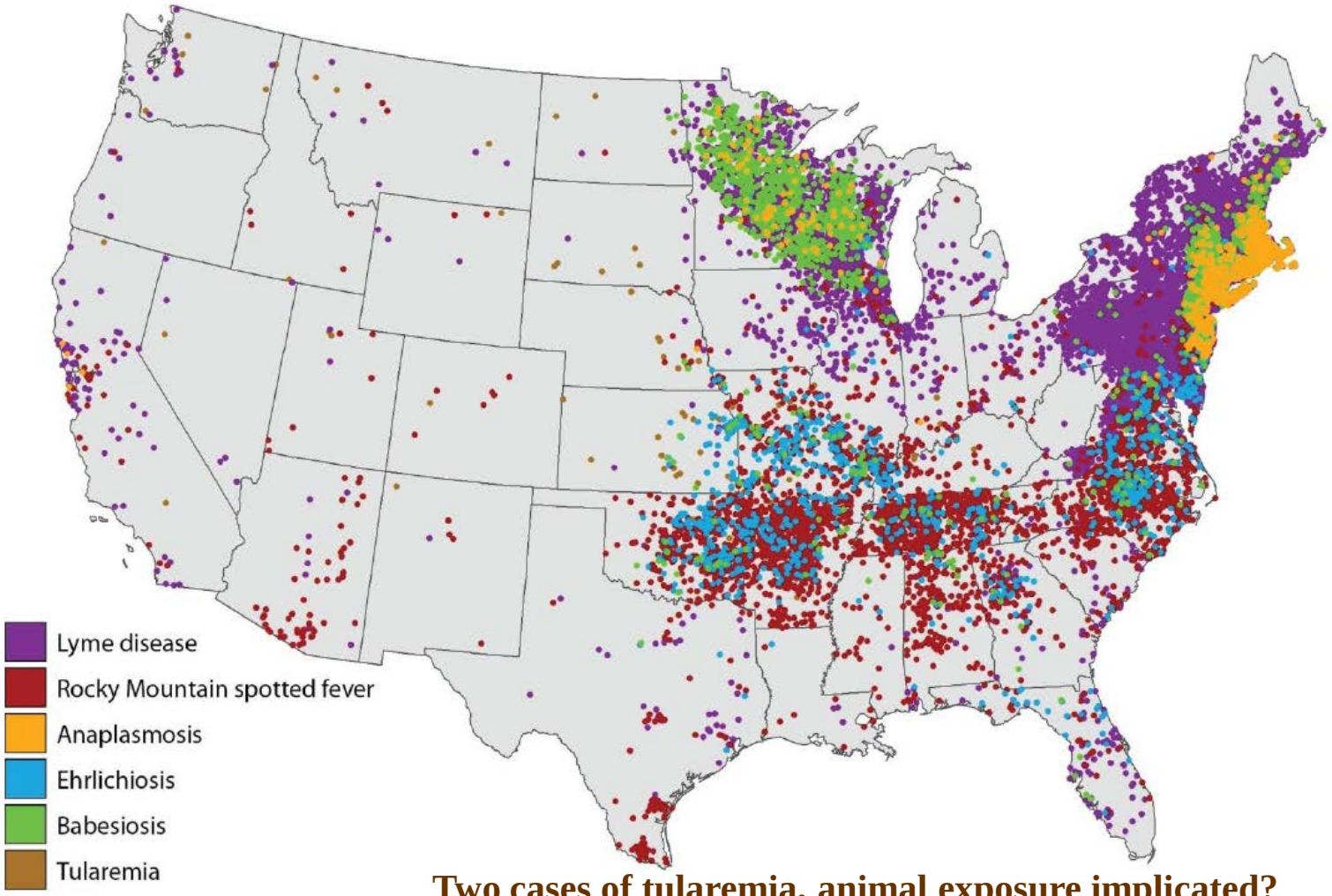
Tick-borne Diseases of Humans in the US

- Lyme dz is most reported TBD and 6th of top notifiable diseases to CDC

Table 3. Tick-borne diseases reported to the CDC, United States, 2011 [Source: CDC]

Disease/agent	Reported cases
Lyme disease	33,097
Spotted Fever Rickettsiosis	2,802
Anaplasma phagocytophilum	2,575
Babesia	1,128
Ehrlichia chaffeensis	850
Tularemia	166
Anaplasma/Ehrlichia – undetermined/other	161
Powassan virus	16

Distribution of Key Tickborne Diseases, 2012



Two cases of tularemia, animal exposure implicated?

NOTE: Each dot represents one case. Cases are reported from the infected person's county of residence, not necessarily the place where they were infected.

NOTE: During 2012, babesiosis was reportable in Alabama, California, Connecticut, Delaware, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Oregon, Rhode Island, Tennessee, Vermont, Washington, Wisconsin, and Wyoming. CDC was not notified through the national surveillance system of cases in other states.

NOTE: In 2012, no cases of tickborne illness were reported from Hawaii. In 2012, Alaska reported ten travel-related cases of Lyme disease.

Possible Reasons of Increased TBDs

1. Ecological changes, climate and shift in land uses
2. Increasing deer and wildlife populations, closer associations between humans/wildlife
3. Human behavior changes led to greater exposure risks
4. Improvements in diagnosis, surveillance, and reporting practices

Why Should Alaskan's be Concerned?

- It's a fallacy that 'we don't have ticks'
  - We always have had many wildlife ticks
- Ticks exotic to Alaska are increasingly being detected
  - At least 2 dog ticks are becoming established

Why Should Alaskan's be Concerned?

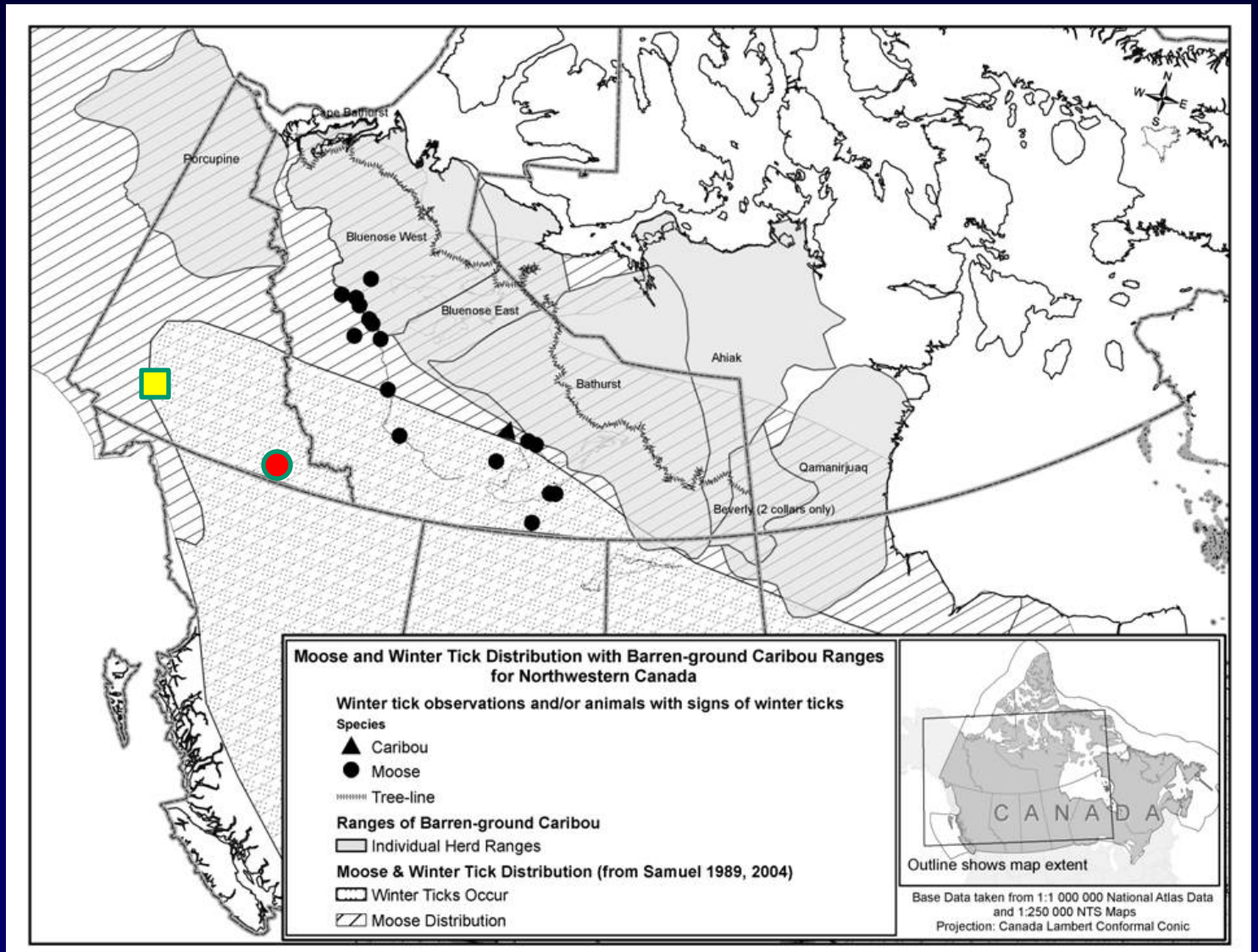
- Enzootic and exotic ticks in AK are competent vectors for TBDs (zoonotic, animal and wildlife susceptible)
  - Infected travelers a potential 'source' of introduction of TBDs as well as hitchhiking ticks
  - The public, physicans, veterinarians less likely to consider TBDs as a Ddx
  - Wildlife non-adapted to exotic ticks nor TBDs, potential for population-level impacts

ADF&G Initiated Targeted Tick Surveillance: Moose Winter Tick

Dermacentor albipictus

Photos: Bill Samuels

Moose Winter Tick on the Move



How Does Winter Tick Cause Disease?

- Animals that die because of heavy infestations with Winter Ticks appear to die because they do not eat enough food to supply the energy they require. =starved to death.
- Heavy infestations with the Winter Tick both increase the amount of energy the host animal requires and cause the animal to spend inadequate amounts of time feeding.
- The ticks have these effects on the host animal in two different ways: 1) by feeding on the animal's blood and 2) by causing severe irritation of the skin.

Blood loss

- Each female tick consumes 2ml, males and larvae less but substantial.
- If ½ of the 40,000 ticks are female, = 40L of blood
- 400kg moose has 32L of blood (8% BW)
- Thus a moose most replace its entire blood volume over 2 months!

Ultimate cause of death but what about TBDs?

Moose Winter Tick vectored animal and zoonotic diseases

- Vector of cattle Anaplasmosis (a rickettsia)
- Suspected vector of Rocky Mtn Spotted Fever

Moose Winter Tick vectored animal and zoonotic diseases

- Potential vector of Tularemia and human anaplasmosis

J Med Entomol. 2009 May;46(3):625-32.

Transovarial transmission of Francisella-like endosymbionts and Anaplasma phagocytophilum variants in Dermacentor albipictus (Acari: Ixodidae).

Baldridge GD[1], Scoles GA, Burkhardt NY, Schloeder B, Kurtti TJ, Munderloh UG.

Moose Winter Tick potential vector for Lyme Disease?

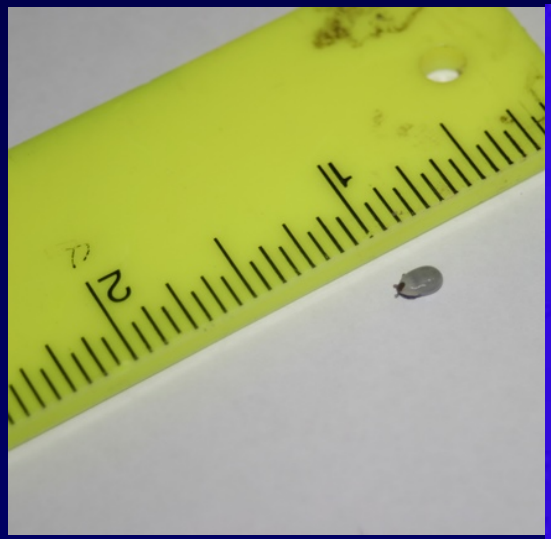
Borrelia infection rates in winter ticks (Dermacentor albipictus) removed from white-tailed deer (Odocoileus virginianus) in Cheatham County, Tennessee. 2007. J Tenn Acad Sci

White-tailed deer, *Odocoileus virginianus*, are significant reservoir hosts of *Borrelia burgdorferi*, the causative agent of Lyme disease. Hard ticks serve as vectors of both *B. burgdorferi* and *Borrelia lonestari*, a species reported from the southeastern United States and associated with Southern Tick Associated Rash Illness or STARI. Winter ticks, *D. albipictus*, were collected from hunter-killed deer in Cheatham County, Tennessee in October and November of 2005. Six of 18 (33%) pooled tick samples tested positive for *Borrelia* species; two of six were identified as *B. burgdorferi* and four as *B. lonestari*. This investigation demonstrates that both *B. burgdorferi* and *B. lonestari* are present in *O. virginianus* populations in Cheatham County, Tennessee. It is noteworthy that *D.albipictus* is capable of harboring Borreliae from infected white-tailed deer. This is the first report of *Borrelia* detection in *D. albipictus* in Tennessee.

SOA Tick Surveillance
June 2011-May 2014 Results

Fifty-eight infestations detected, >100 ticks examined from:

- 25 dogs
- 8 humans
- 3 cats
- 1 hare and 3 marten



Submitted to OSV and ADF&G
All identifications confirmed by Dr. Lance Durden, Georgia Southern University

Most common enzootic tick

Squirrel or Lemming tick, *Ixodes angustus*

- 21 cases from dogs, cats, people and a single hare
- Reported vector of Lyme disease (case report in WA) and Babesiosis

Second common enzootic tick

Rabbit or Hare tick

Haemahysalis leporispalustris

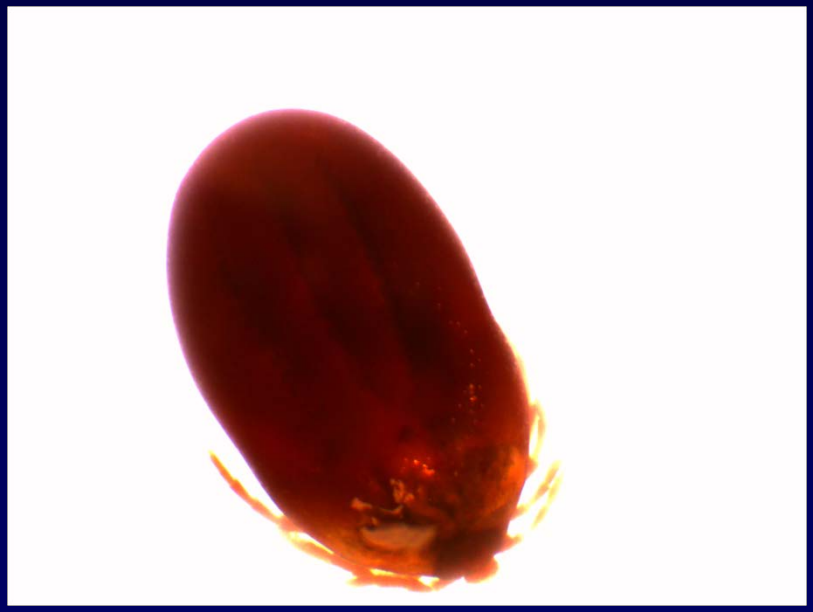
- 2 dogs, 1 human
- Primary vector for **Tularemia**, competent for Q-fever

Less commonly detected enzootic tick fauna

Seabird ticks

Ixodes auritulus

- *Previously reported on birds in Alaska but recently found on a dog in Sitka*



Enzootic or exotic?

Raccoon tick

Ixodes texanus

- Not previously reported in Alaska until found on a marten near Ketchikan
- Common on dogs and raccoons elsewhere…sign of expanding geographic range?

Ticks Exotic to Alaska
Invasive Dog Ticks Detected

- *Rhipicephalus sanguineus* - Brown Dog Tick 15 cases
- *Dermacentor variabilis* - American Dog Tick 12 cases
- *Dermacentor andersoni* - Rocky Mountain Wood Tick 2 cases
- *Amblyomma americanum* - Lone Star Tick 2 cases




American Dog Tick Establishing in Alaska?

- *Dermacentor variabilis*

12 cases: Dogs and people in North Pole Fairbanks, Anchorage, Denali NP, Juneau, Valdez, Willow, Sitka, Chugiak

Dogs that had never traveled from Valdez or JNU. Documented tick-free dog infected in Potter's marsh. Another just arrived in Sitka airport last week! Dog in Chugiak last week (owner returned from hunting in NE.

Larvae: voles, mice

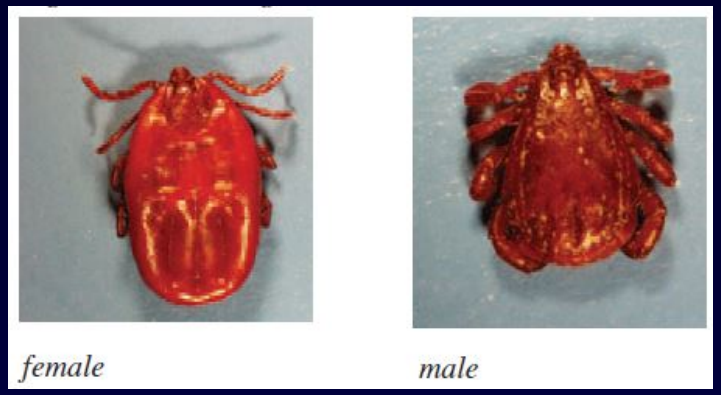
Nymphs: cats, dogs, rabbits

Adults: Cats, coyotes, dogs, large mammals, people

- **Tularemia**
- **Rocky mtn spotted fever**
- **Tick fever and tick paralysis**
- **Q-fever**
- **Human monocytic ehrlichiosis**
- Anaplasmosis
- Canine babesiosis
- Canine granulocytic ehrlichiosis
- Canine ehrlichiosis
- Feline theileriosis

Brown Dog Tick Established in Interior AK

- *Rhipicephalus sanguineus*



15 cases: Dogs and people in North Pole Fairbanks, Anchorage, and Sitka

Dogs that had never traveled from Fairbanks, Sitka, Anc. Documented 3 boarding kennel transmission and 2 infested homes in Fairbanks

Worldwide distribution except polar regions

Larvae: Dogs rodents

Nymphs: Dogs, rabbits

Adults: Dogs, bears, coyotes, large mammals, rodents/rabbits, people

- **Tularemia**
- **Rocky mtn spotted fever**
- **Q-fever**
- **Mediterranean spotted fevers**
- **Tick paralysis**
- Anaplasmosis
- Canine babesiosis
- Canine infectious cyclic thrombocytopenia
- Canine ehrlichiosis
- Canine hepatozoonosis

Rocky Mountain Wood Tick

- *Dermacentor andersoni*

2 cases: Dogs in Anchorage and Sitka

Dogs Returning from OR and CA, 2 wks previous (latter in Jan)

- **Rocky mtn spotted fever**
- **Colorado Tick fever**
- **Tick paralysis**
- **Tularemia**
- **Q-fever**
- Anaplasmosis

Lone Star Tick

- *Ambylomma americanum*

2 cases: Dogs from Fairbanks and Eagle River

Dog from Fairbanks (returned from Tx, FL and PA) and Eagle River dog never travelled nor out of fenced yard

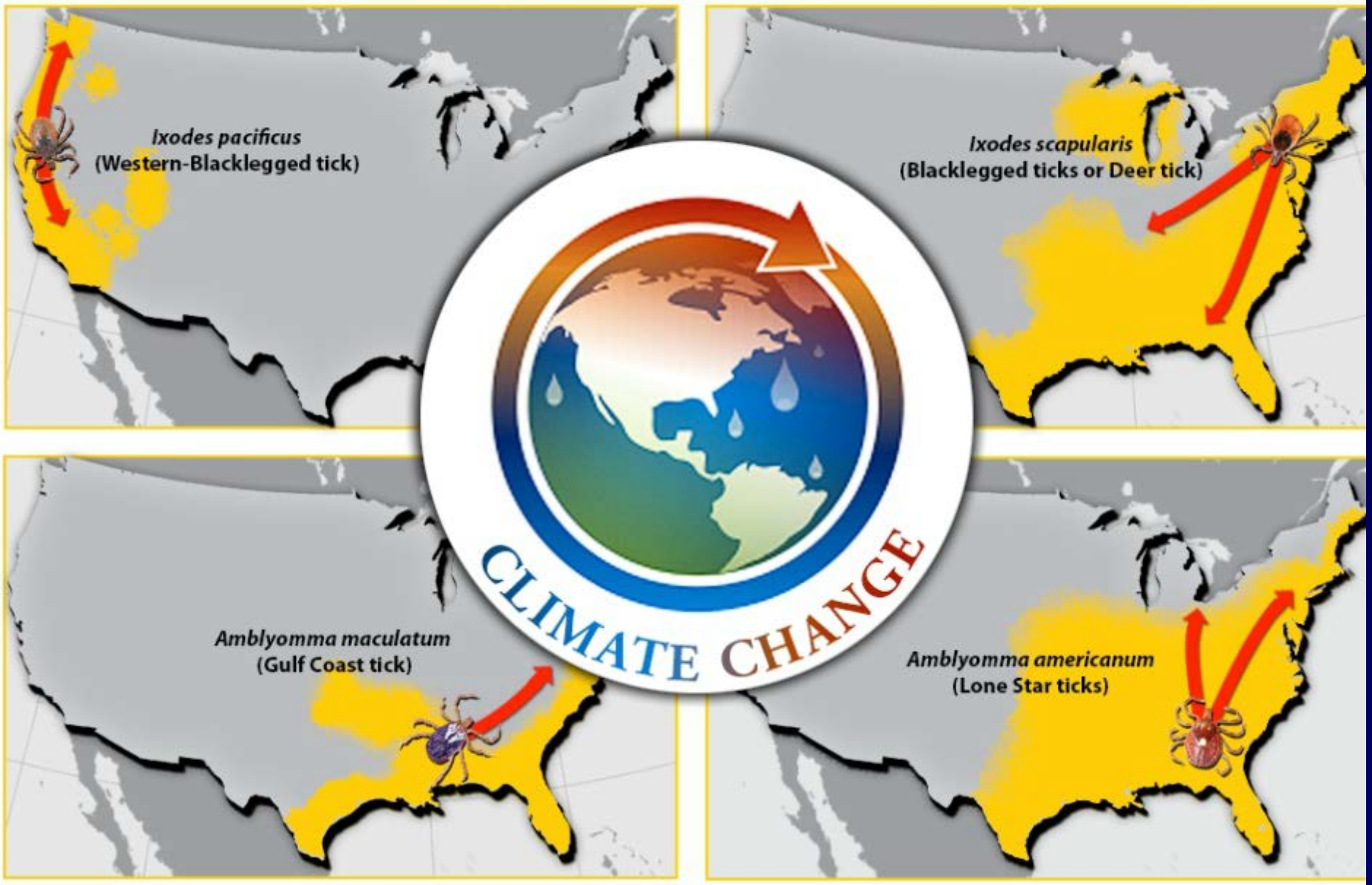
- **Tularemia**
- **Human monocytic ehrlichiosis**
- **Tularemia**
- **Tick paralysis**
- **RMSP**
- **STARI:** southern tick-associated rash illness (Borrelia lonestari?)

Changing tick ecology worldwide

- Tick species occurring in locations where they previously did not exist.
  - Tick-transmitted diseases are diagnosed in locations they previously did not exist.
  - New tick-transmitted diseases are being discovered
- Ticks are active throughout the year in many locations.
  - Due to natural climate fluctuations and introduction of different tick species.
- Tick densities are significantly higher in many locations.
- Ticks are now common in many suburban areas.
- It’s not just an Alaska problem

More Ticks In More Places...

...and likely even more to come!



Expansion of Tick Ranges

- Climate change: increases tick ranges, shortens life cycle, increases densities
  - Only a 2-3 degree increase in mean temp April to Sept was speculated to allow Brown dog ticks to establish outdoors in Northern temperate climates (already established indoors)
  - Humidity also important for deer tick survival

Introduction and Expansion of Dog Tick Ranges

- Tourists/visitors, pets and imported animals
- Alaskans traveling and returning, esp. w/ animals (Sitka example May 7, 2014). Chugiak couple brought back ticks from NE that transferred to dog.
- Migratory birds and mammals transporting ticks
- Increased human contact with natural areas increasing risk of tick encounters

  → recreation, occupation, housing developments in wooded areas.

Tick Biology 101: Saliva

- Anticoagulant, anesthetic, anti-inflammatory
- Secrete cement to attach, dissolves after feeding
- Saliva transmits diseases but 24-36hr of feeding needed to transmit

- Host response to saliva determines host specificity

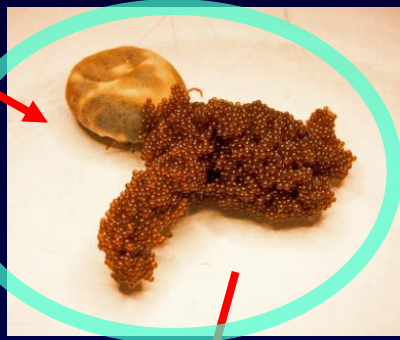
Photos by Dr. M. Dryden, KSU

3-Host, 2yrs to complete in northern climates

adult

Engorge in 4 – 13 days

00-6000 eggs



Eggs hatch ≈35 days

Larvae

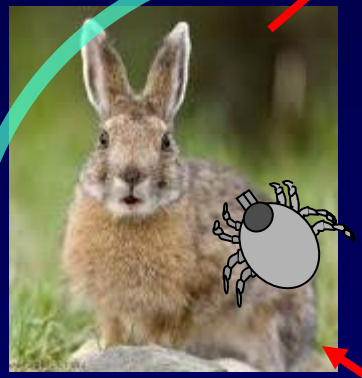
activity peaks in early summer

Engorge in 3 – 7 days

Molt in 6 – 250 days

Nymph

Peak activity late summer



Engorge in 3 – 11 days

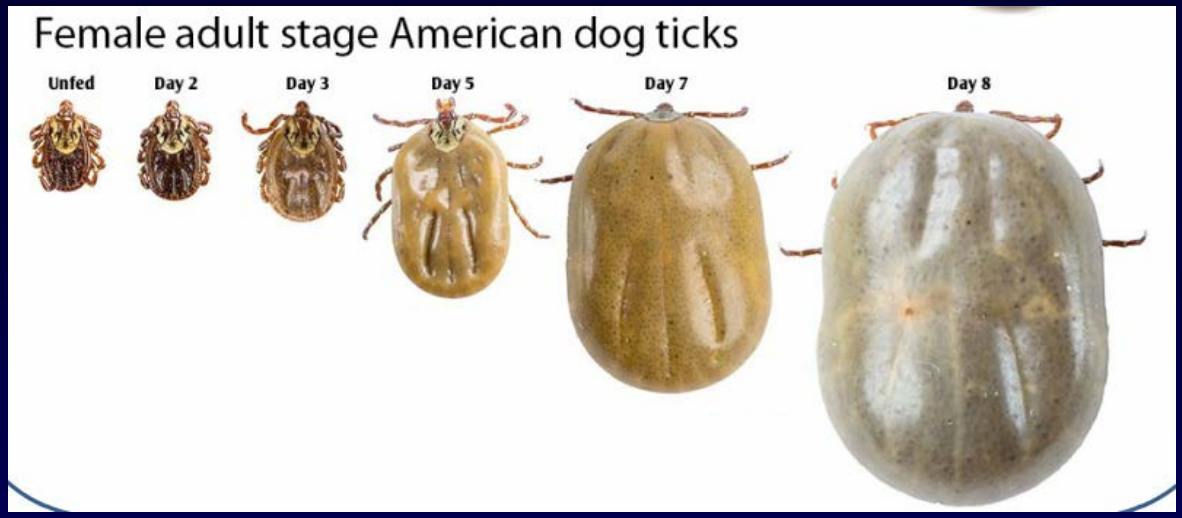
Molts in 3wk to several months, adult overwinters or feeds on host

American Dog Tick

Dermacentor variabilis

Adapted from Dr. M. Dryden, KSU

Tick Longevity & Host Association



American dog ticks can take from 2 to 3 yrs to complete their lifecycle and adults can live 2 to 3 years.

- During that time they will feed for
  - 2 to 7 days as larvae
  - 2 to 11 days as nymphs
  - 3 to 15 days as adults

→ <2% of the life of an adult tick is on an animal thus **~99.5%** of their life not on an animal.

Dryden MW, Payne PA. Biology and Control of ticks infesting dogs and cats in North America Vet Ther 2004;26:2-16.

Brown Dog Tick Rhipicephalus sanguineus

Only tick in North America to inhabit buildings

currently a problem primarily in boarding kennels and some Fairbanks area households

Photo by Dr. M. Dryden, KSU

Dog Tick-vectored zoonotic diseases

- Endemic diseases, Tularemia (and Q-fever) prevalence likely to increase with increased tick vector density, survival and diversity (esp w/ increased human host preferences)
- Tularemia cases will increase in pets and subsequent exposure risk for humans increases (direct and indirect)

Tularemia in Alaska

- Agent
  - Bacteria
  - *Francisella tularensis*
  - Select agent' → potential use in biowarfare
- Natural Hosts
  - Snowshoe hare
  - Muskrat
  - Beaver

Tularemia- Transmission

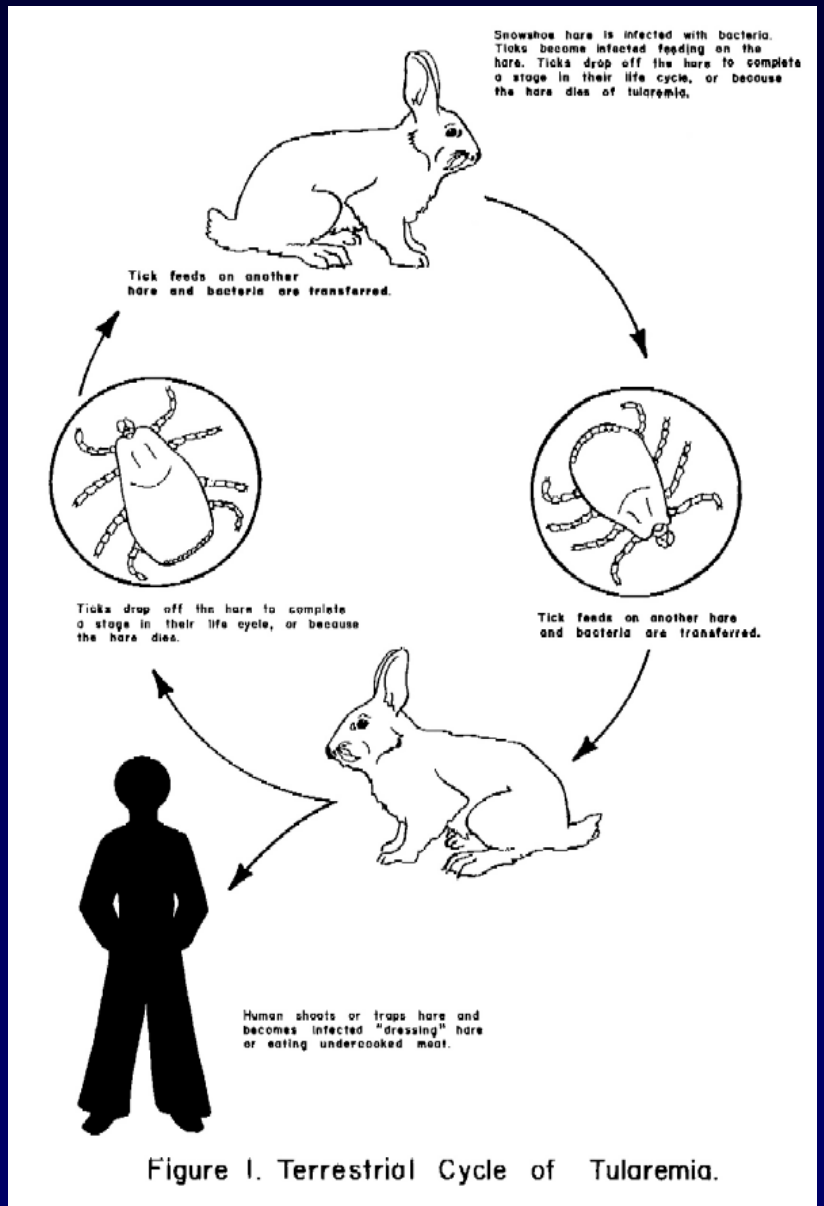


Figure 1. Terrestrial Cycle of Tularemia.

- Terrestrial cycle
  - Tick feeds on the blood of infected hare
  - Hare dies, tick drops off and attaches to differ hare
  - Tick transmits bacteria to second hare
  - Hare mortalities only seem to occur May to September (tick activity?)
  - Pet & human cases May-August

Tularemia

- Human implications
  - Biologists and trappers get infected when skinning or gutting infected hares, muskrats, beavers
  - Human exposure via pets:
    - → Dogs and cats catch sick hares and quickly become severely ill with high fever, die if untreated.
    - → Bite of pet with contaminated mouth can infect people.
    - → Pet saliva into a pre-existing wound.
    - → Annual outbreaks in pets in Interior Alaska esp. with high hare populations
  - Tick, fleas or biting fly transmits to man
- **Symptoms in humans-**
  - Ulcerating papule
  - Swollen lymph nodes
  - Weakness, fever, headache, nausea
  - Pneumonia, septicemia
- Reportable disease
- **Treatment-** Streptomycin or gentamicin

Reports of Human cases of Tularemia in AK

- 1995-1999 5 cases
- 2000-2004 2 cases
- 2005-2009 4 cases
- 2010-2013 2 cases

- Eight Interior, three Anc/Mat-Su, two Southeast

Number of tularemia cases (n=19) reporting animal exposure

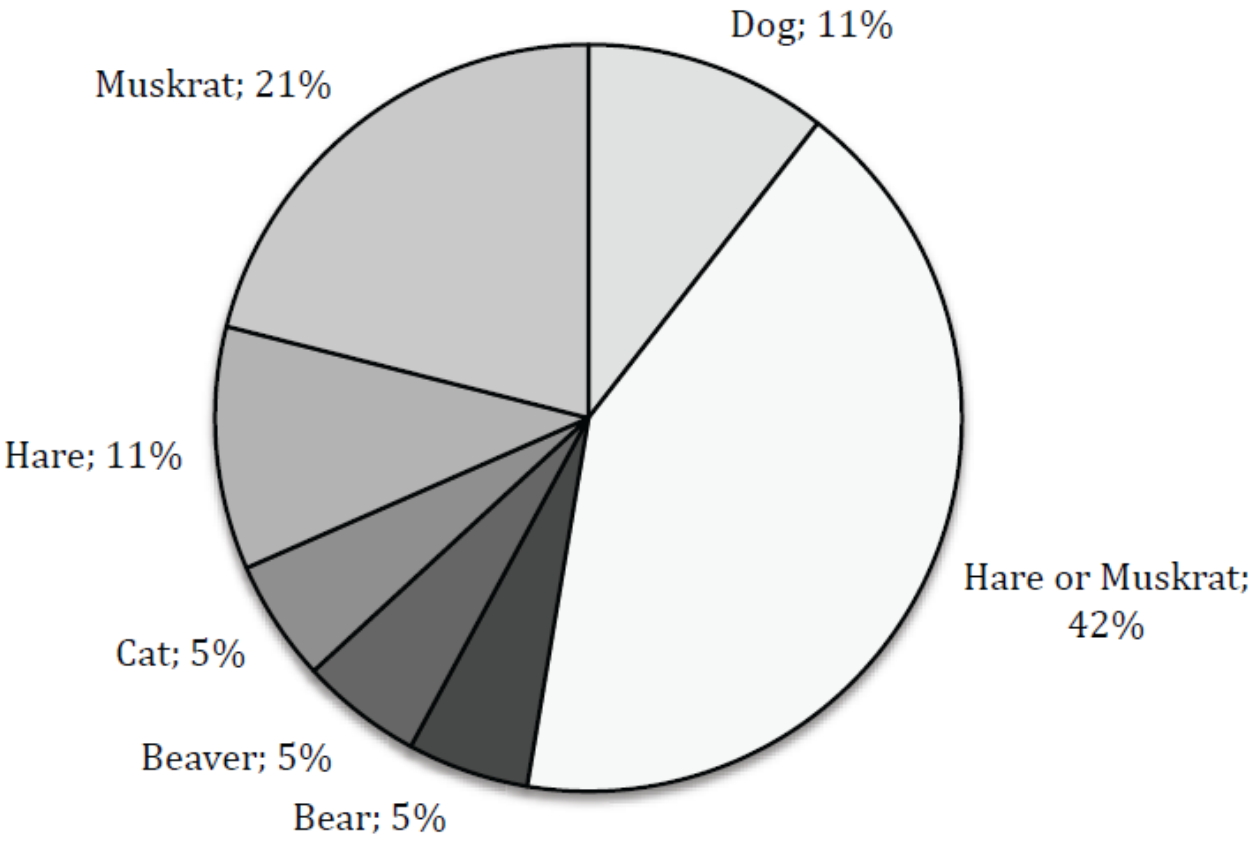


Figure 1 Number of human tularemia cases in Alaska reporting animal exposure.

Hansen et al 2011

Coxiella burnetii = Q Fever

- *Coxiella burnetii* in sheep, Q- Fever in man
  - \+ Select agent' → potential use in biowarfare
  - – Gram negative, obligate intracellular rickettsia with worldwide distribution
- Transmission: aerosol, contact, and vector (ticks)
- Wide host range-including most wild and domestic mammals, birds, and man
  - – Small ruminant: reservoir and suffer disease
    - →Seropositive in AK: Dall's sheep, Mtn goat, Muskox, CB, moose, bison, deer, fox, bear, wolf.
  - – Often asymptomatic: abortions after intro
- Marine mammals: zoonotic potential?
  - – Harbor seal (1999), Steller sea lion (2010), Northern Fur seal (2010-2011, 3% prevalence of lesions, 75% positive COM1)

Coxiella burnetii = Q Fever

- Large numbers of organisms present in infected placenta and fetal membranes; organisms also present in wool (pelt?), feces, and milk
- Resistant to heat (pasteurization temperature targeted to kill this organism), drying, and to physical and chemical agents; survives for long periods (months to years) in dust/soil

Q-Fever, Coxiella

- **Transmission to humans** –skin contact or inhalation exposure to infected animals or contaminated (e.g. urine, feces, milk, birth fluids/placenta) environments, tick bite
- **Symptoms-** Acute to chronic (<5%) illness in humans although half of humans infected show no symptoms
  - Acute symptoms develop 2-3 wks after exposure: high fever, severe headache, malaise, myalgia, chills/sweats, cough, nausea/vomiting, diarrhea, abdominal and chest pain
  - Complications: hepatitis, pneumonia, endocarditis. Fatality <2%
- **Treatment-** doxycyline
- **Prevention**- wear gloves, don't handle placentas or fetuses w/ bare hands, tick prevention.

Final thoughts and considerations

- Hitchhiking ticks on pets and human travelers are not so uncommon and are a potential source of TBDs introductions to AK
- To date we've not detected *Ixodes scapularis* or *I. pacificus* but for how long?

Final thoughts and considerations

- Dog ticks as well as some wildlife ticks are competent vectors for TBDs not currently endemic to AK, are we just a blood meal away from an infected person or pet to introduce Lyme Disease, RMSF, etc. to Alaska?

Final thoughts and considerations

- Climatic changes are likely to favor increases in endemic ticks as well as newly established & introduced ticks.

- What will it take and how long for TBDs to become established considering how quickly TBDs and ticks are spreading across North America?

What needs to be done

- Public awareness of tick prevention and treatment needs to be increased
- Veterinarians should to dispense appropriate products to at risk pets (Advantix II best, alternative Frontline Plus)
- Physicians, veterinarians be altered to consider TBDs in Ddx