

Rocky Mountain Spotted Fever: Tick Biology and Control



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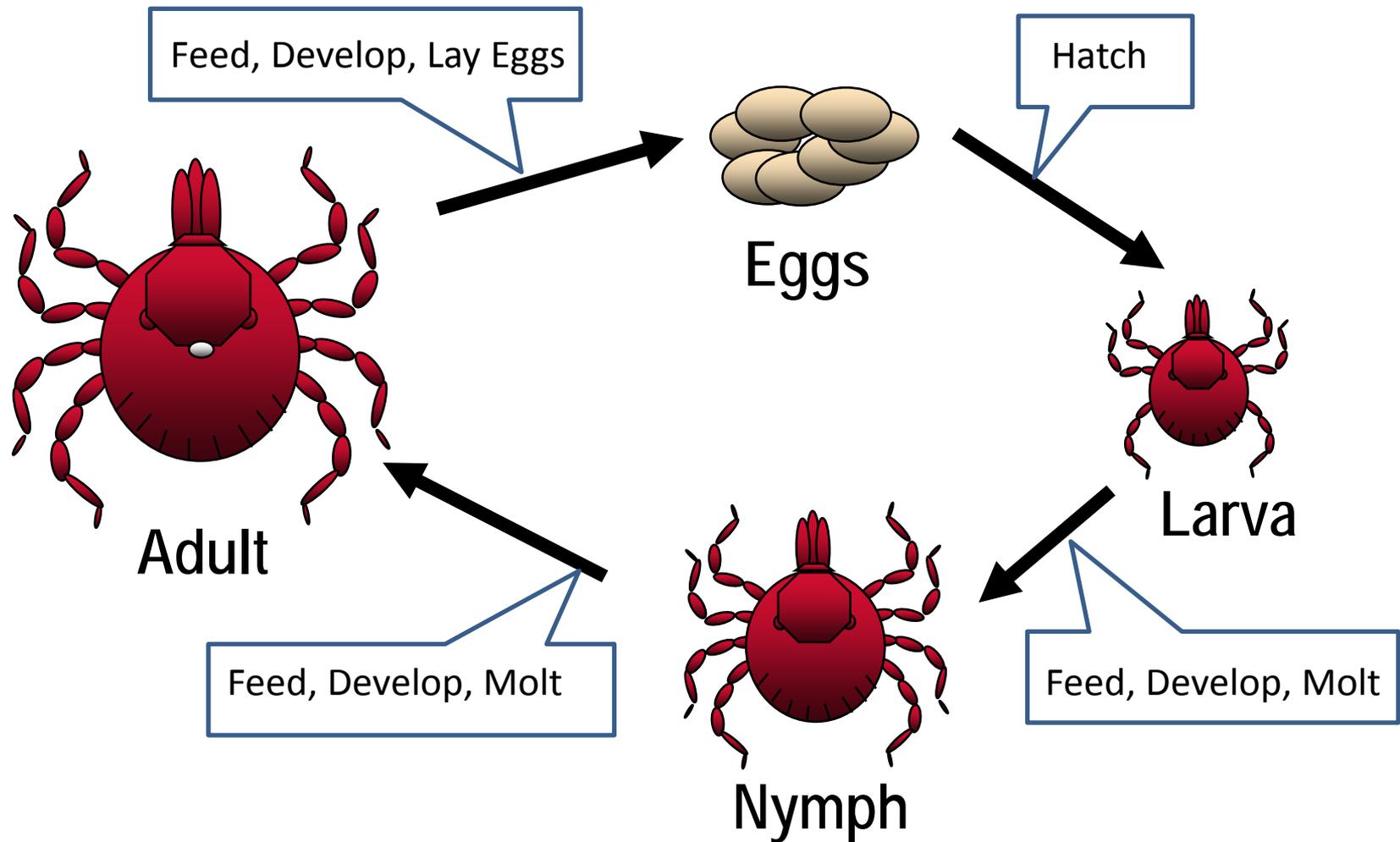
Overview

- Summarize tick biology and the role of ticks as disease vectors
- *Rhipicephalus sanguineus* as a vector for spotted fever group rickettsiae
- Environmental and behavioral measures for prevention, management, and control of ticks and RMSF

Introduction to Tick Biology

- Over 850 species worldwide, approximately 80 in the United States
 - 25 species in Arizona
- Divided into three families
 - Ixodidae (hard ticks)
 - Argasidae (soft ticks)
 - Nuttalliellidae (“primitive” ticks)
- Approximately 12 species are of public health or veterinary interest in the US
 - Four known to be of public health concern in Arizona

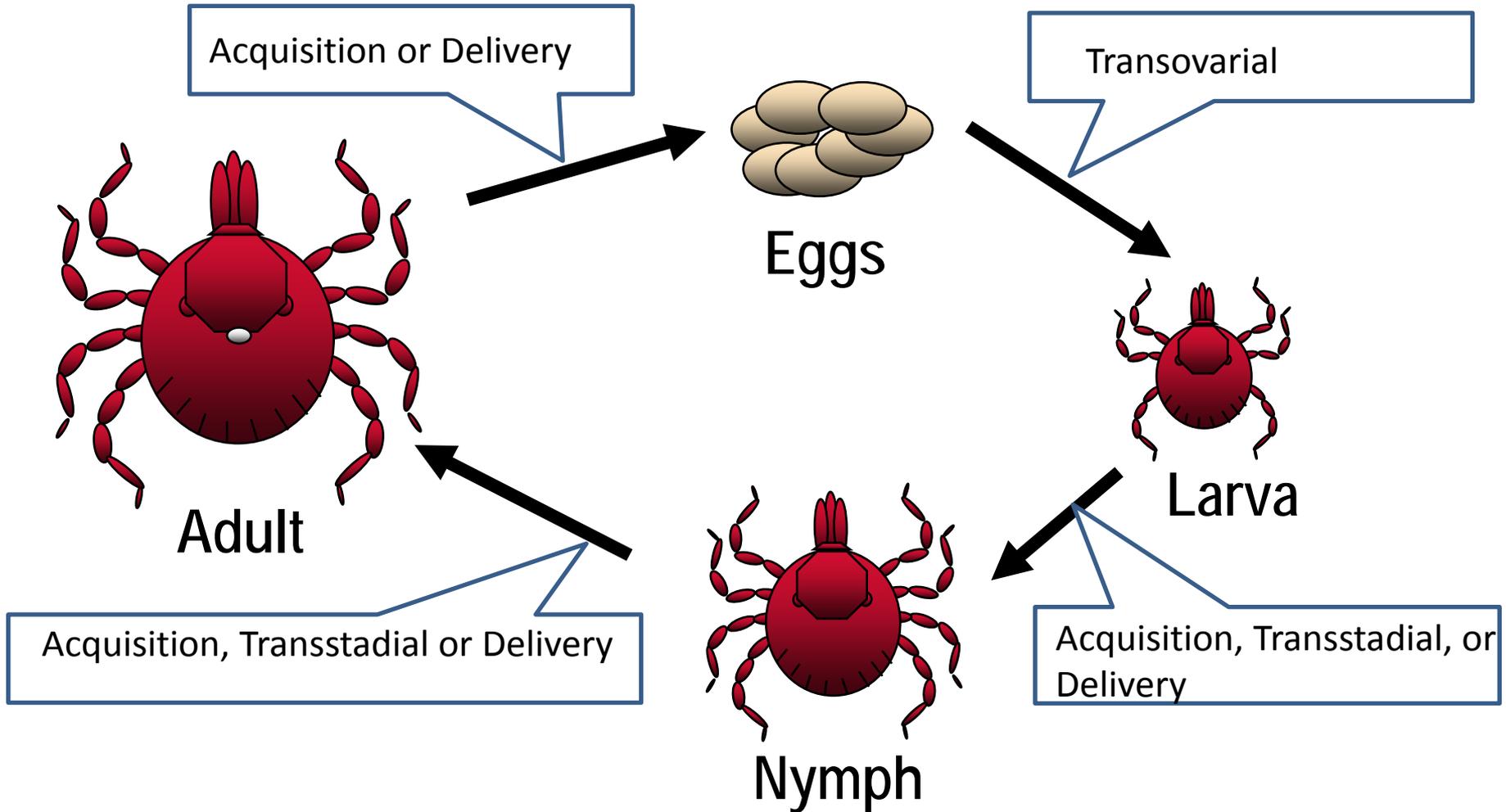
Generalized Tick Life Cycle



Pathogen Transmission in Tick Populations

- Transovarial transmission: transfer from one generation to the next through the egg
 - Spotted fever group rickettsiae
 - Tick-borne encephalitis virus
 - Colorado tick fever virus
- Transstadial transmission: transfer from one life stage to the next through blood meals
 - Lyme borreliae
 - Ehrlichia organisms
 - Anaplasma organisms
 - Babesia parasites

Generalized Tick Life Cycle



Blood Feeding Strategies

- Soft ticks attach for longer periods as larvae, but then use a feed-and-hide strategy (feed time \leq 30 minutes)
 - Spend most of their life cycle off host
- Ixodid ticks attach strongly for longer periods (multiple days)
 - Can need from one to three hosts to complete life-cycle
- Vary from host specific feeding to feeding on a wide array of vertebrate species
- Feeding strategy effects disease transmission

Survival Time Between Feedings

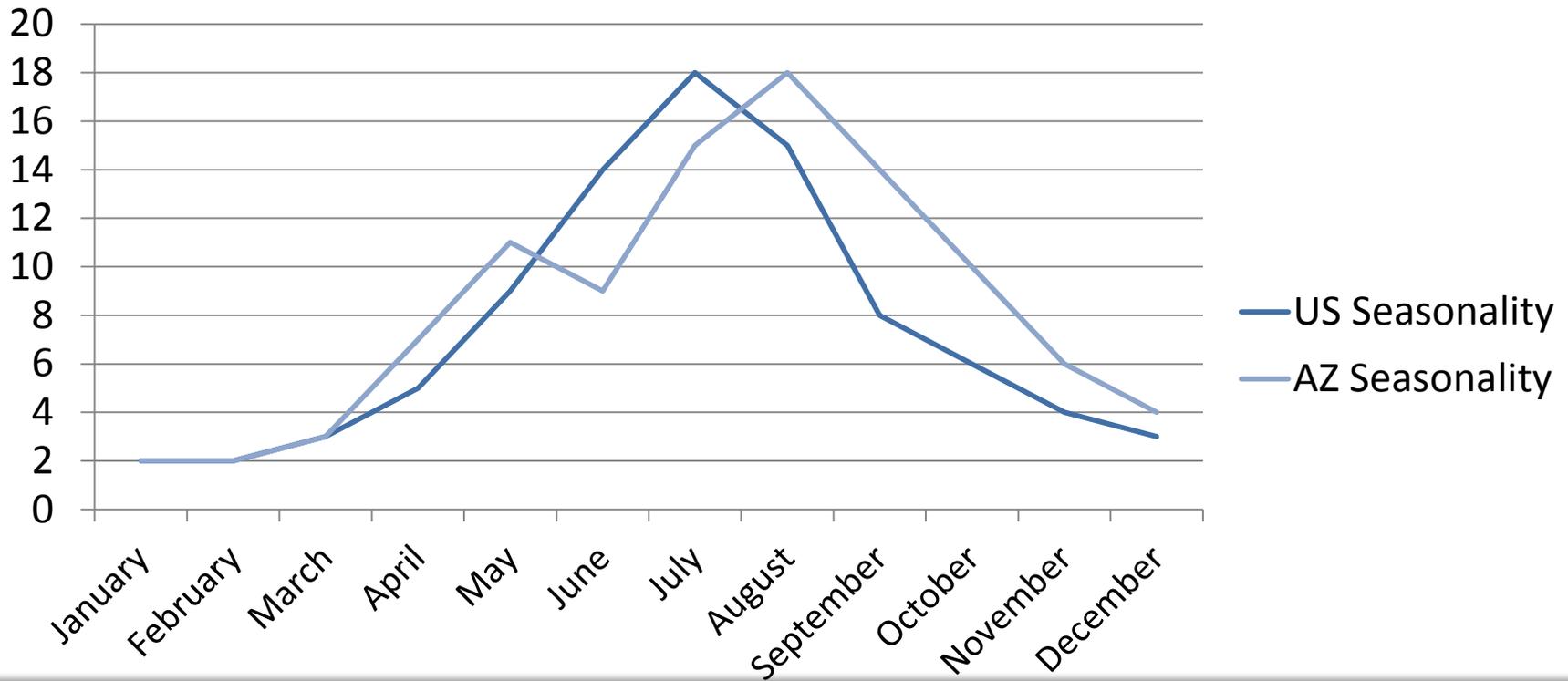
- Soft ticks :
 - Larvae: Need to feed immediately to transform to nymphal stages
 - Nymphs: Need to feed within days-weeks to move between nymphal instars (up to 8) and adult
 - Adults: Can survive years between blood meals
- Ixodid ticks:
 - Larvae: 1 month – 15 months
 - Nymphs: 4 months – 20 months
 - Adults: 4 months – 30+ months

Ecologic Needs for Tick Survival

- Correct humidity
- Temperature
- Available hosts
- Hiding spots for molting and egg laying
- Predation
- Natural diseases
- Pathogen induced mortality

Ticks and tickborne diseases are seasonally distributed

Peak of disease activity corresponds with peak of tick activity
(especially the life stages most important for transmission)



RMSF Vectors

The Primary U.S. Tick Vectors of RMSF



Dermacentor variabilis
American dog tick



Dermacentor andersoni
Rocky Mountain wood tick



Photos and maps courtesy of CDC

Dermacentor variabilis **American dog tick**

- Three host tick
- Dogs are preferred hosts, but also feed large mammals (deer, cattle, raccoon, humans, etc.) as adults
- Feed on small mammals (mice, squirrels, chipmunks, etc.) as nymphs/larvae
- Prefers wooded, shrubby, long grasses
- Susceptible to desiccation in high temperatures/low humidity

Dermacentor andersoni **Rocky Mountain wood tick**

- Three host tick
- No preferred host. Feed on large mammals (deer, cattle, sheep, humans, etc.) as adults.
- Feed on small mammals (ground squirrels, chipmunks, etc.) as nymphs/larvae
- Brushy vegetation that attracts small mammals
- Larvae prefer cool soil and high relative humidity

The Primary Arizona Tick Vector of RMSF



Rhipicephalus sanguineus
Brown dog tick



Photos and maps courtesy of CDC

Rhipicephalus sanguineus

Brown Dog Tick

- Three host tick – needs 3 feedings to complete lifecycle
- Primarily feeds on dogs in all life stages
 - Humans and other species are incidental hosts
- Requires a dog to find a mate
- Can live in a variety of climates
- Good survival rates with low humidity and high temperatures (33% survival at 50° C – Yoder et al, 2006)
- Peridomestic – capable of living indoor and outdoor

Brown Dog Ticks in the Human Environment



Photos courtesy of CDC and “Biology and ecology of the brown dog tick *Rhipicephalus sanguineus*” Filipe Dantas-Torres <http://www.parasitesandvectors.com/content/pdf/1756-3305-3-26.pdf>

Rhipicephalus sanguineus

Brown Dog Tick

- Transovarial transmission of RMSF
- Ticks are the primary hosts of *Rickettsia rickettsii* and transmit to their offspring
- Animals play minimal role as reservoir
 - Spirochete unlikely to transmit from hosts because it is an intracellular pathogen
- Capable of laying up to 4000 eggs
- Can complete life cycle in as little as 93 days if hosts available and environmental conditions are favorable

The Role of Dogs in RMSF

- Dogs cannot transmit RMSF, but they are preferred hosts
- Dogs develop RMSF and can die from disease
- Recovered dogs are immune to reinfection
- Free-roaming dogs spread ticks into nearby homes and yards
- New puppies (especially sick ones) may increase the number of infected ticks due to higher probability of having circulating rickettsiae in blood

The Role of Dogs in RMSF

- Seropositivity in dogs and human risk
 - In general, no human cases have occurred in communities where canine seropositivity is ~5%
 - Human cases observed in communities where canine seropositivity is >50%
 - Threshold for human cases somewhere in between
 - Canine seropositivity has been observed prior to first reported human cases in some reservations

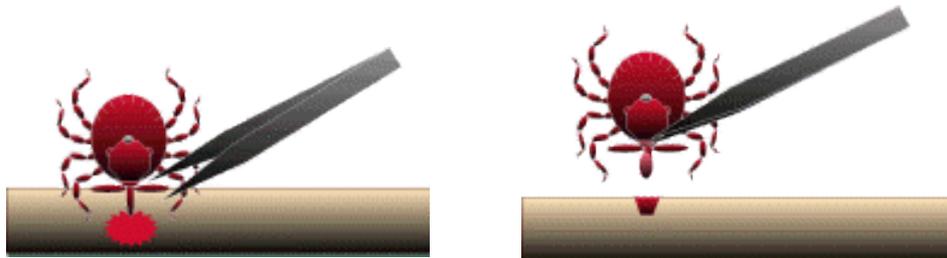
Prevention of RMSF

Personal Prevention

- Proper use of EPA approved products
- Skin Applications
 - DEET (20%+)
 - Picaridin
 - Oil of Eucalyptus
 - BioUD
- Clothing Applications
 - Permethrin (Permanone)
 - BioUD

Personal Prevention

- Routine tick checks and removal
 - The shorter the attachment time the lower the probability of transmission
 - RMSF transmission unlikely to occur in less than 6 hours
- Ticks should be removed using fine tipped tweezers
 - Hands should be gloved or tissue used to grasp tick
 - Tick should be flushed down toilet, not thrown in trash



Tick Control and Management in the Environment

- Management of habitat
 - Reduce tick survival
 - Reduce suitable host habitats
- Management of free living ticks
 - Reduce number of ticks in the environment seeking hosts
- Management of host population
 - Reduce the number of ticks in the environment by reducing the number of available hosts

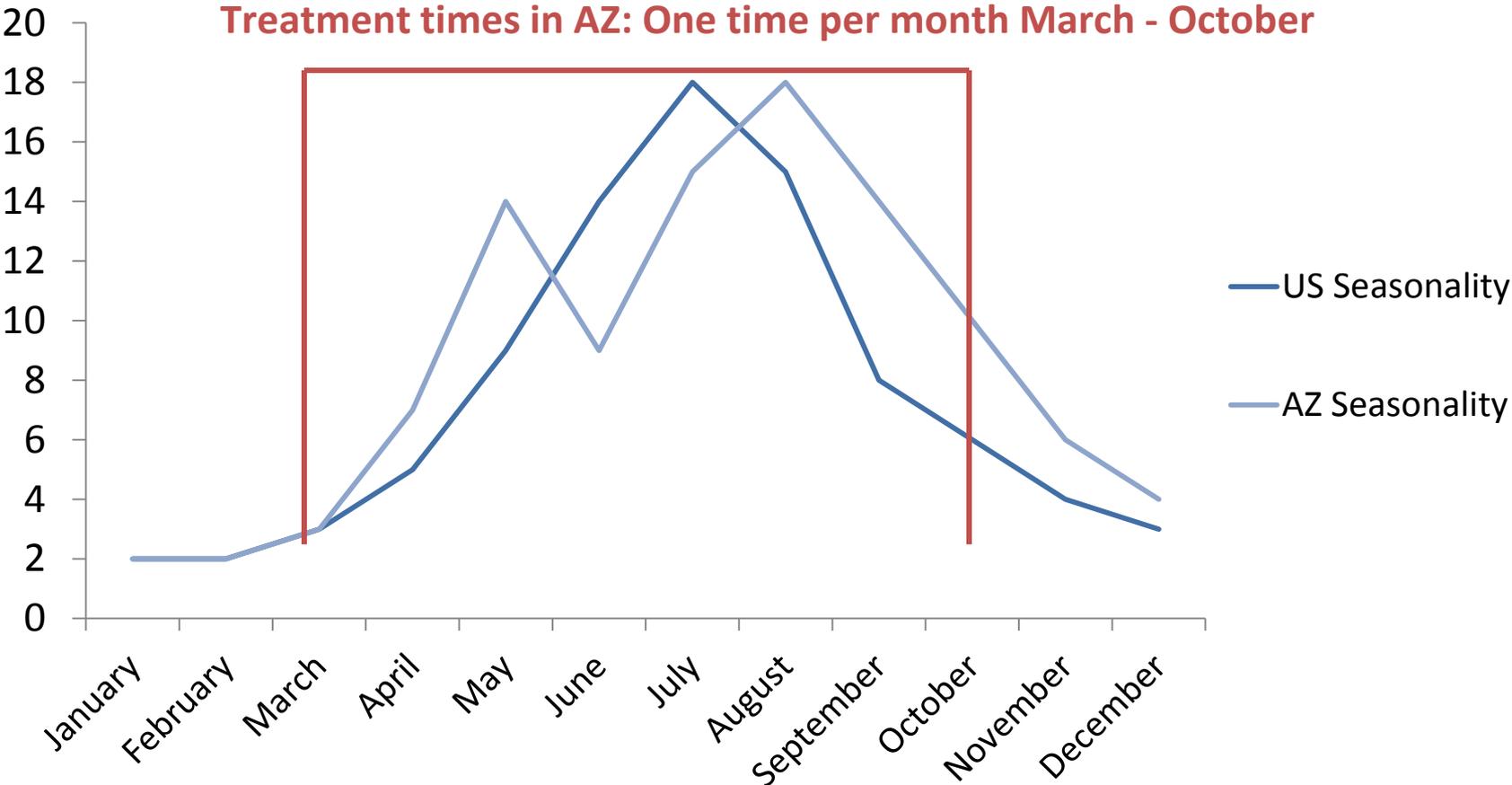
Management of Habitat

- Decrease tick harborage
 - Decrease outdoor storage, clean up debris
 - Skirt houses to exclude animals
- Decrease harborage of molting ticks
 - Caulk openings, cracks, crevices
- Reduce moisture
 - Reducing weeds and mowing areas allows sun to dry areas and reduce tick survival

Management of Free-living Ticks

- Apply pesticides to areas where ticks are likely to be found
 - Places where dogs sleep
 - Under decks and porches
 - Cracks and crevices
- Use products that are effective for ticks and are safest for people and animals
- Apply often and in the right season
 - Focus on early spring tick emergence
 - In AZ climate reapply every 3-4 weeks in heavily infested areas
- Use appropriate chemicals for area being treated
 - Different products for indoor and outdoor use

Seasonality of Ticks and Treatment Timing in AZ



Indoor Treatment

- Treat cracks and crevices, edges
 - Do not treat food preparation areas
- Available products
 - Dusts and powders
 - Dessiccants/scarification
 - Dessiccants+chemical pesticide
 - Sprays
 - Pyrethrins
 - Pyrethroids

Outdoor Treatment

- Treat tick infested areas and animal sleeping areas
 - Do not treat groundwater or areas where runoff could occur
- Available products
 - Sprays
 - Pyrethrins, Bifenthrin, Permethrin, Lambda-Cyhalothrin, Carbaryl
 - Granules
 - Pyrethrins, Bifenthrin, Permethrin, Lambda-Cyhalothrin
 - Dusts
 - Permethrin, Deltamethrin, Carbaryl

Management of Host Population

- Reduce host (dog) contact with vector
 - Topical tick treatment
 - Tick collars
- Prompt removal of ticks
 - Prevents infection and illness
 - Treat ill animals with long-acting tetracyclines
- Reduce the transport of ticks from one area to
 - Keep dogs in fenced, escape proof yards
 - Safely tie-out dogs in areas without fences
 - Spay and neuter dogs
 - Removal of unwanted and uncared for dogs

Management of Ticks on Dogs

- Sprays/dips
 - Effective, but not long lasting (<2 weeks)
 - Products of various chemical classes
 - Organophosphates
 - Carbamates
 - Pyrethrins
 - Pyrethroids

Management of Ticks on Dogs

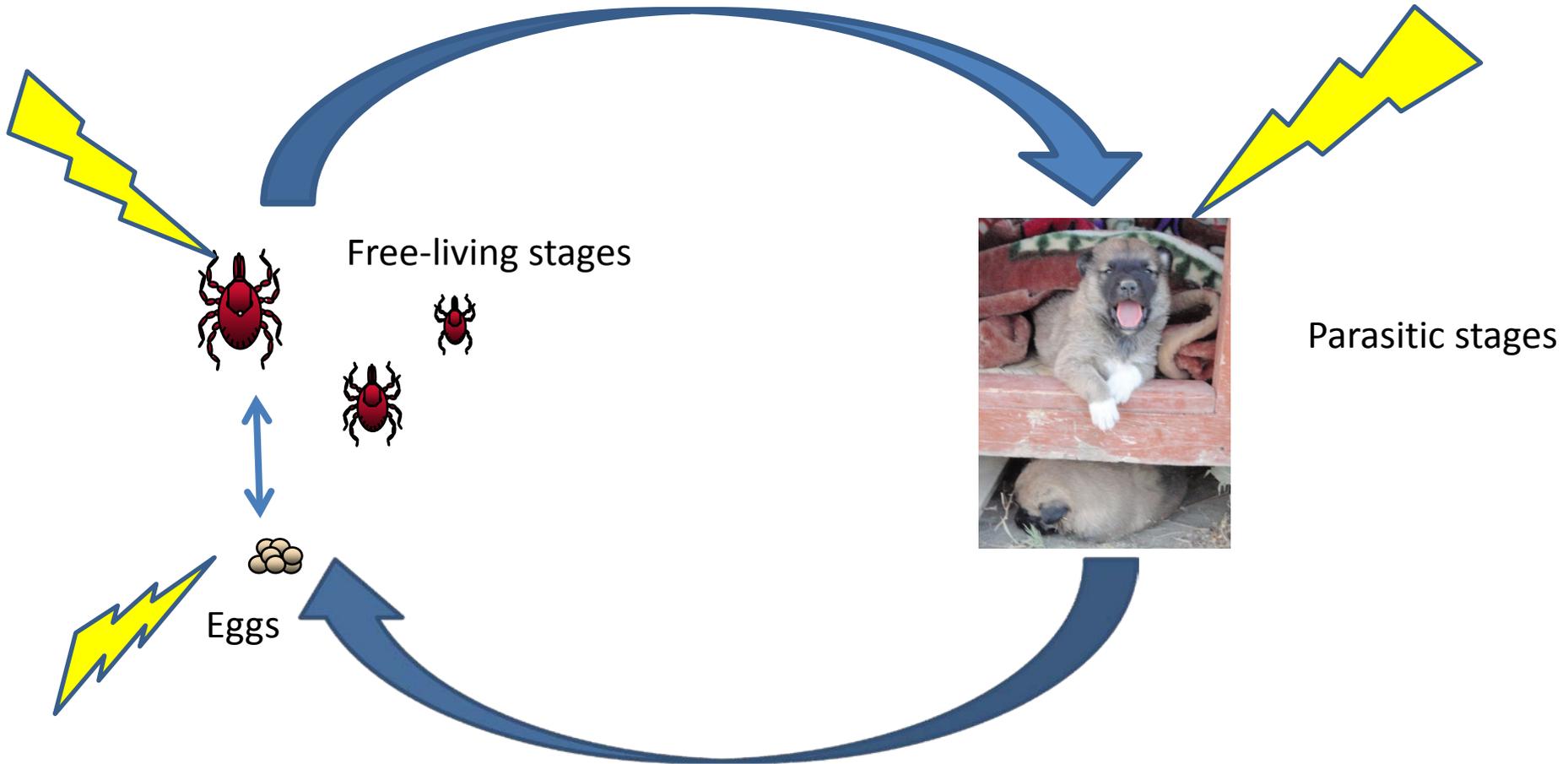
- Topicals
 - Pyrethrins
 - Permethrin, Permethrin + Pyriproxyfen
 - Fipronil
 - Fipronil + Methoprene
 - Fipronil + Methoprene + Amitraz
 - Metaflumizone + Amitraz
 - Selamectin

Management of Ticks on Dogs

- Collars

- Tetrachlorvinphos
- Tetrachlorvinphos + (S)-methoprene
- Propoxur
- Amitraz
- Amitraz + Pyriproxifen
- Deltamethrin
- Flumethrin

Effective Tick Control Targets All Life Stages



Resources

ADHS RMSF Website:

<http://azdhs.gov/phs/oids/vector/rmsf/ticks.htm>

CDC RMSF Website:

<http://www.cdc.gov/ticks/>

Tick Control Handbook (CT Ag. Extension)

<http://www.ct.gov/caes/lib/caes/documents/publications/bulletins/b1010.pdf>



Health and Wellness for all Arizonans

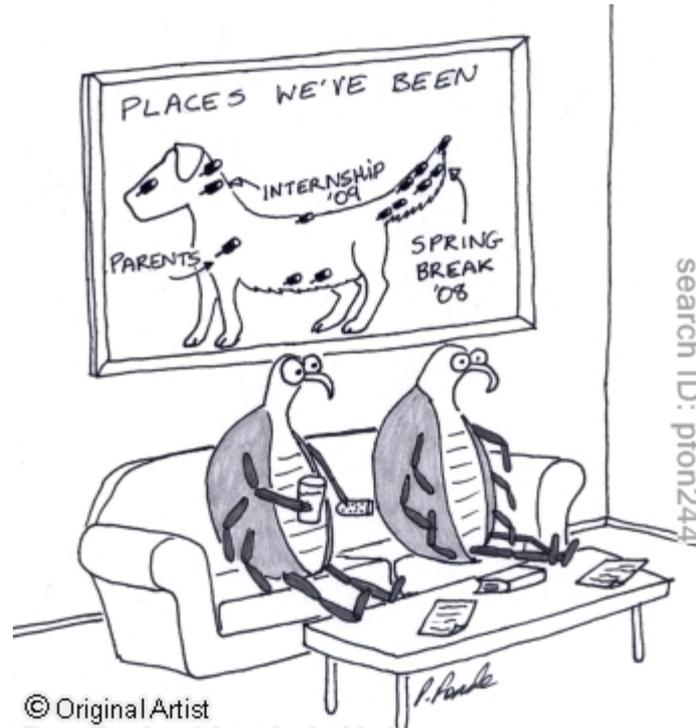
azdhs.gov



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Questions?



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