

# Zoonotic Diseases

Diseases Spread Through Animals and Vectors

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## Outline for Today

Zoonotic diseases that are impacted by wildlife and domestic animal management and control

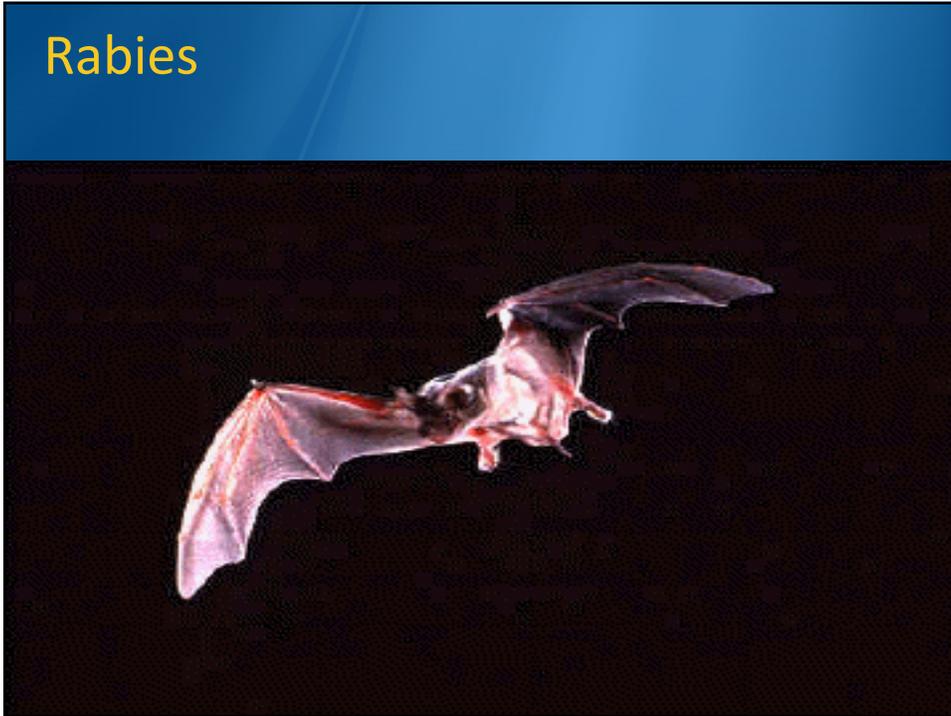
- Rabies
- Leptospirosis
- Zoonotic Roundworms

Update

- Arboviral Surveillance



## Rabies



## What is Rabies?

- Acute viral disease of mammals most often transmitted by the bite of a rabid animal
  - Genus: *Lyssavirus* – there are 7 viruses in this genus
- Some studies support the spread of rabies from Europe to Asia, Africa and the Americas

## Susceptibility

- All mammals are susceptible to infection with rabies
- With the elimination of canine rabies from the US, rabies has moved in to wildlife populations
- There are 8 terrestrial rabies virus variants
  - Raccoon
  - Skunk (south central, north central, CA)
  - Fox (TX & AZ gray fox, arctic fox)
  - Mongoose
  - Bat (non-terrestrial)
- Rabies variants may vary in their ability to cause disease, and how rapidly the disease progresses
  - Site of exposure/bite also important



CDC



## Period of Communicability - CDC

- Extensive studies on dogs, cats, and ferrets show that the rabies virus can be excreted in the saliva of infected animals several days before illness is apparent.
- Such extensive studies have not been done for wildlife species, but it is known that wildlife species do excrete rabies virus in their saliva before the onset of signs of illness.
- The excretion of virus may be intermittent, and the relative amount of excreted virus may vary greatly over time, before and after the onset of clinical signs.



## Transmission

- Bite exposure: Saliva containing virus of a rabid animal introduced through a bite or scratch.
- Non-bite exposure: Scratches, abrasions, open wounds or mucous membranes contaminated with saliva or other potentially infectious material (such as brain tissue) from a rabid animal.
- Airborne transmission: VERY RARE. Has been documented in a cave where bats were roosting and in lab settings.
- Virus moves up the axons of the nerves from the site of exposure



## Clinical Features

- Acute Illness
- Rapidly progressive central nervous system manifestations, including anxiety, headache, fever, malaise, dysphagia, hydrophobia and seizures
- Some patients have paralysis starting at the site of the bite
- Almost invariably progresses to death (a handful of documented survivors)



CDC



## Epidemiology

- ~59,000 people die of rabies each year around the world
  - Dogs are the main source in these areas (98% of cases)
  - Bats are the main source in the Americas
- In this century, the number of human deaths in the United States attributed to rabies has declined from 100 or more each year to an average of 1 or 2 each year.
  - Animal control and vaccination – 1940's
  - Oral rabies vaccination – 2000's
  - In the US, fatalities are due to not seeking medical care



CDC



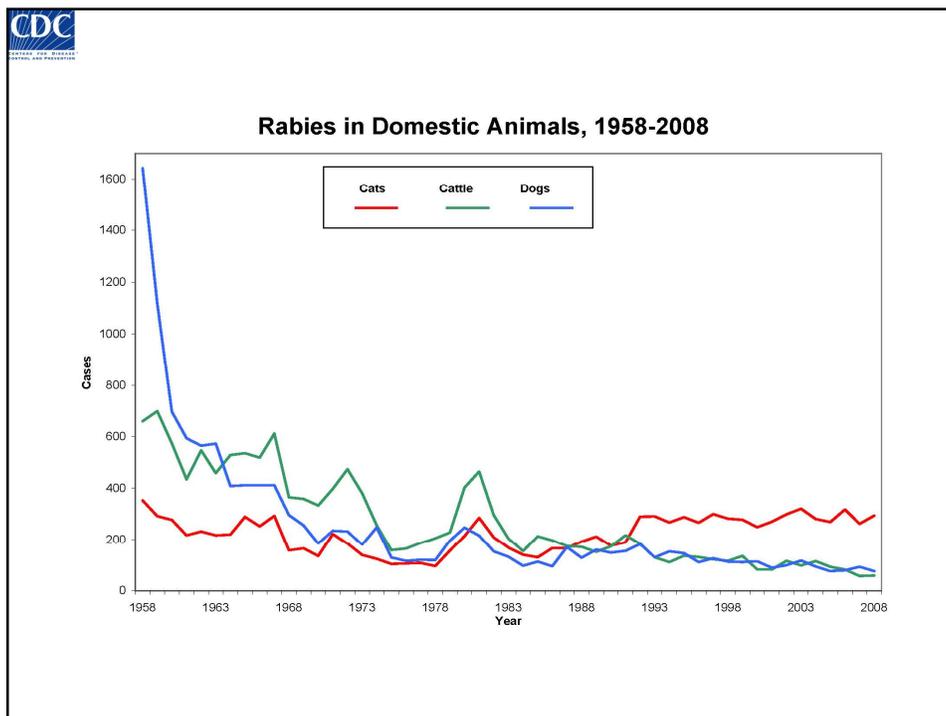
## Control Methods

- Reportable disease – 24 hours
- Register, license, immunize all dogs
- Immunize all cats, ferrets, and horses, in addition to select livestock species
- Educate pet owners and public
- Maintain active surveillance for rabies in animals
- Detain and clinically observe for 10 days any healthy-appearing dog or cat known to have bitten a person.



CDC





## Control Methods

- All wild animals known to have bitten a person should be sacrificed and examined for rabies
- Oral immunization of wildlife animals performed in certain areas of the country
- High risk groups (vets, rangers, etc.) should consider receiving pre-exposure prophylaxis.



CDC

## PEP Considerations

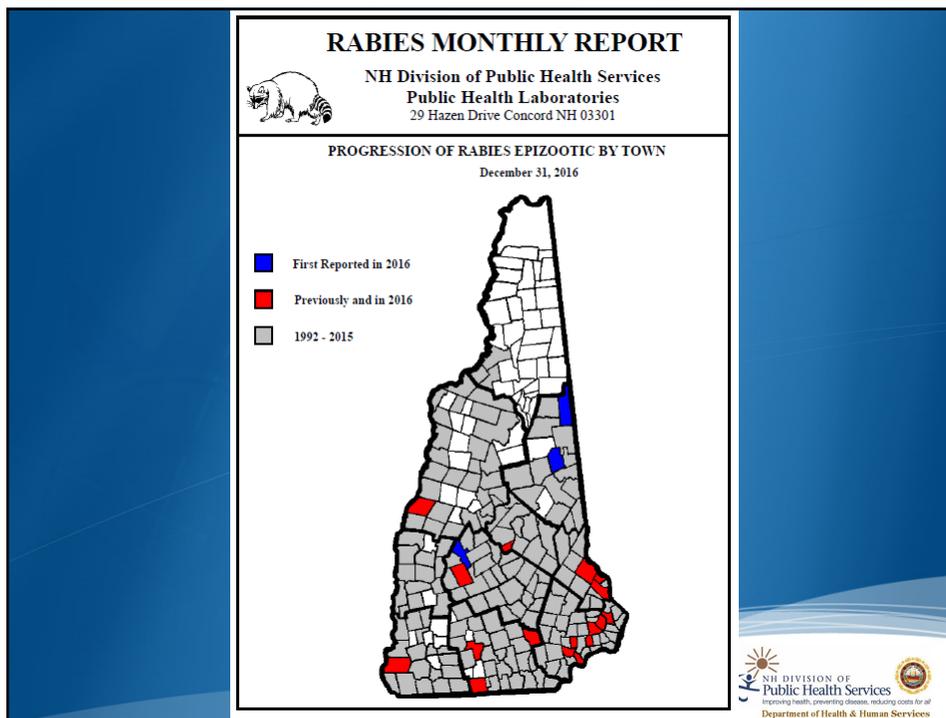
- Type of animal?
- Animal healthy or sick?
- Animal available?
- What was the type of exposure? How severe?
- Where is the exposure on the body?



## Wound Management

- Immediately wash with soap and water and if possible an anti-viral agent such as povidone-iodine solution
- Tetanus prophylaxis and measures to control bacterial infections should be considered
- If PEP is recommended (in someone not previously vaccinated): HRIG and Vaccine





## Cost of Rabies

- Estimated public health costs are between \$245 and \$510 million annually in US
- Costs include the vaccination of companion animals, national rabies diagnostic testing, and biologics used for rabies postexposure prophylaxis (PEP) and pre-exposure prophylaxis (PrEP).
  - ~40,000- 50,000 PEP treatments annually
- Does not included the cost of other associated healthcare costs, animal control measure, or lost work time

# Rabies Surveillance in the United States During 2015

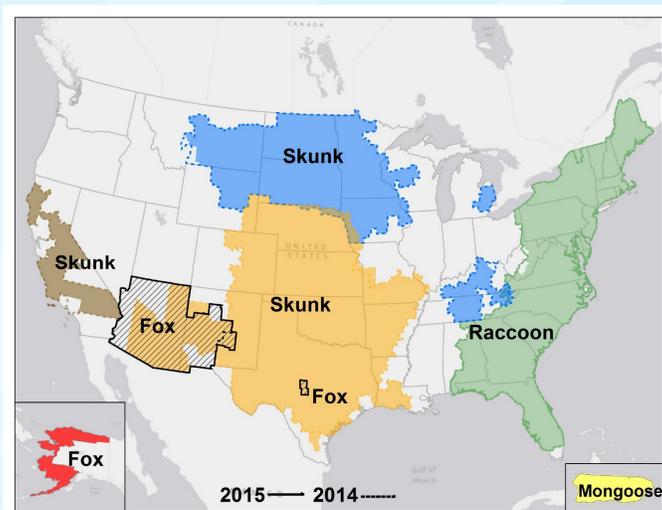
Division of High-Consequence Pathogens and Pathology  
Poxvirus and Rabies Branch

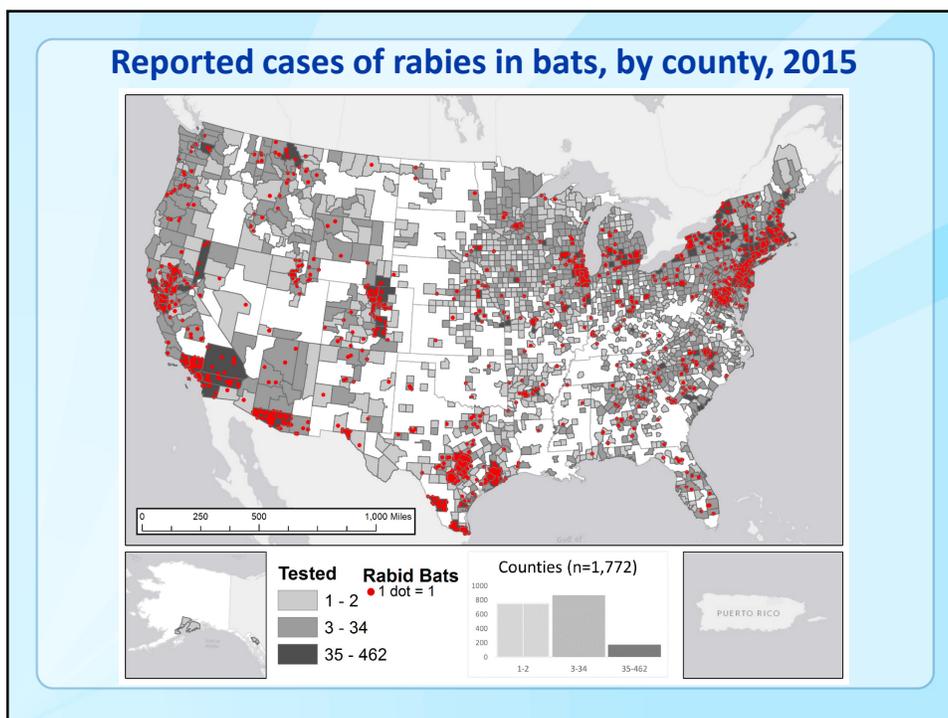
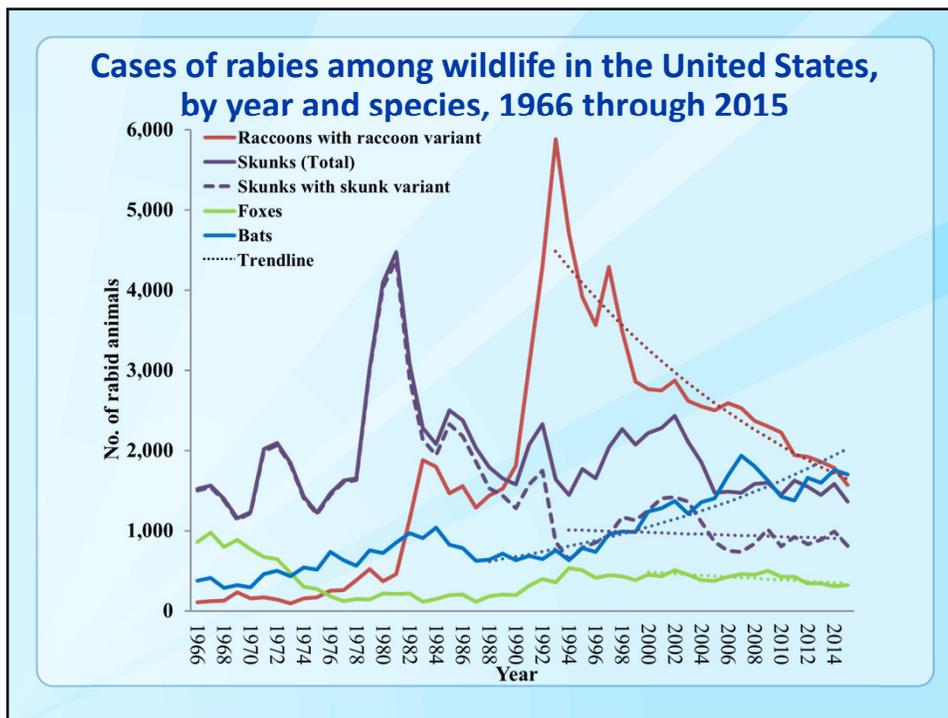
May 2017

National Center for Emerging and Zoonotic Infectious Diseases  
Division of High-Consequence Pathogens and Pathology

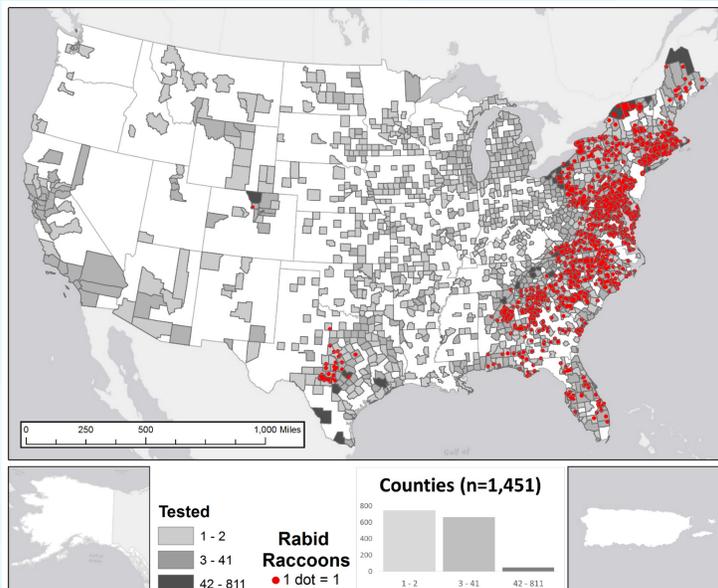


## Distribution of major rabies virus variants among mesocarnivores in the United States and Puerto Rico, 2008 to 2015

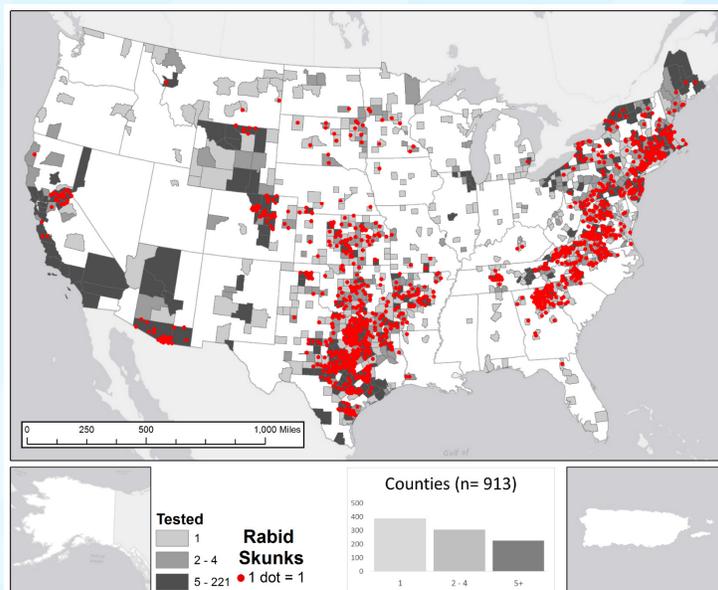




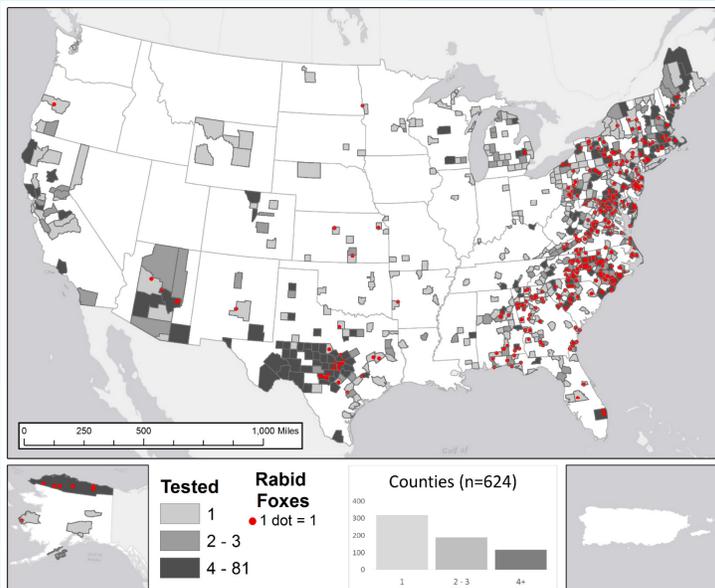
### Reported cases of rabies in raccoons, by county, 2015



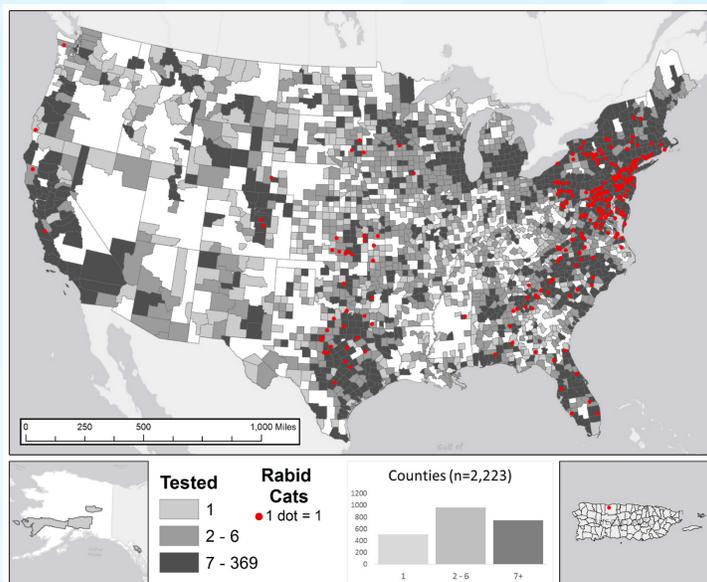
### Reported cases of rabies in skunks, by county, 2015



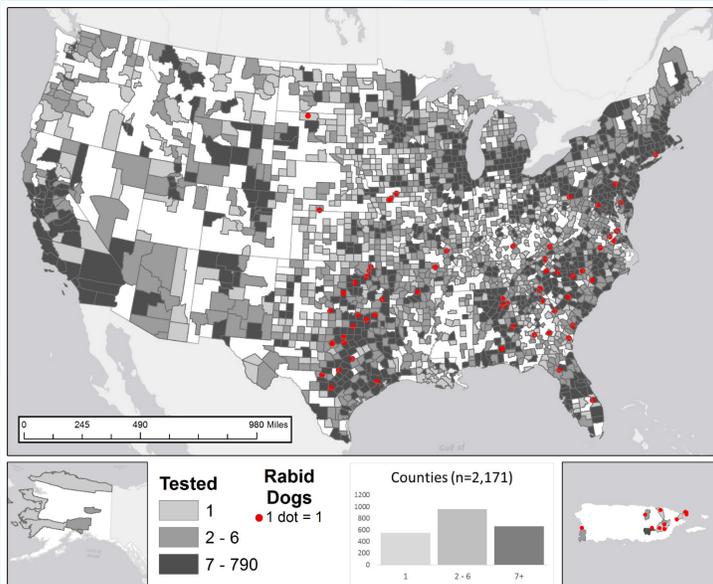
### Reported cases of rabies in foxes, by county, 2015



### Reported cases of rabies in cats, by county, 2015



### Reported cases of rabies in dogs, by county, 2015



## Leptospirosis

## Leptospira - Darkfield Microscopy



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## Leptospirosis

- Leptospirosis is caused by pathogenic bacteria belonging to the species *Leptospira interrogans*
- More than 200 pathogenic serovars have been identified; broken into 25 serogroups by serologic relatedness.
- Commonly identified serovars in the U.S. include:
  - icterohaemorrhagiae
  - canicola
  - autumnalis
  - hebdomadis
  - ustralis
  - pomona

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## Transmission

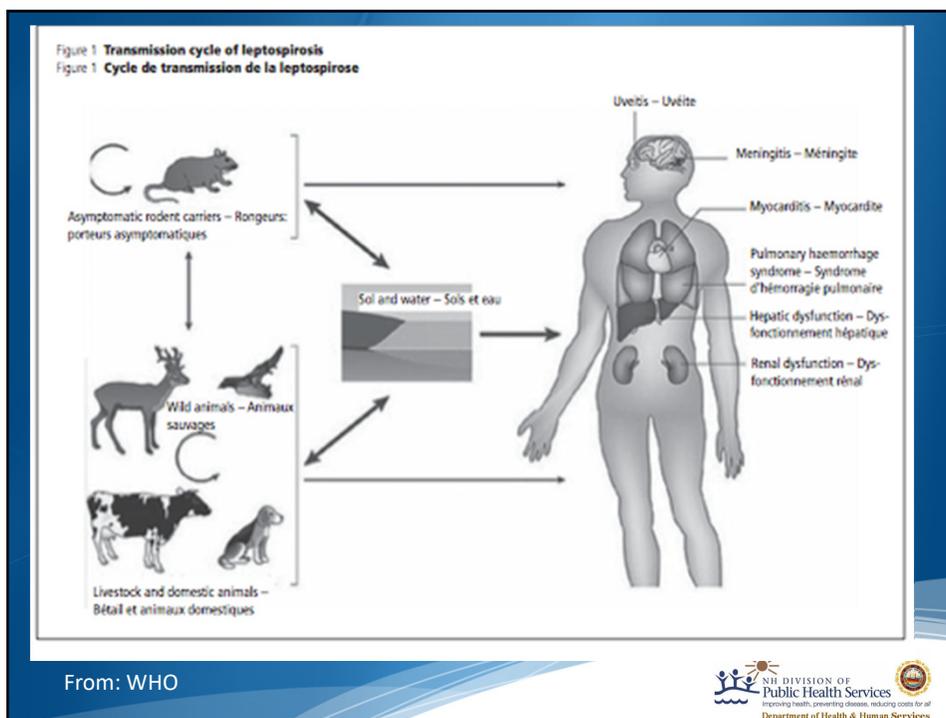
- Contact of the skin (especially if abraded) or mucous membranes with:
  - Moist soil or vegetation contaminated with the urine of infected animals or contaminated water
  - Direct contact with tissue or urine of infected animals.
- Inhalation of droplet aerosols of contaminated fluids.

## Clinical Features

- Can range from subclinical to a fulminating fatal illness
  - Fever/chills
  - Headache
  - Vomiting
  - Muscle aches
  - Jaundice
  - Organ failure (liver, kidney)
- Illness may be from a few days to weeks or longer

## Epidemiology

- **Reservoir** = Pathogenic leptospire are maintained in the renal tubules of wild and domestic animals.
  - Serovars vary with depending on type of animal.
  - Common hosts include: rodents, swine, cattle, horses, dogs, and wild animals
- **Incubation Period** = range of 2-28 days.
- **Period of Communicability** = Direct person-to-person transmission is rare. Organisms are usually excreted in urine for one month but have been observed for months/years after acute illness.



## Prevalence

- Occurs worldwide (except polar regions) but is most common in tropical climates and urban temperate areas
- It is an occupational hazard for many people who work outdoors or with animals.
- It is also a recreational hazard for campers or those who participate in outdoor sports in contaminated areas
- Increasing as a hazard in urban populations during heavy rains and flooding.



## Control Methods

- Immunization of animals prevents illness but not necessarily infection or shedding.
  - Vaccine needs to contain local serovars.
  - No human vaccine licensed in US.
- Rodent control
- Doxycycline may be effective in preventing leptospirosis in exposed person in areas of high exposure.
  - Administered - 200mg in one weekly dose for as long as necessary.



## Zoonotic Roundworm Infections



### *Baylisascaris procyonis*

- Why is this of interest?
  - Serious sequelae of infection
  - Raccoons are peridomestic
  - Latrines on roofs and around homes



CDC



## *Toxocara* spp.

- Dogs: *Toxocara canis*
- Cats: *Toxocara cati*
- Why is this of interest?
  - Co-habitation with dogs and cats
  - Large feral cat population

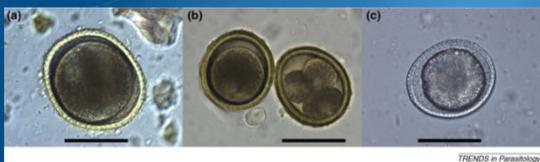


## Roundworm Basics

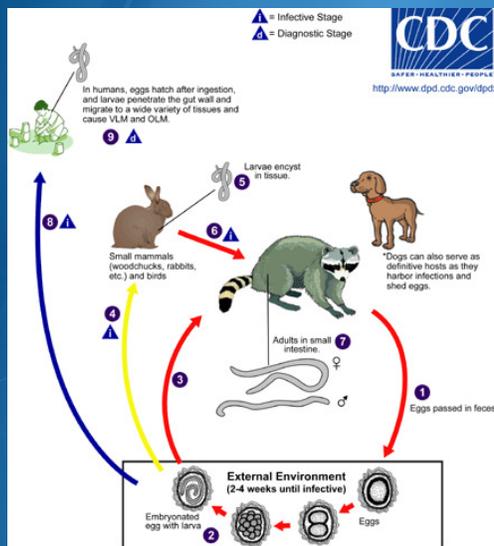
- Symptomatic zoonotic infections are not frequently reported
  - About 20 reported cases of *Baylisascaris* since 1975
  - Seroprevalence of 13.9% for *Toxocara* and 8% for *Baylisascaris*
- Infections in their respective hosts are common
  - Raccoons: 64% in the Northeast/Mid-Atlantic
  - Dogs/Cats: consider most are infected when young

## Roundworm Basics

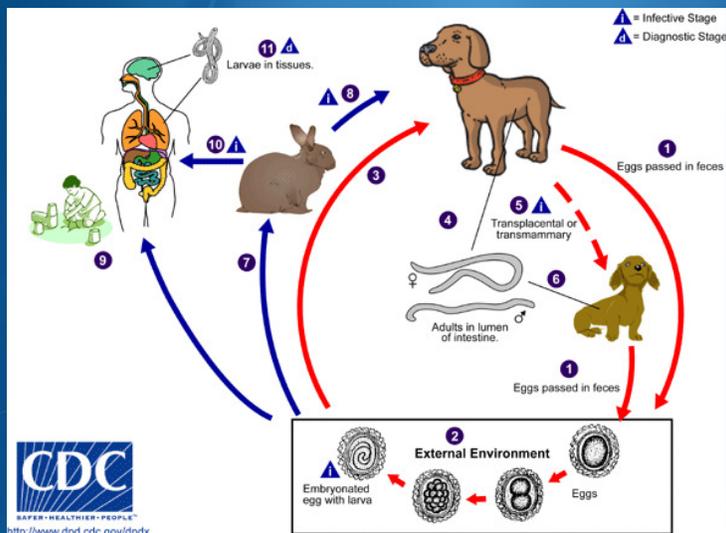
- Eggs are extremely resistant to degradation and can last in the environment for years
- Transmission: fecal-oral
  - Exceptions:
    - Dog: transplacental, transmammary
    - Cat: transmammary
    - Dog, Cat, Raccoon: paratenic hosts



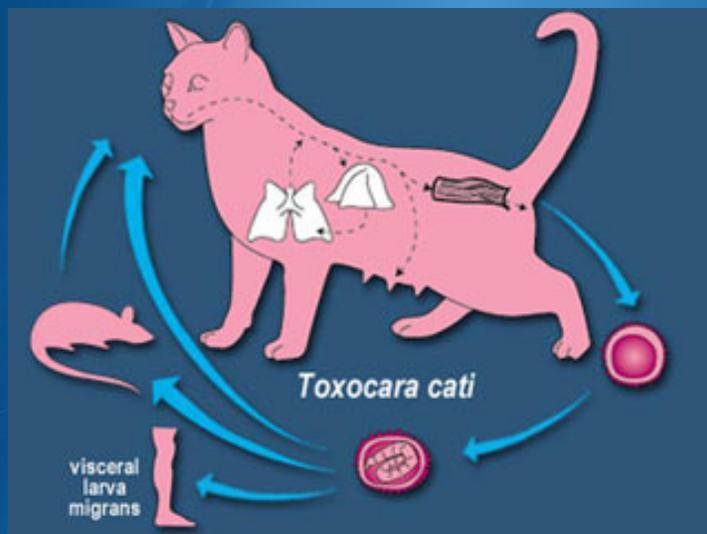
## Lifecycle: *B. procyonis*



## Lifecycle: *T. canis*



## Lifecycle: *T. cati*

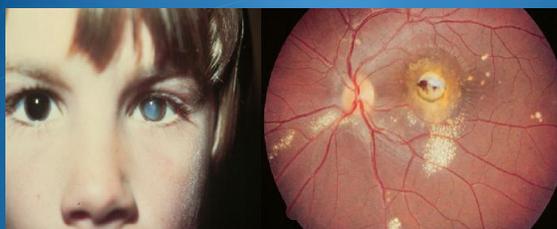


<http://vetpda.ucdavis.edu/parasitolog/Parasite.cfm?ID=149>

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## Ocular Larva Migrans

- Most common with *Toxocara* spp.
- Permanent damage to the globe
- Usually unilateral
- Can be confused with retinoblastoma – most commonly seen in older children and young adults



[www.norwalkvet.com](http://www.norwalkvet.com)



## Visceral Larva Migrans

- Most often vague signs and symptoms
  - Depends on number of larvae and where they are migrating
  - May include: fever, cough, wheezing, abdominal pain, hepatomegaly
- Can be severe
- More common with *Toxocara*

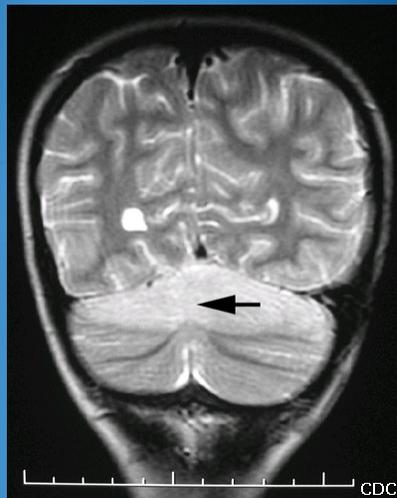


CDC



## Neural Larva Migrans

- See this more with *Baylisascaris* – much more aggressive
- Severity depends on where the larvae are migrating
- Likely permanent CNS damage
- Potential to be fatal



<https://redbook.solutions.aap.org/>



## Diagnosis and Treatment

- Diagnosis is difficult
  - Non-specific symptoms
  - No good test for *B. procyonis*, except tissue section
  - Relatively high seroprevalence of *Toxocara* antibodies
- Treatment can also be challenging
  - Albendazole or Mebendazole
  - Not as effective for OLM or NLM
  - For OLM and NLM, attempt to limit further destruction with anti-inflammatories



## Prevention

- Modify the environment to make it undesirable for wild/feral animals to visit
- Removal of raccoon latrines, clean up dog and cat fecal material
- Cover sandboxes
- Regularly deworm pets
- Hygiene

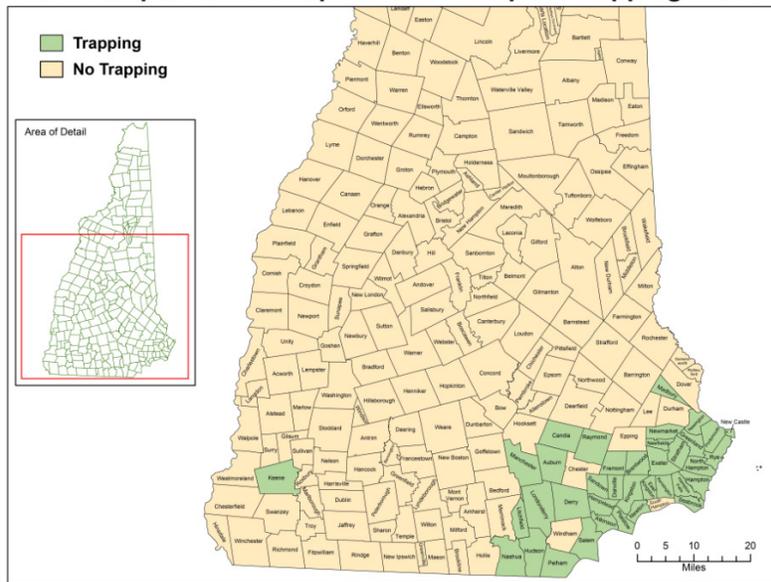


## Arboviral Update



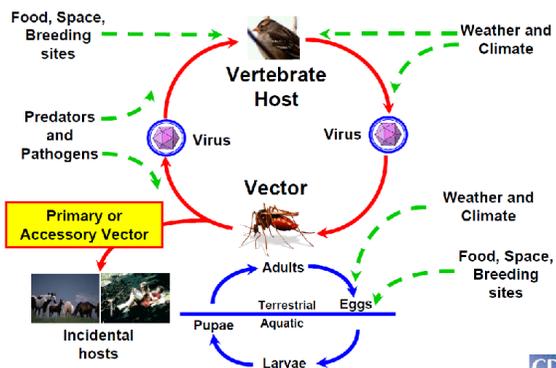
## NH Town Sponsored Mosquito Trapping, 2016

### New Hampshire Town Sponsored Mosquito Trapping - 2016



## Arboviral Basics

### Arbovirus Transmission Cycle

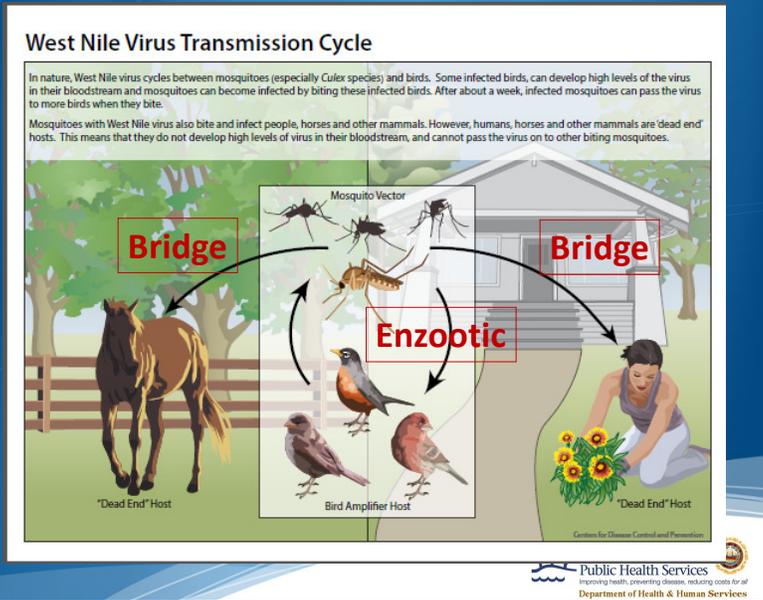


## Transmission Cycle – Boiled Down

WNV/EEE

Aedes  
Culex  
Coquillettidia  
Culiseta

(we test more than this)



## Mosquitoborne Diseases in NH

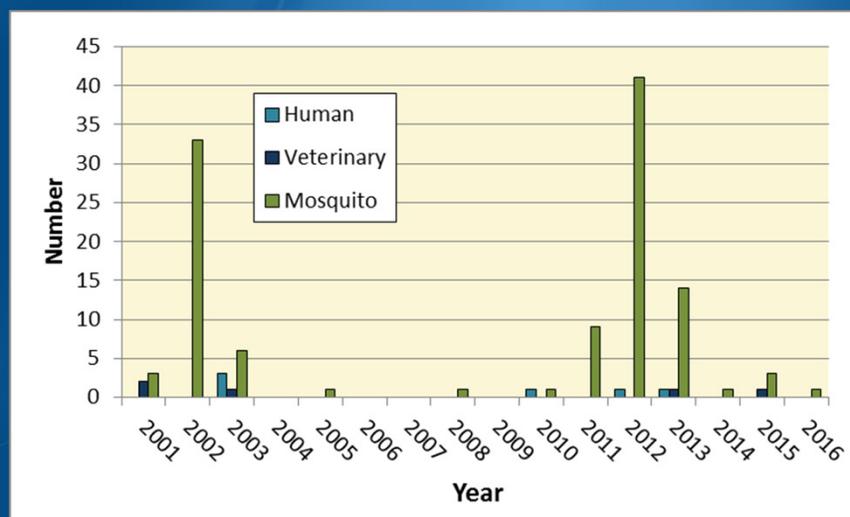
- West Nile Virus (WNV)
- Eastern Equine Encephalitis Virus (EEE)
- Jamestown Canyon Virus (JCV)

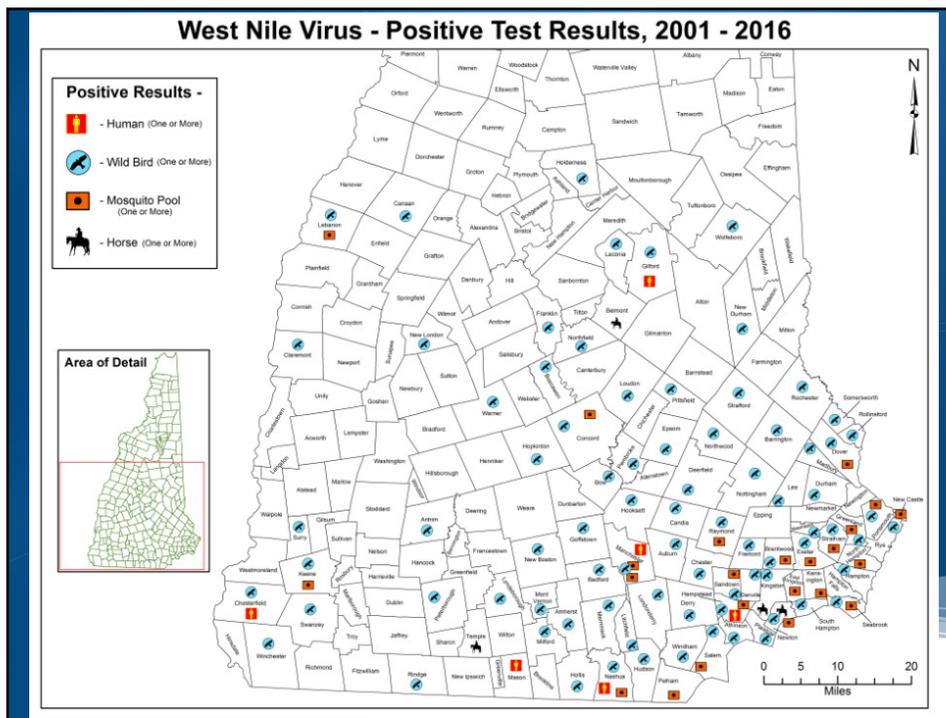
## West Nile Virus

- 3-14 days after bite from infected mosquito
- “West Nile Fever”
  - About 20% of those people infected will have mild illness
  - Fever, headache, body aches, swollen lymph nodes
- WNV Neuroinvasive Disease
  - About 1 in every 150 people infected
  - High fever, headache, neck stiffness, muscle weakness, disorientation, meningitis, encephalitis
- People over 50 years of age are at higher risk of developing serious symptoms



## NH WNV Activity: 2001-2016

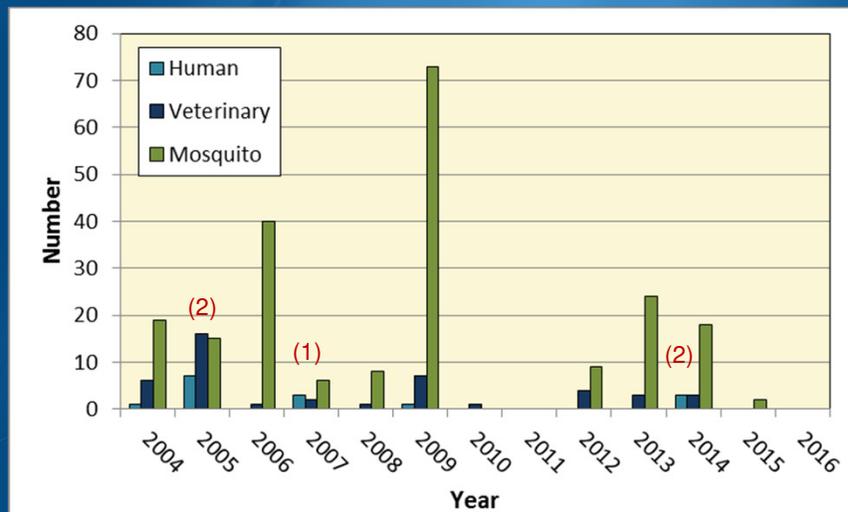




## Eastern Equine Encephalitis

- Rare but serious disease
- 4-10 days after bite from infected mosquito
- Severe EEE: Encephalitis
  - Sudden high fever, severe headache, stiff neck, can be followed by seizures, coma
  - Approximately 33% mortality
  - Survivors often suffer long-term to permanent brain damage
- May also appear as milder, flu-like illness
- Persons < 15 and >50 are most at risk for severe disease

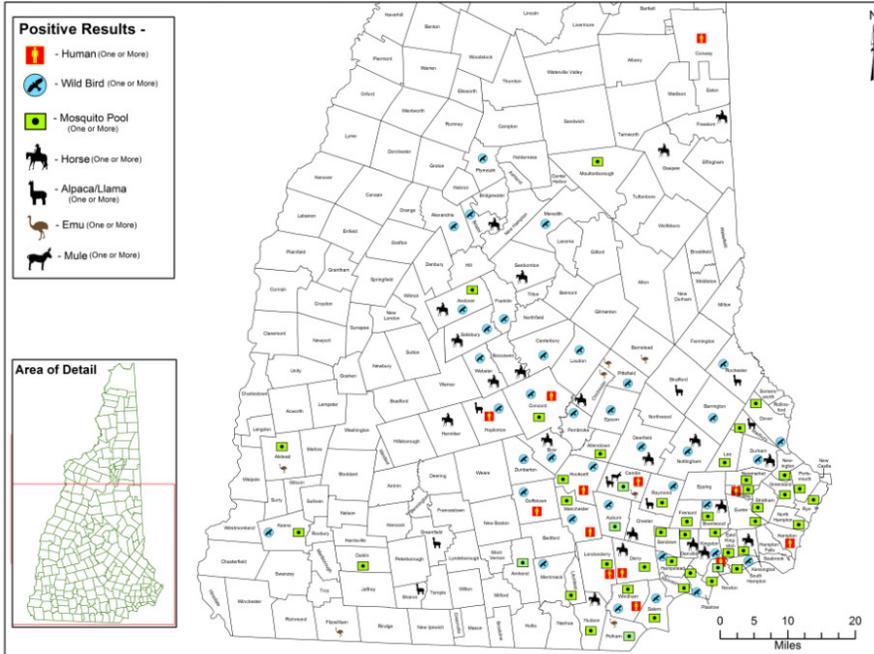
## NH EEE Activity 2004 - 2016



Mosquito Testing initiated in 2004



## Eastern Equine Encephalitis – Positive Test Results, 2004-2016



## Jamestown Canyon Virus

- Rare arboviral illness, although is being recognized more frequently.
  - There have been 41 cases nationally in 2017
- NH has now had four cases of Jamestown Canyon Virus (JCV) – two of them in 2017.
- Symptoms for this viral infection are similar to those of EEE and WNV. Treatment is supportive
- JCV circulates and amplifies in the white tailed deer population.



## Prevention and Control Measures



## Minimize Mosquito Bites

- Use EPA registered repellent
  - Minimize outdoor activity between dusk and dawn
    - Peak mosquito activity
  - Wear long sleeves, pants to deter bites
  - Keep screens in good repair--keep mosquitoes out of your home
- \*\*Vitamin B, bug zappers, ultrasonic devices, incense, etc have NOT been proven to work



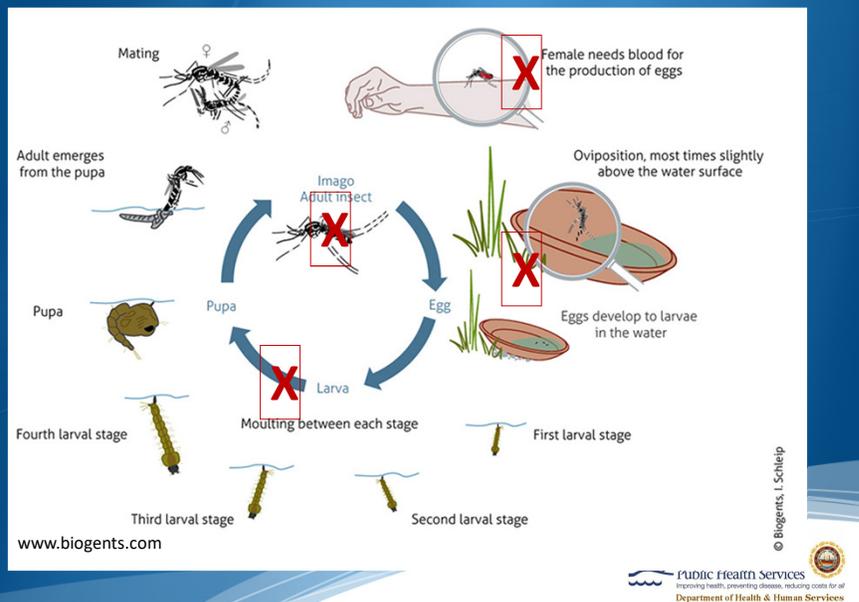
## Mosquito-proofing

*Don't give mosquitoes a place to breed!*

- No standing, stagnant containers of water
- Treat standing water
- Dump small containers and put away if possible
- Turn over wheelbarrows, kiddie pools, portable containers
- Clean gutters
- Change water in bird-baths/fountains weekly
- Fold and store tarps
- **Drill holes in tires**



## Opportunities for Control



## Additional Information

- The CDC has more national surveillance information and disease specific information
  - [www.cdc.gov](http://www.cdc.gov)
- The State of New Hampshire Arboviral Illness Surveillance, Prevention and Response Plan can be found here:
  - [www.dhhs.nh.gov/dphs/cdcs/arboviral/documents/arboviralresponse.pdf](http://www.dhhs.nh.gov/dphs/cdcs/arboviral/documents/arboviralresponse.pdf)
  - This document has additional information about arboviruses, vectors, and control
  - Updated annually

## Mosquito and Tick Repellent

- Always use according to the product label
- For information on EPA registered repellents and their active ingredients:

<https://www.epa.gov/insect-repellents/find-insect-repellent-right-you>



## Acknowledgments

- NH DHHS Division of Public Health Services
  - Benjamin Chan, Elizabeth Talbot, Elizabeth Daly, Carolyn Fredette, Tylor Young
- NH Public Health Laboratories
  - Christine Bean, Fengxiang Gao, Denise Bolton, Carol Loring, Amanda Cossar, Trevor Lester



## Questions?

- Helpful resources
  - NH Bureau of Infectious Disease Control
    - <http://www.dhhs.nh.gov/dphs/cdcs/index.htm>
  - CDC
    - <http://www.cdc.gov/ncezid/dvbd/>
  - Connecticut Agricultural Experimental Station
    - <http://www.ct.gov/caes/site/default.asp>
- Contact information:
  - abigail.mathewson@dhhs.nh.gov
  - (603) 271-0274 or
  - (603) 271-4496



## Resources We Talked About

- UMass Tick Testing
  - <https://ag.umass.edu/services/tick-borne-disease-diagnostics>
- Feral Cats
  - <https://www.avma.org/KB/Policies/Pages/Free-roaming-Abandoned-and-Feral-Cats.aspx>
- Unusual Rabies (interesting, and not what would be considered a real risk)
  - <https://www.ncbi.nlm.nih.gov/pubmed/26201090>
- Jamestown Canyon Virus
  - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4530766/pdf/tropmed-93-384.pdf>

