# RABIES EPIDEMIOLOGY, PREVENTION AND CONTROL

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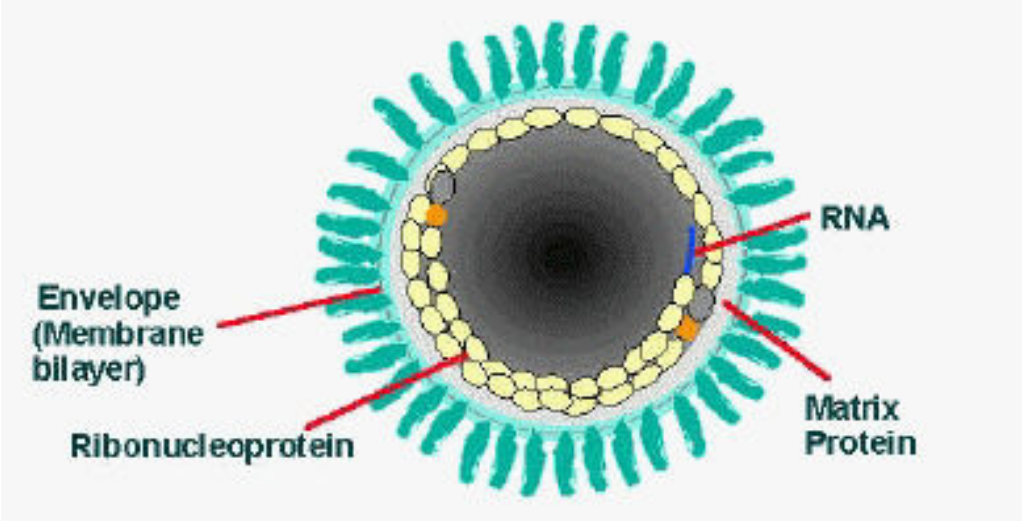
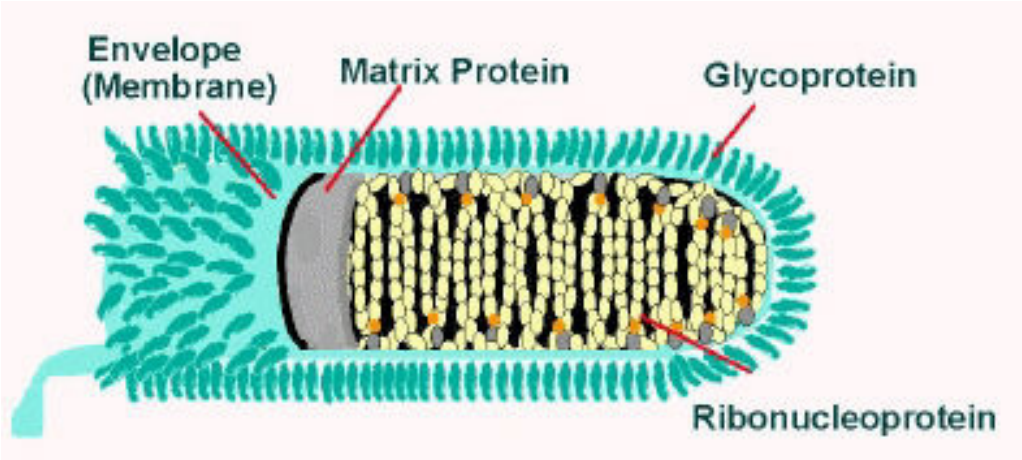
TN Department of Health


https://tn.gov/assets/entities/health/attachments/RabiesManual2016.pdf

# Rabies virus

- RNA virus
  - Host-adapted variants
  - Enveloped virus—rapidly destroyed in environment
- Neurotropic
  - Long, highly variable incubation period
  - Causes rapidly progressive, fatal encephalitis
- No “carrier” state



# Worldwide burden of illness

- Kills ~60,000 annually, Asia and Africa
- Vaccine-preventable
- Sustained elimination of dog-to-dog transmission has been demonstrated

# Human rabies epidemiology: US

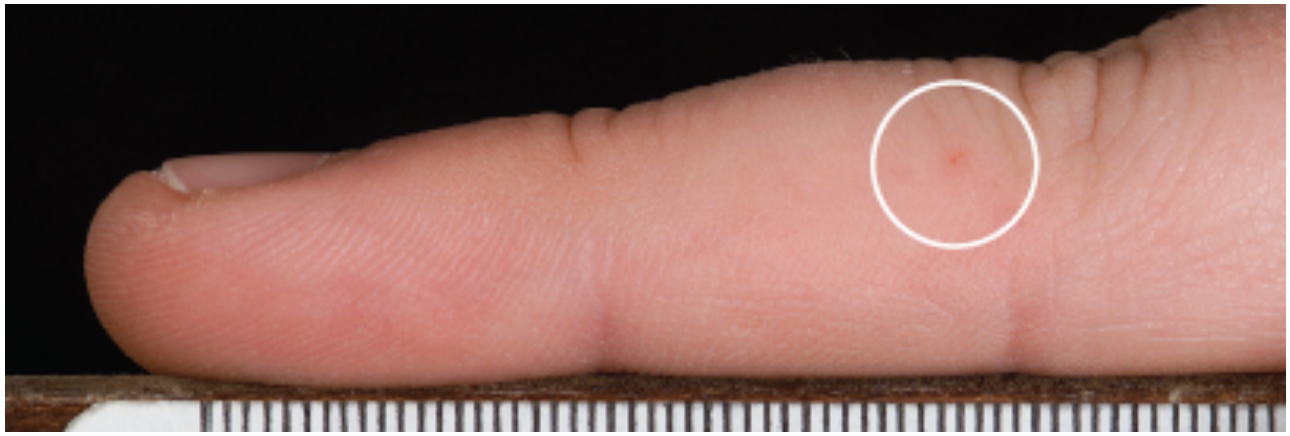
- 2-3 cases per year
  - Bat variants in locally-acquired cases
  - Canine variant in immigrants / travelers

- Last Tennessee case in 2002 (bat)

- Last case in Tennessee due to a rabid dog bite was 1955

# United States: Bat-variant rabies

- Majority of human rabies
  - ~ 75% cases
  - Silver-haired/Eastern pipistrelle bat
- Minor bite wound, difficult to detect



# Human rabies clinical presentation

- Incubation
  - Highly variable (1 week to >1 year), averages 30-90 days
- Nonspecific prodrome
  - Up to 10 days
  - Fever, headache, nausea, paresthesia at site of bite
- Progressive neurologic phase
  - 2-10 days
  - Confusion, agitation, hypersalivation, hydrophobia, aerophobia, dysphagia
- Paralysis, coma: hours to days
- Death: mortality almost 100% once symptoms develop

# 2002 Tennessee Case

- 13 year old Franklin County boy

- Brought home bat he found on the ground ~ July 1, not reported, no bite noted
  - Onset August 21 (7 week incubation)
  - Headache, neck pain
  - August 22-25: right arm weakness, blurry vision, fever, slurred speech, dysphagia

- Transferred to VUMC

# 2002 Tennessee Case, cont.

- August 26-31: encephalitis, deteriorating mental status, hypersalivation, intubation, agitation (sedation), pronounced brain dead
- Diagnosis: Rabies antibodies in serum / CSF, virus in nuchal skin biopsy and saliva (PCR)
- Rabies variant: silver-haired / eastern pipistrelle bats

# Treatment?

- Treatment not considered a possibility historically
- Aggressive, experimental therapies under evaluation
- 2004 rabies treatment success story

# Rabies survivor, Wisconsin, 2004

- 15 year old girl, Jeanna Giese
  - Bat bit finger, not reported, no rPEP
  - Onset 1 month later
- Treatment: Induced coma, ketamine, midazolam, barbiturates, ribavirin, amantadine
- Immune response and survival
- Extensive rehabilitation

# Jeanna Giese

The NEW ENGLAND JOURNAL of MEDICINE

BRIEF REPORT

## Survival after Treatment of Rabies with Induction of Coma

Rodney E. Willoughby, Jr., M.D., Kelly S. Tieves, D.O., George M. Hoffman, M.D., Nancy S. Ghanayem, M.D., Catherine M. Amlie-Lefond, M.D., Michael J. Schwabe, M.D., Michael J. Chusid, M.D., and Charles E. Rupprecht, V.M.D., Ph.D.

SUMMARY

We report the survival of a 15-year-old girl in whom clinical rabies develope month after she was bitten by a bat. Treatment included induction of coma whil tive immune response matured; rabies vaccine was not administered. The patie treated with ketamine, midazolam, ribavirin, and amantadine. Probable drug-r toxic effects included hemolysis, pancreatitis, acidosis, and hepatotoxicity. Lu puncture after eight days showed an increased level of rabies antibody, and se was tapered. Paresis and sensory denervation then resolved. The patient was re from isolation after 31 days and discharged to her home after 76 days. At nearly five months after her initial hospitalization, she was alert and communicative, but with choreoathetosis, dysarthria, and an unsteady gait.

# Human rabies prevention

**Primary defense:**

- **Prevent bites from wildlife / bats**

- **Pet vaccination / animal control creates a barrier to human exposure**
  - **Reduction of stray populations**

- **Canine-variant rabies in U.S. eliminated**
  - **Re-establishment must be continually prevented**

# Post-exposure prophylaxis (PEP)

**Secondary defense:**

- **Rabies immune globulin (RIG) on day 0**
- **Rabies vaccine on days 0, 3, 7, and 14**
- **100% effective when administered properly**
- **~40,000 prescriptions per year in U.S.**
  - **$5,000-$10,000+ per course**
  - **75% unnecessary based on rabies risk**

# Pre-exposure prophylaxis

## For high-risk populations:

- **Animal control personnel, veterinarians / staff, animal diagnostic lab workers, wildlife workers, some travelers**

## Series of 3 doses of vaccine

- **If exposed: 2 vaccine doses, no HRIG**
- **May protect against unrecognized exposures**

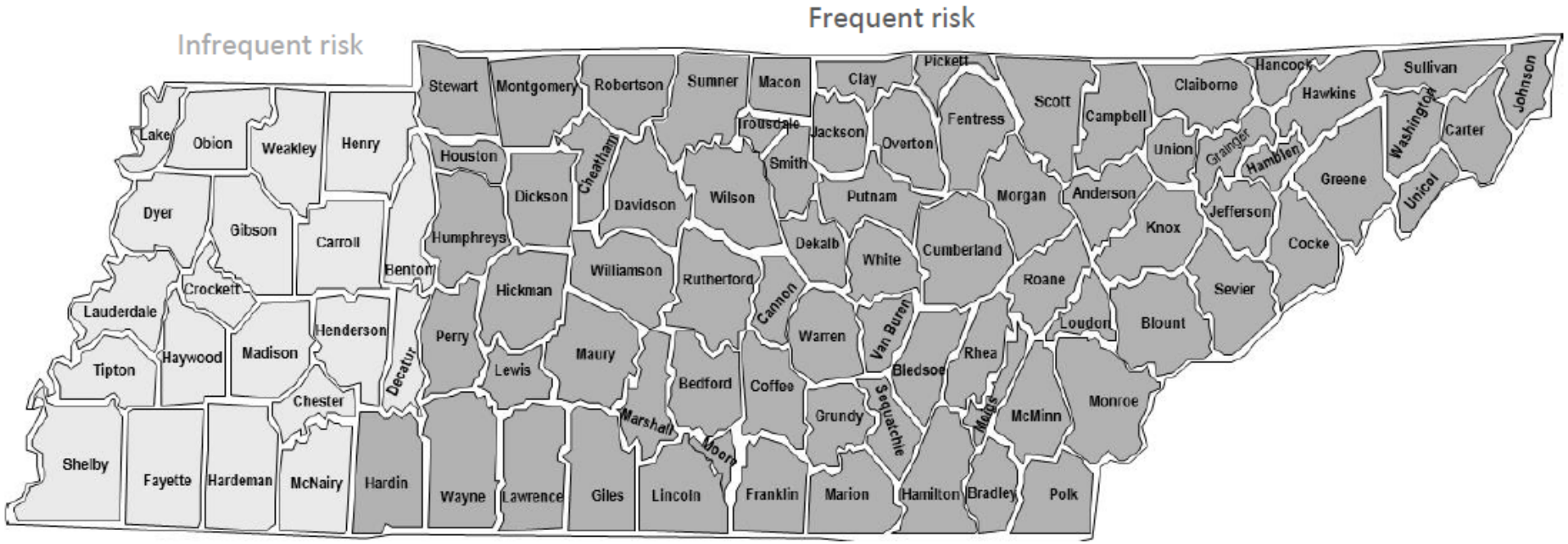
# Pre-exposure prophylaxis

**Serologic testing and booster recommendations**

| Risk category | Nature of risk | Typical populations | Pre-exposure recommendations |
|---|---|---|---|
| **Continuous** | Virus present continuously, often in high concentrations, with specific exposures likely to go unrecognized; bite, nonbite, or aerosol exposure possible | Rabies research laboratory workers; rabies biologics production workers | Primary course with serologic testing every 6 months; booster vaccination if antibody titer is below acceptable level* |
| **Frequent** | Exposure usually episodic, with source recognized, but also might be unrecognized; bite, nonbite, or aerosol exposure possible | Rabies diagnostic laboratory workers; cavers; veterinarians and staff; animal control and wildlife workers in rabies-enzootic areas; all persons who frequently handle bats | Primary course with serologic testing every 2 years; booster vaccination if antibody titer is below acceptable level* |
| **Infrequent** | Exposure nearly always episodic with source recognized; bite or nonbite exposure possible | Veterinarians and animal control staff in areas where rabies is uncommon; veterinary students; travelers to rabies-enzootic areas where access to medical care is limited | Primary course with no serologic testing or booster vaccination |

*Minimum acceptable antibody level is complete viral neutralization at a 1:5 serum dilution (CDC recommendation) or 0.5 IU per ml (WHO recommendation) by the rapid fluorescent focus inhibition test.

Risk categories for pre-exposure prophylaxis in Tennessee counties



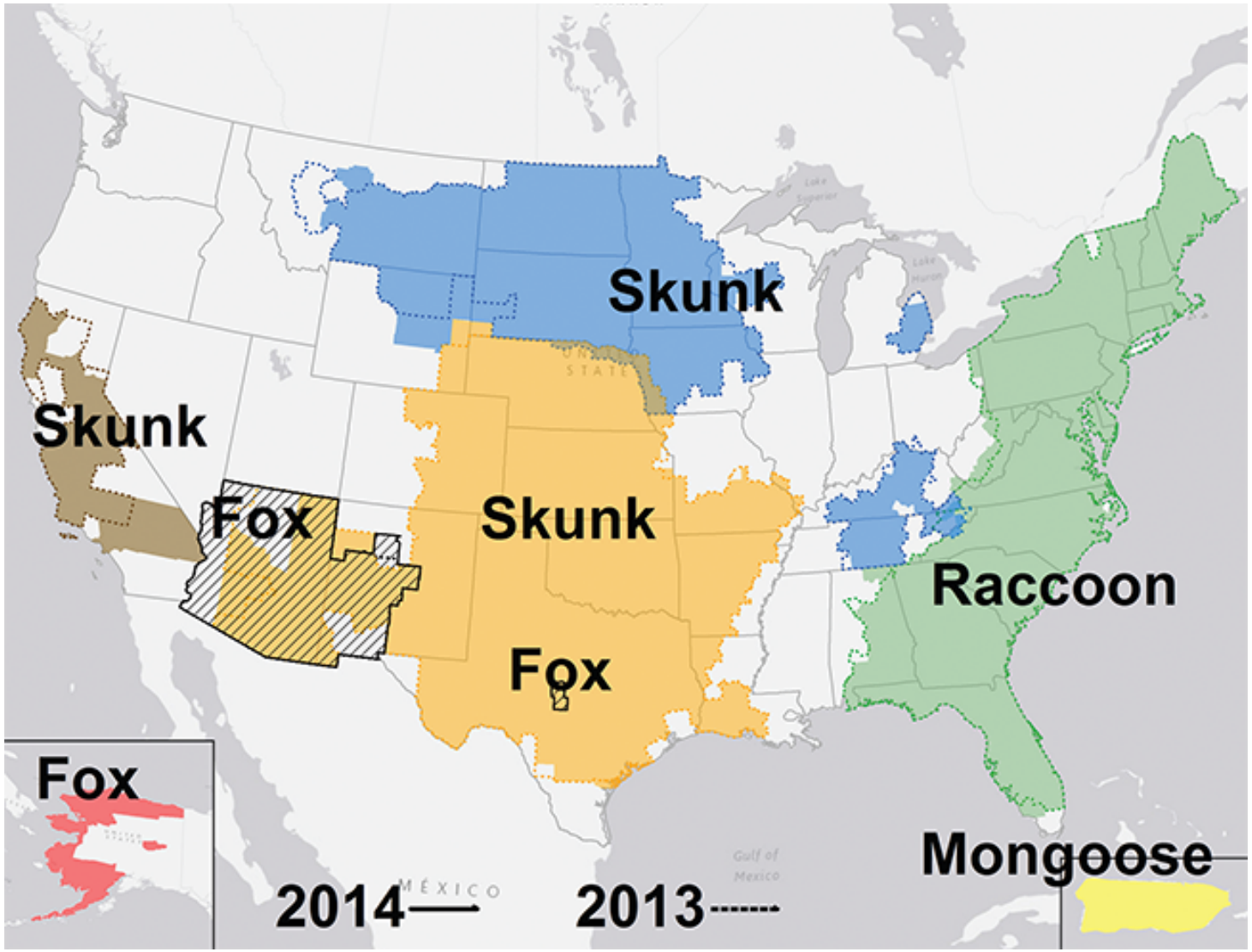
# EPIDEMIOLOGY OF RABIES IN ANIMALS

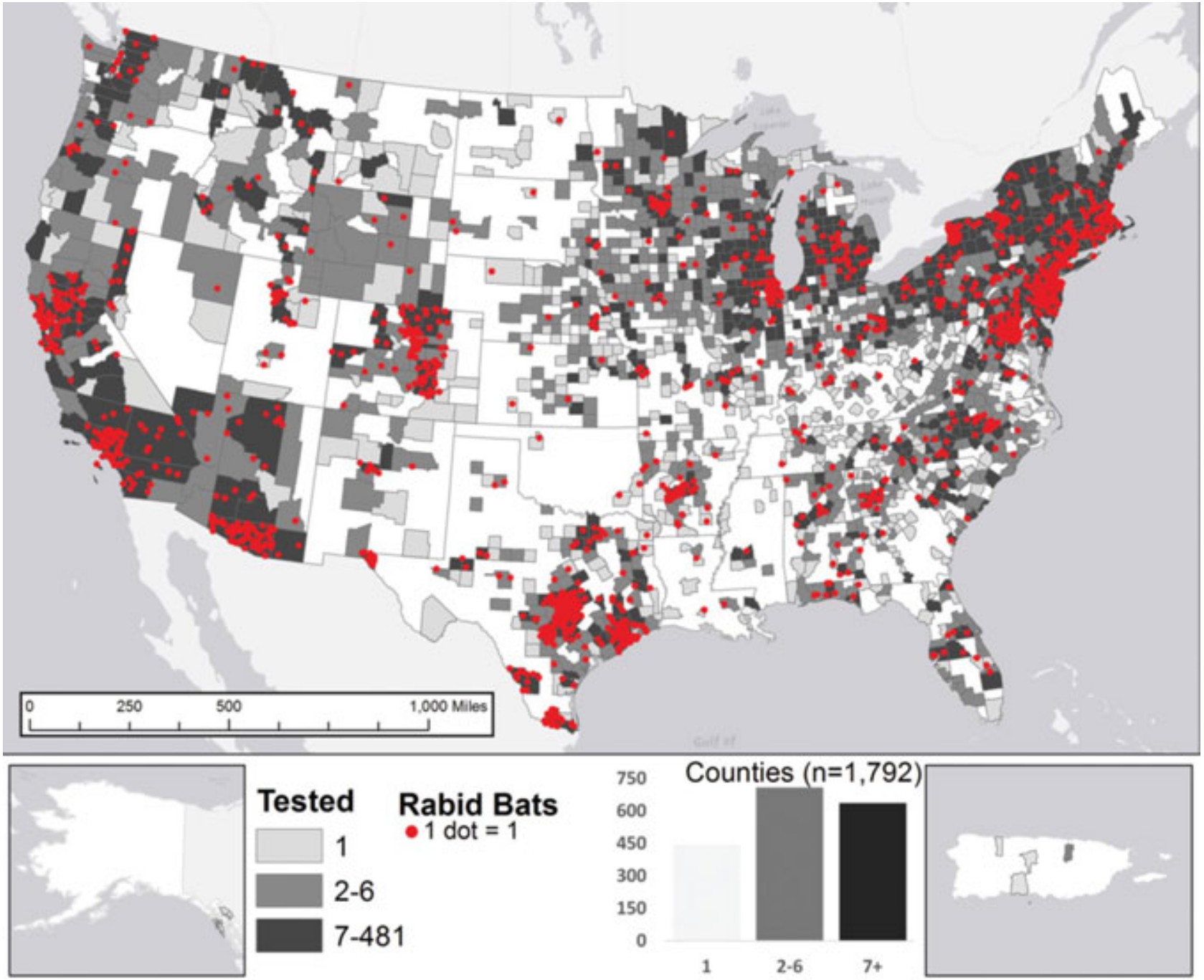
# Animal rabies in the U.S.

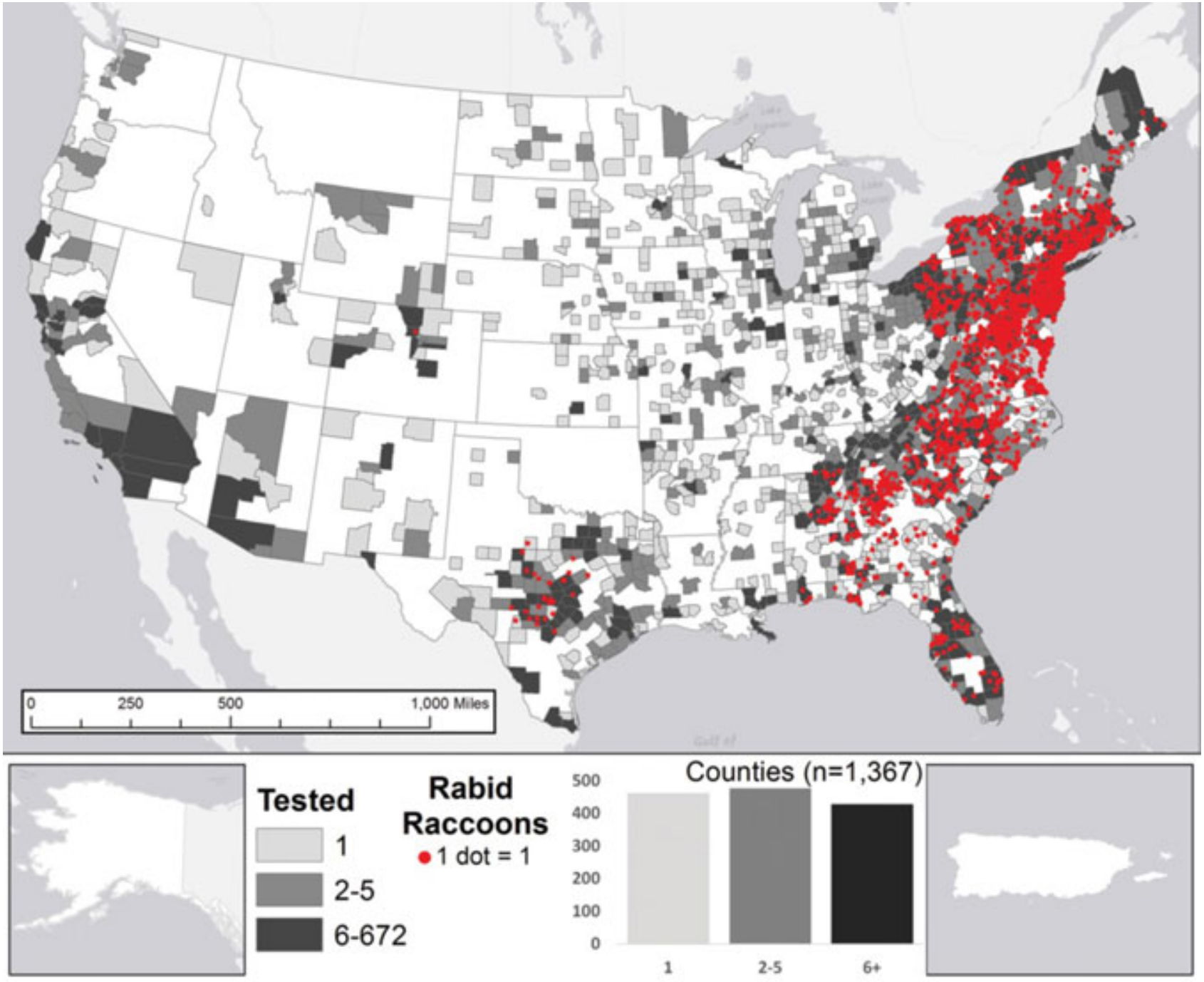
- > 90% in wildlife
  - Bats
  - Carnivores: raccoons, skunks, foxes

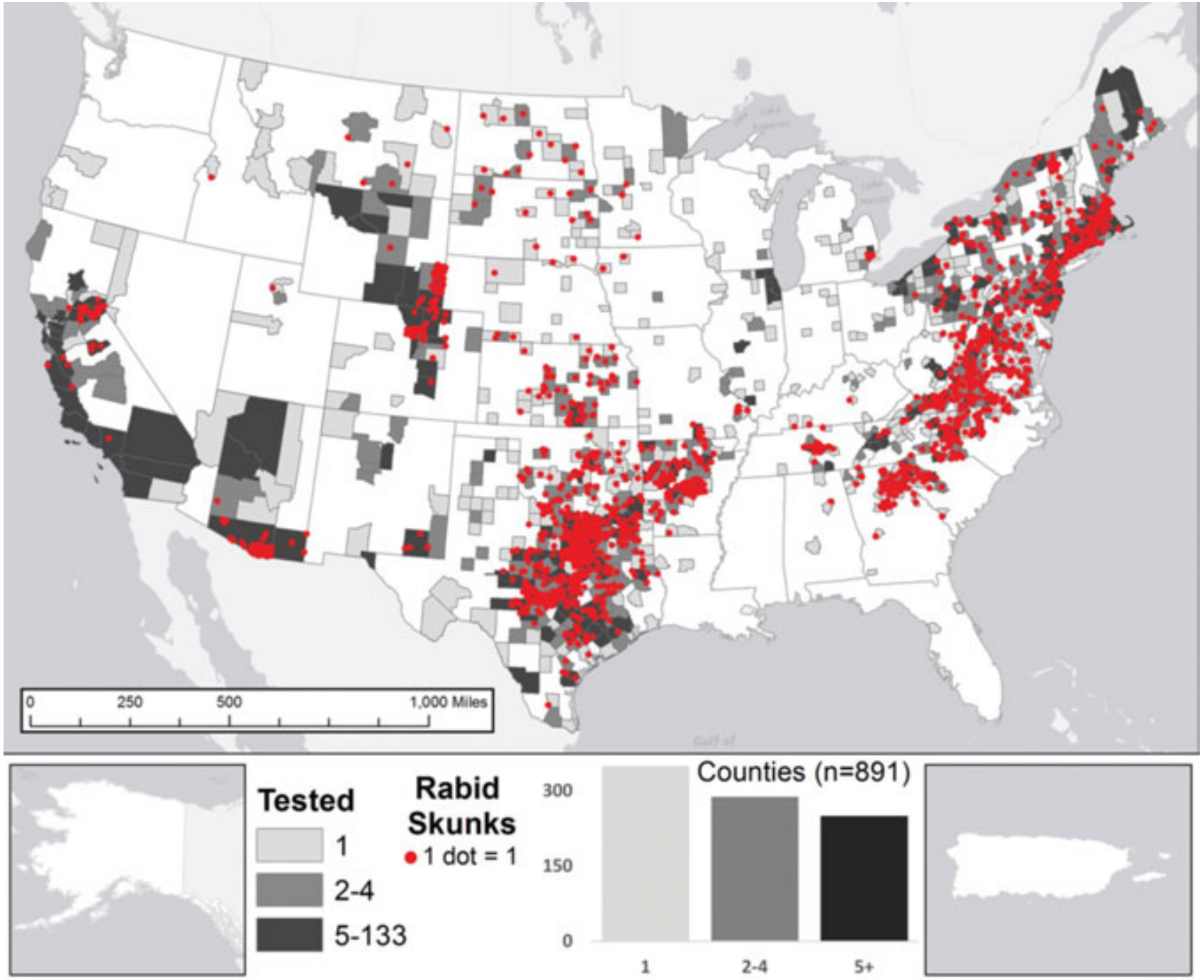
- ~ 6,000 cases reported per year
  - Mostly animals involved in human or domestic animal exposures
  - Not reflective of true number of cases

# Terrestrial rabies reservoirs in U.S. and Puerto Rico




0
250
500
1,000 Miles
Tested
1
2-6
7-481
Rabid Bats
1 dot = 1
Counties (n=1,792)
750
600
450
300
150
0
1
2-6
7+


0
250
500
1,000 Miles
Tested
1
2-5
6-672
Rabid Raccoons
1 dot = 1
Counties (n=1,367)
500
400
300
200
100
0
1
2-5
6+


0
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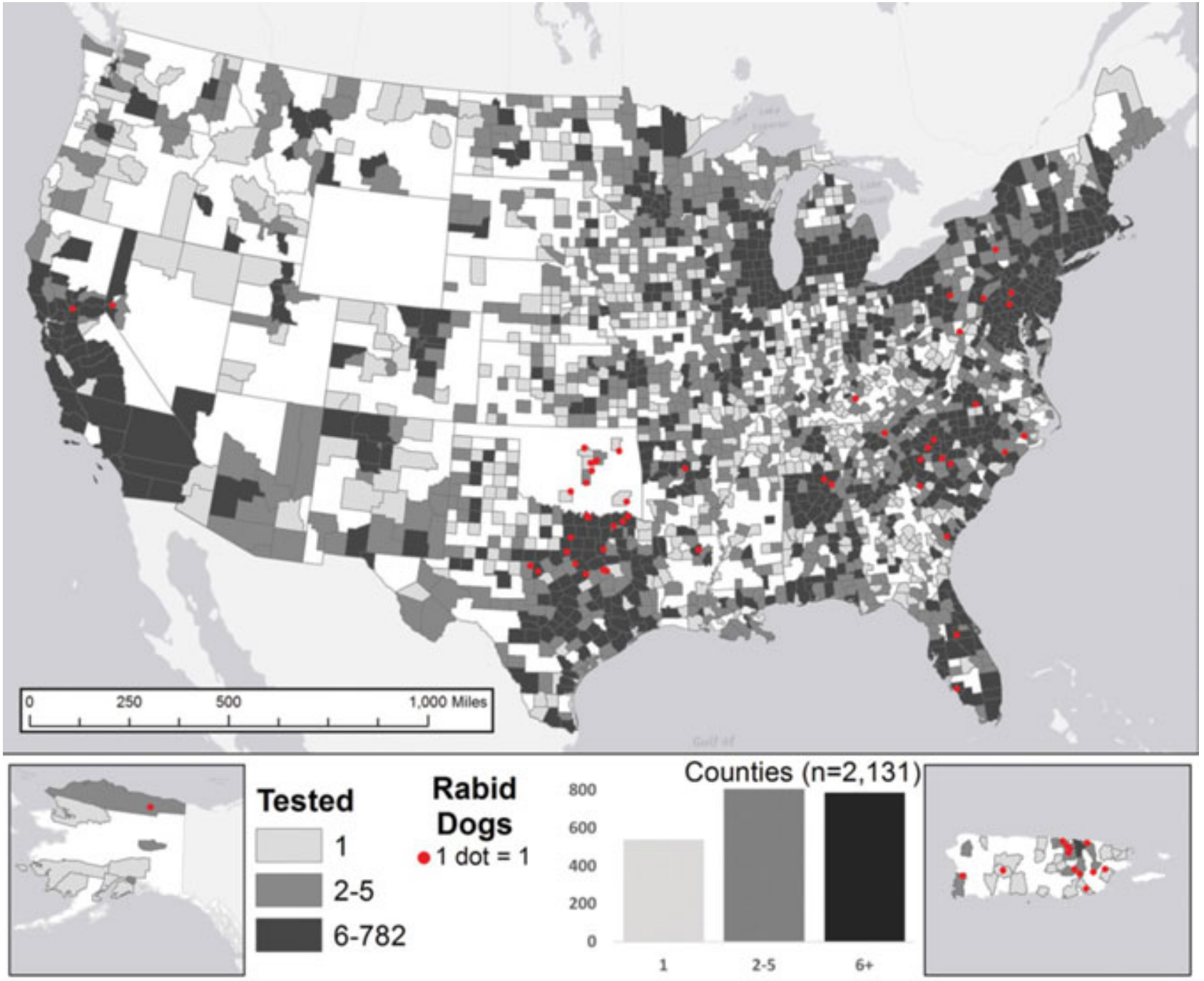
500
1,000 Miles
Tested
1
2-4
5-133
Rabid Skunks
1 dot = 1
Counties (n=891)
300
150
0
1
2-4
5+


0
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500
1,000 Miles
Tested
1
2-5
6-782
Rabid Dogs
1 dot = 1
Counties (n=2,131)
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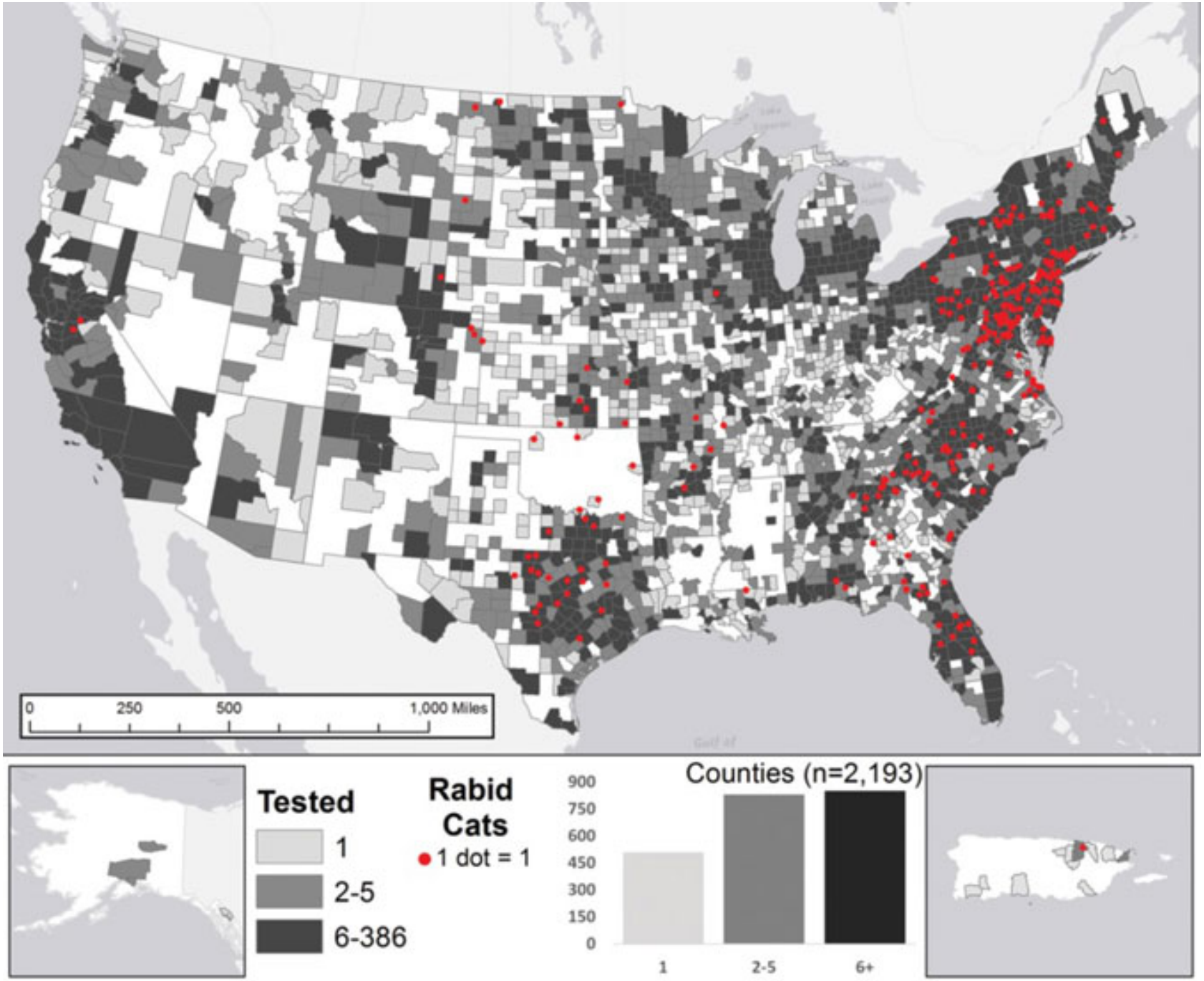
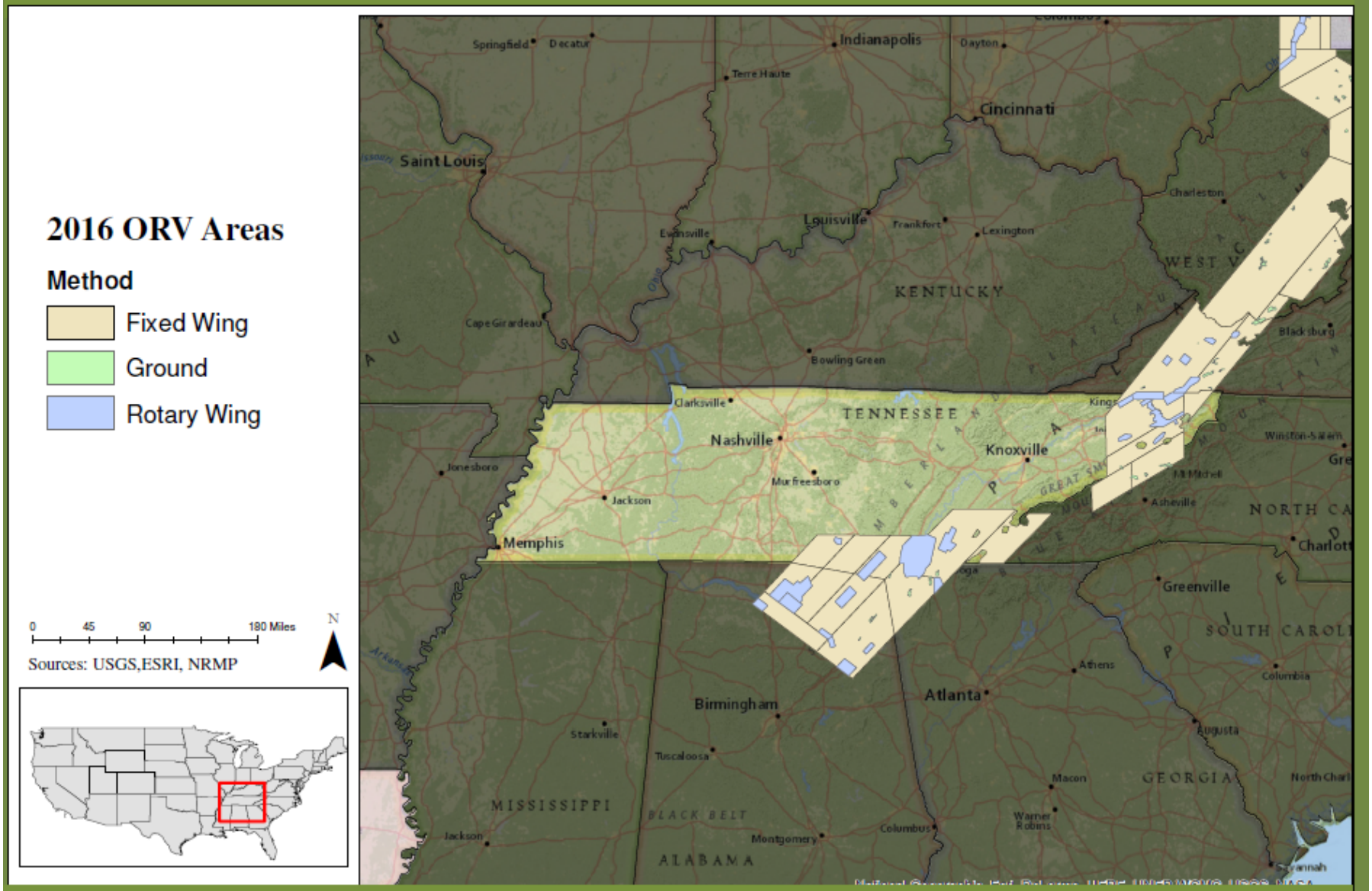
600
400
200
0
1
2-5
6+


0
250
500
1,000 Miles
Tested
1
2-5
6-386
Rabid Cats
1 dot = 1
Counties (n=2,193)
900
750
600
450
300
150
0
1
2-5
6+

# Oral rabies vaccination (ORV) USDA-APHIS Wildlife Services

- National Rabies Management Program
  - State, local governments, other partners
- V-RG vaccine
  - Rabies glycoprotein gene incorporated into vaccinia virus
  - Distributed by airplane and by hand in designated areas

# 2016 ORV Operations in Tennessee



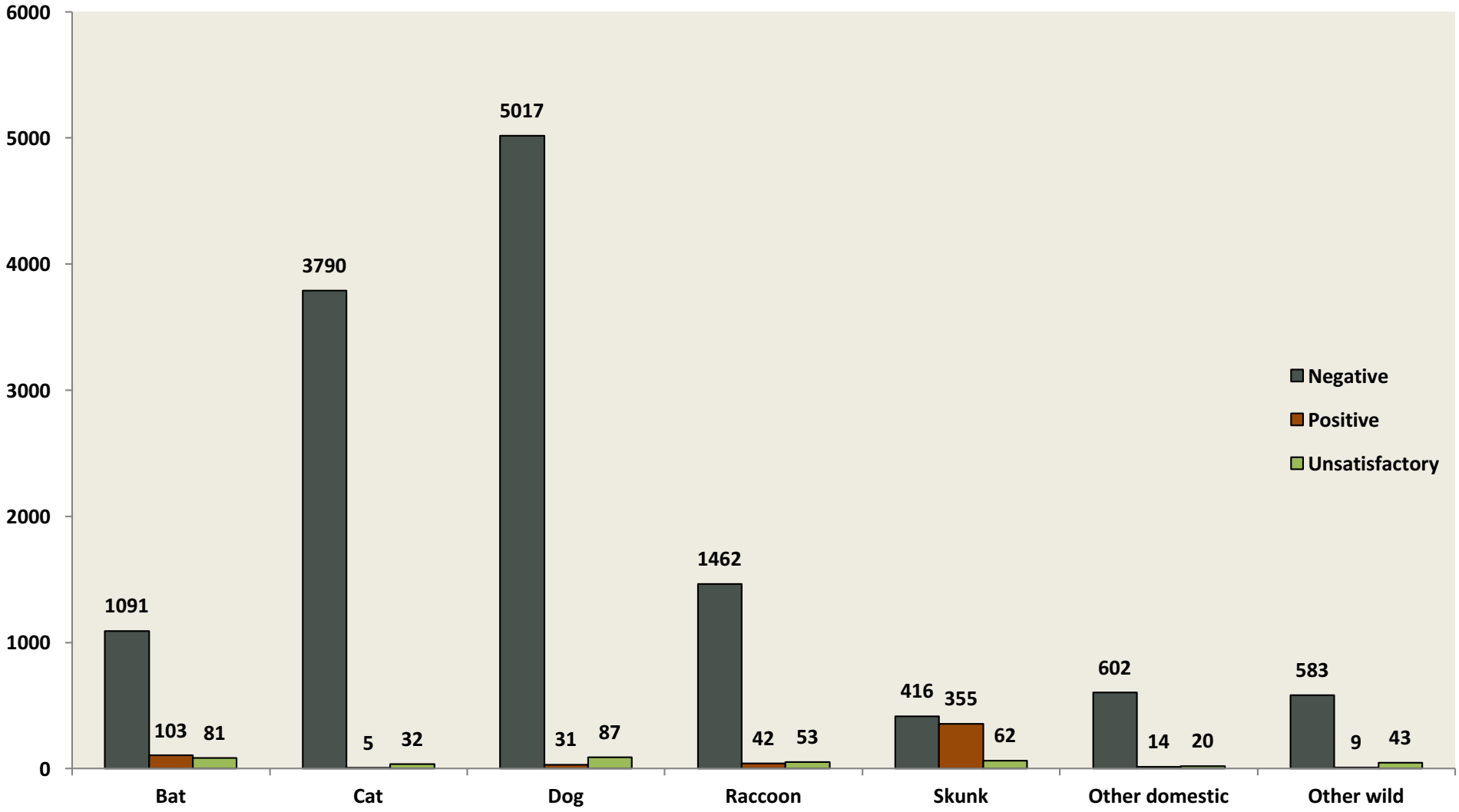

United State Department of Agriculture
Animal Plant Health Inspection Service
Wildlife Services - TN/KY

# Animal submissions for testing, 2007-15

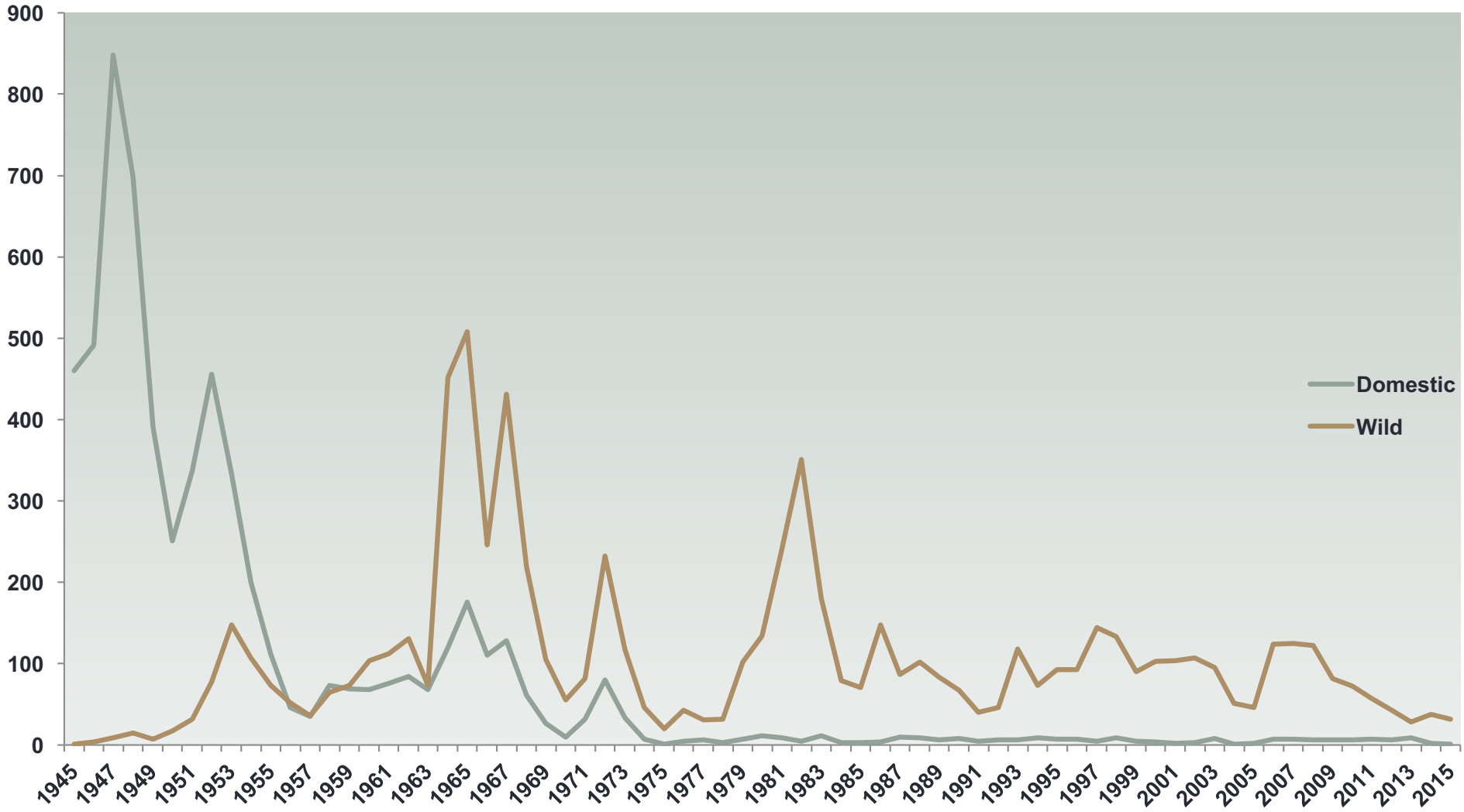
- **13,949 submissions to TDH labs**
  - 559 (4%) positive
  - 12,961 negative
  - 378 unsatisfactory specimen

- **92 additional positives from USDA-WS surveillance**

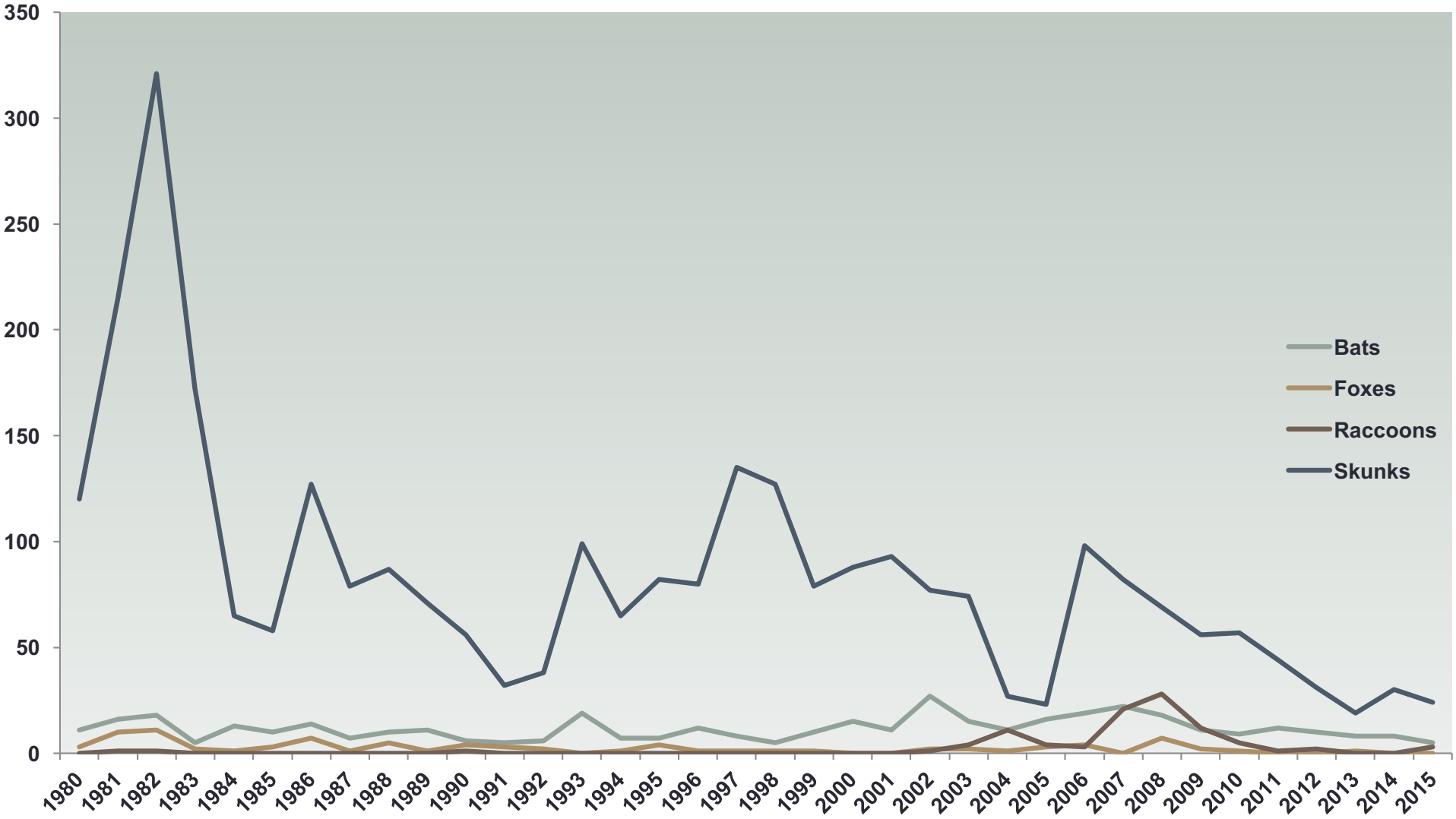
# Submissions by species, 2007-15



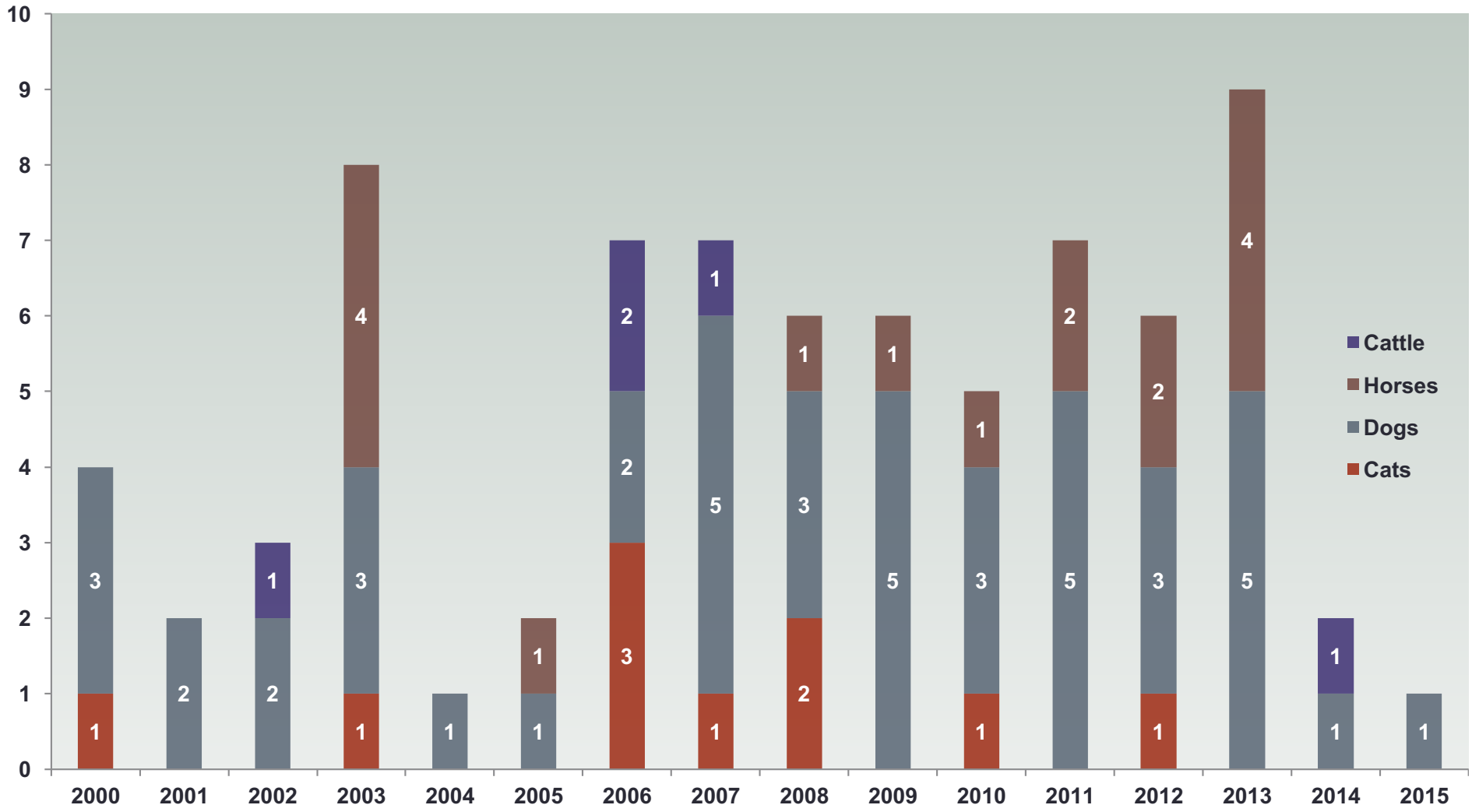
# Animal rabies in Tennessee, 1945-2015



# Wild animal rabies in Tennessee, 1980-2015



# Domestic animal rabies in Tennessee, 2000-2015



# Characterizing domestic animal rabies in Tennessee

**Began collecting data in 2008 to examine rabies in domestic animals**

- **Clinical signs**
- **Course of disease**

| Cases | Variant |
|---|---|
| 30 dogs | Skunk |
| 5 cats | Skunk, Bat, Raccoon |
| 8 horses | Skunk, Bat |
| 1 cow | Skunk |

# Clinical signs in dogs

- Earliest recognized signs
  - Weakness, lethargy, not eating, behavior change
  - Most clinical signs developed 1-2 days before death

- Aggressiveness reported in 5 dogs
  - No documented bites from rabid dogs
  - Biting dogs statistically less likely to be rabid

- Other common clinical signs
  - Unsteadiness
  - Difficulty swallowing
  - Paralyzed jaw / tongue
  - Jumpiness / nervousness

# RABIES EXPOSURE, ASSESSMENT, TESTING, AND TREATMENT

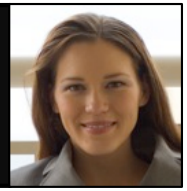
# Management of animal bites: Domestic

| | |
|---|---|
| Healthy dog, cat, or ferret: | 10 days observation from the time of the bite.<br>Not a "quarantine." |
| Other healthy domestic animal: | No observation period defined.<br>Rabies risk extremely low. |
| Sick domestic animal: | Should be evaluated by a veterinarian.<br>If vet has concerns about rabies—submit for testing. |

# Management of animal bites: Wild

| | |
|---|---|
| **Rabies reservoir species (skunk, bat, raccoon):** | **Test animal if available, otherwise PEP is recommended.** |
| **Carnivore—non-reservoir species (coyote, bobcat):** | **Test animal if available, otherwise PEP may be recommended.** |
| **Non-carnivore:** | **Consult Central Office or Health Officer regarding need for testing.**<br>**PEP rarely indicated.** |
| **Rodent / rabbit / opossum:** | **Usually will not be tested.**<br>**PEP almost never indicated.** |

**Human that is bitten by an animal**



Wash wound thoroughly with soap and water. Seek medical attention for the wound if necessary. THEN consider the type and availability of the biting animal in consultation with local or state public health authorities.

**Healthy dog, cat, or ferret**

Observe for 10 days. If the animal remains clinically normal, there is no need to test animal or for bitten person to receive postexposure prophylaxis.*

**OR**

**Other healthy domestic animal**

Very low risk. Evaluate on a case-by-case basis in consultation with public health authorities.

**Rabies reservoir species (raccoon, skunk, fox, bat)**

Contact local health department to arrange testing of animal for rabies. If animal is not available for testing, the bitten person should receive postexposure prophylaxis.†

**OR**

**Other wild animal (non-reservoir species)**

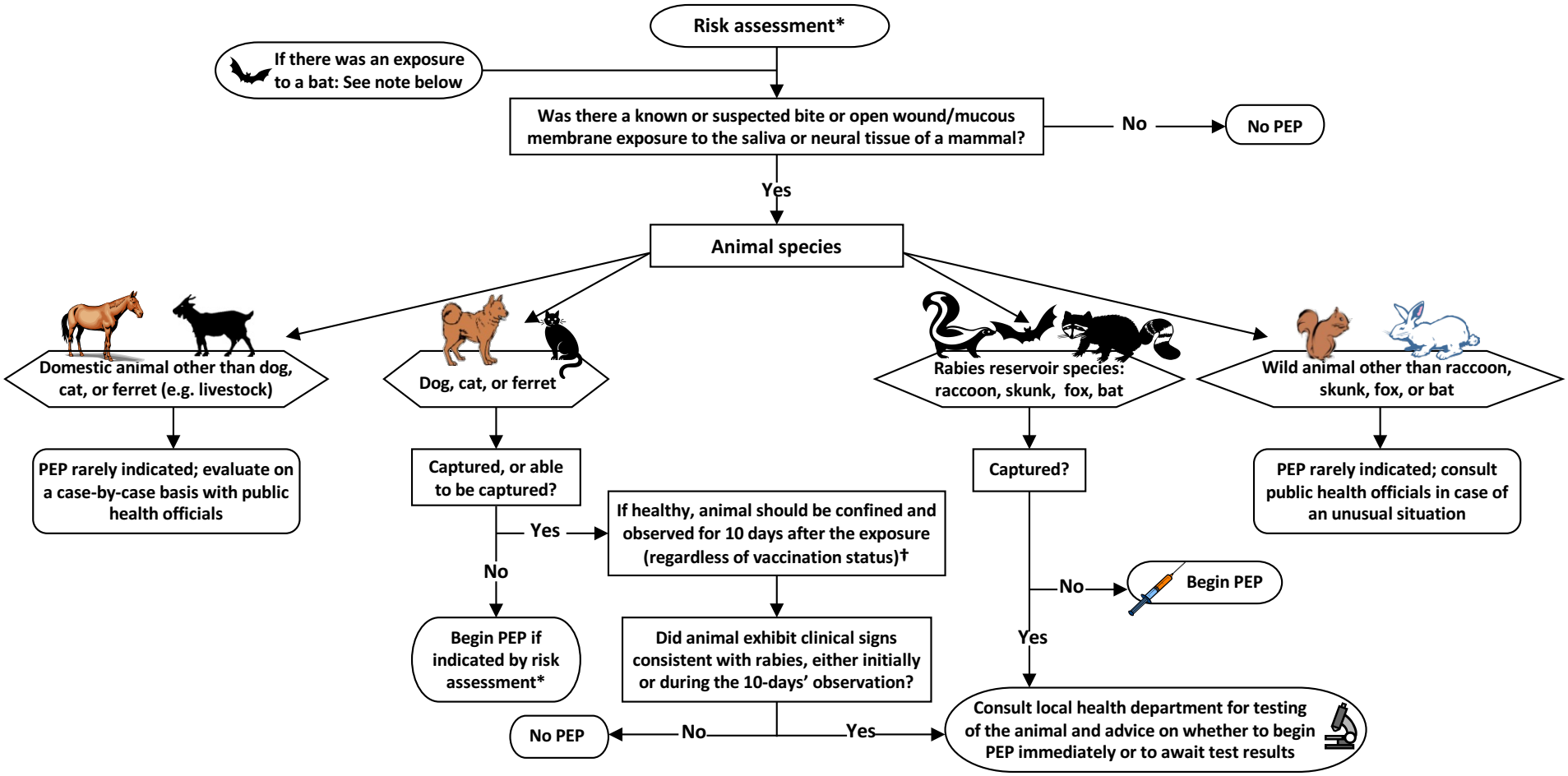
Testing or postexposure prophylaxis rarely indicated. Evaluate on a case-by-case basis in consultation with public health authorities.

**Any illness in animal during the observation period should be evaluated by a veterinarian and reported immediately to local health department.*

†*See* "Human Rabies Prevention—United States, 2008", *available at* http://www.cdc.gov/mmwr/preview/mmwrhtml/rr57e507a1.htm, *for additional details and post-exposure prophylaxis protocols for rabies-vaccinated and unvaccinated individuals.*

# Indications for Rabies Postexposure Prophylaxis (PEP)

**General guidance only, to be used in combination with public health consultation**




*Risk assessment includes the species of animal, its health/vaccination status, the circumstances of the exposure, and local rabies epidemiology. A non-bite exposure or a bite from an apparently healthy dog or cat, even if unvaccinated, is very unlikely to transmit rabies and rarely requires PEP. Possible exposure to rabies is a medical urgency, not an emergency. There is time to allow local animal control to attempt to locate the animal for observation or testing, as appropriate.

†The local health department should generally be involved in monitoring animals during the 10-day observation period; however, local animal control may perform this function in some areas.

Bat exposures: PEP is recommended for a person who has direct contact with a bat, unless the person can be certain that no bite occurred or the bat tests negative for rabies. When a bat is found indoors and there is no history of contact, the risk of exposure to rabies is typically very low. PEP can be considered for persons who were in the same room with a bat and might be unaware that direct contact had occurred (e.g. a deeply sleeping person awakens to find a bat in the room, or a bat is found in the room with an unattended child or incapacitated adult), and the bat is not available for testing. In such cases PEP is not warranted for other household members.

Public health officials are available by telephone 24 hours per day for consultation; however, health departments in Tennessee do not stock anti-rabies biologics for PEP. CDC no longer recommends a 5th dose of rabies vaccine for PEP in immunocompetent persons, although product package inserts do not reflect this change.

## Tennessee Department of Health Epidemiologist On Call: 615-741-7247

# Management of domestic animals exposed to rabies

**Exposure refers to a bite or mucous membrane exposure to saliva or brain / spinal cord from a confirmed or suspected rabid animal.**

- **If ever vaccinated (does not have to be current):**
  **Booster vaccine immediately and owner observation for 45 days***
  - *Not a quarantine or confinement period

- **If dog or cat that has never been vaccinated:**
  **Euthanasia or immediate vaccination, strict quarantine for 4 months****
  - **Reduced from 6 months in 2016 Rabies Compendium

- **Other domestic species that has never been vaccinated:**
  **Euthanasia or immediate vaccination, strict quarantine for 6 months**

# Rabies Exposure Flow Chart

## For animals exposed or suspected to have been exposed to a rabid animal

****Local or state public health authorities should be consulted immediately****

## Domestic animals (Dogs, cats, ferrets, livestock)

### VACCINATED*

**Revaccinate immediately and observe for 45 days under owner's control.**

**Any illness in the animal during the observation period should be reported immediately to the local health department**

***Either currently vaccinated or overdue for vaccination. Currently vaccinated is defined as initial dose given at least 28 days previously or boosters have been given in accordance with established guidelines.***

### UNVACCINATED

**Dog or cat: Euthanize immediately or, if the owner is unwilling, vaccinate as soon as possible and place in strict isolation for 4 months.**

**Other: Euthanize immediately or confine and observe, on a case-by-case basis, for 6 months.**

***If signs suggestive of rabies develop during the isolation period, the animal should be euthanized and tested for rabies. Contact the local health department for assistance.***

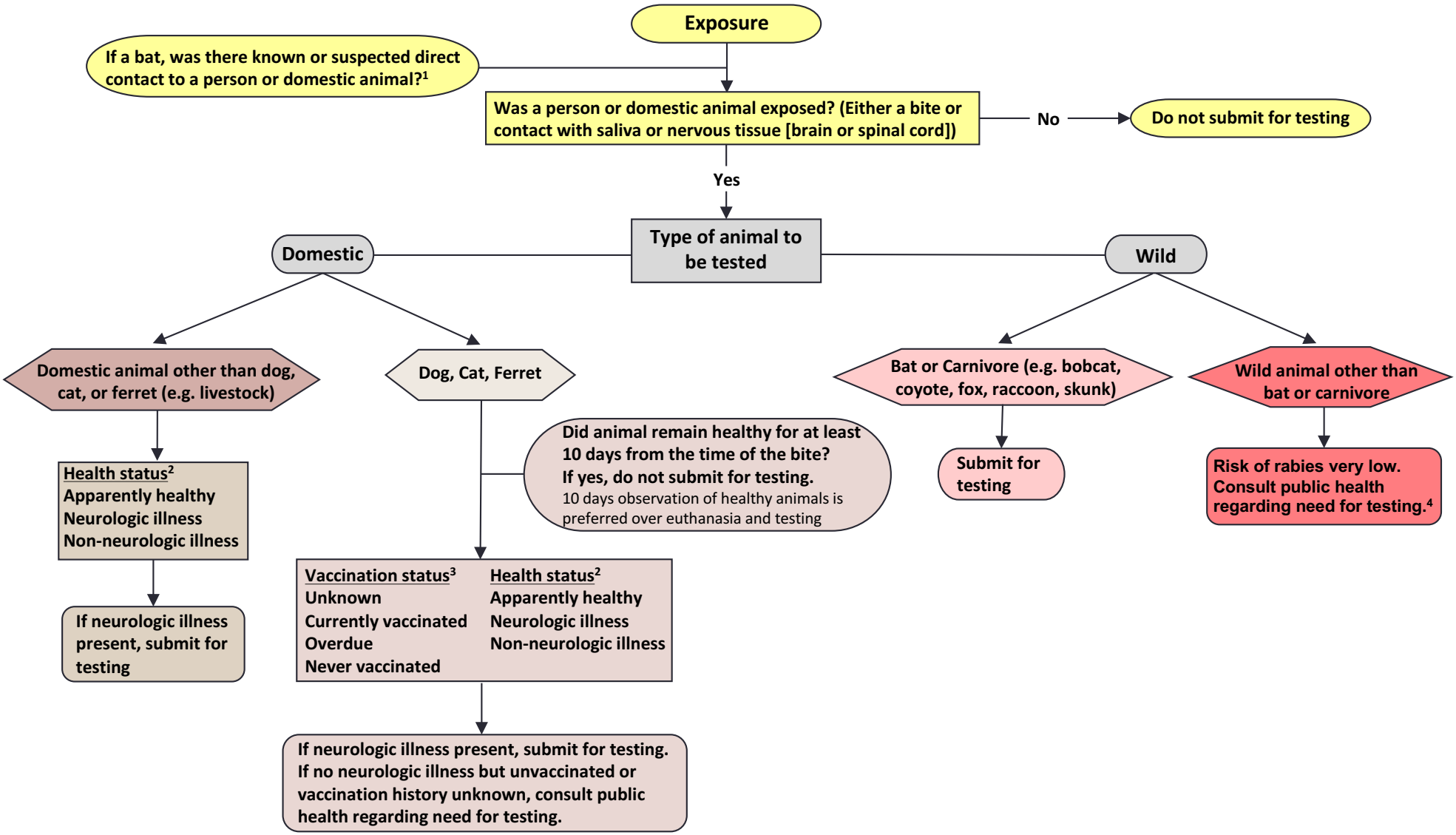
## Wild animals and hybrids (Any offspring of wild animals crossbred to domestic animals)

**If exposed to a rabid animal, it should be euthanized immediately. If the owner is unwilling, consult public health authorities.**

**No injectable rabies vaccines are licensed for use in wild animals or hybrids; however, vaccination status may be considered by public health authorities in determining disposition of animal.**

*Source:* "Compendium of Animal Rabies Prevention and Control 2016". *Available at* http://www.nasphv.org/Documents/NASPHVRabiesCompendium.pdf.

# Guidelines: Animal submission for rabies testing




[1] If a bat was in the room with a sleeping person or an unattended young child or pet, unrecognized direct contact may be suspected.

[2] If animal was healthy at the time of bite/exposure, it is very unlikely to be rabid. Neurologic illness greatly increases the likelihood of rabies.

[3] If animal has ever received at least 2 rabies vaccines, it is very unlikely to be rabid.

[4] Small rodents (e.g. squirrels, chipmunks, mice, hamsters, rats) are not considered a risk for rabies transmission and generally will not be tested.

**Tennessee Department of Health: 615-741-7247**

# Conclusions

- Rabies is rare but fatal, there is time to assess
- Rabies in Tennessee from skunks and spillover from skunks, raccoon rabies is a risk
- Animal submissions do not reflect epidemiology of rabies in Tennessee, testing is a valuable resource
- Partnership and communication among stakeholders is key


https://tn.gov/assets/entities/health/attachments/RabiesManual2016.pdf

# Questions?

# Raccoon Rabies in Tennessee

# Why problematic?

- Raccoons thrive in suburban settings
- Aggressive and swift
  - Increase in dog and cat (2X) rabies
  - Increase in other rabid species
- Increase in human exposures
  - Need for PEP risk assessment
- Increased animal control calls & anxiety


N72L

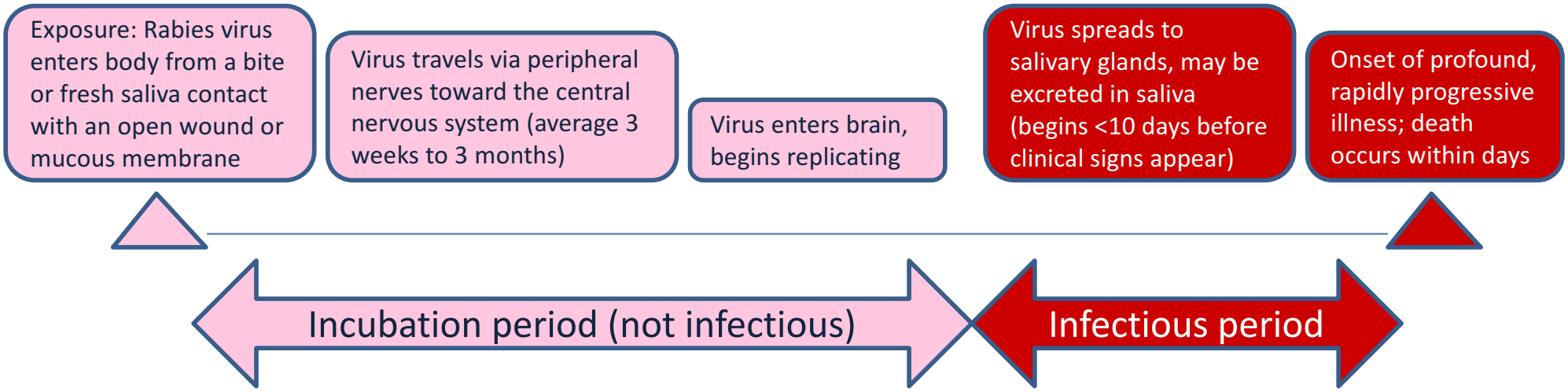
# Tennessee response

- Education
  - Reduce risk
  - Protect pets through vaccination
  - Control translocation
- Increase surveillance
  - USDA-Wildlife Services
- Help prevent spread
  - Oral rabies vaccination (ORV) campaign

# How long should an animal be confined and observed?

**10 days***: If the animal has bitten a person or other domestic animal. Strict confinement is not necessary. If the animal remains healthy for 10 days after a bite, rabies cannot have been transmitted at the time of the bite, regardless of the animal's vaccination status.

**4 months**: If a dog or cat is unvaccinated and has been bitten by a confirmed or suspected rabid animal, and the owner refuses euthanasia. Strict confinement is necessary. Public health officials should be consulted. Other species may be confined for 6 months.




*Applies ONLY to dogs, cats, and ferrets. Viral shedding periods are not established for any other species.