

# *Baylisascaris* and you

A study of exposure and risk factors in wildlife rehabilitators

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Southeastern Cooperative Wildlife Disease Study

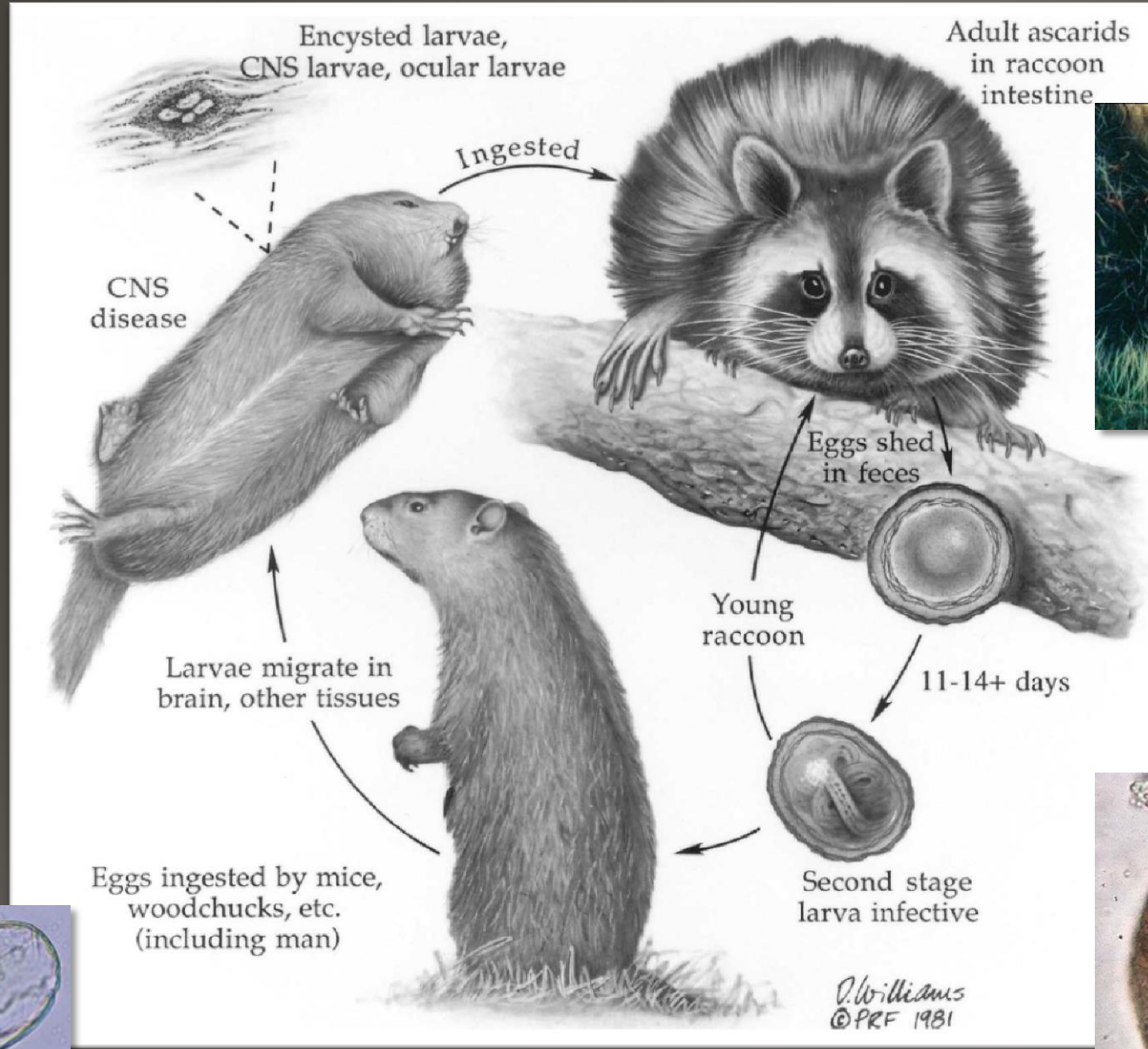
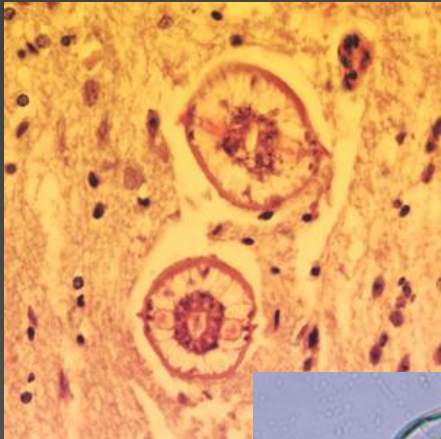
University of Georgia

1. Background on *Baylisascaris procyonis*
2. Our study
3. Results thus far
4. Future directions
5. How to participate

# *Baylisascaris procyonis*

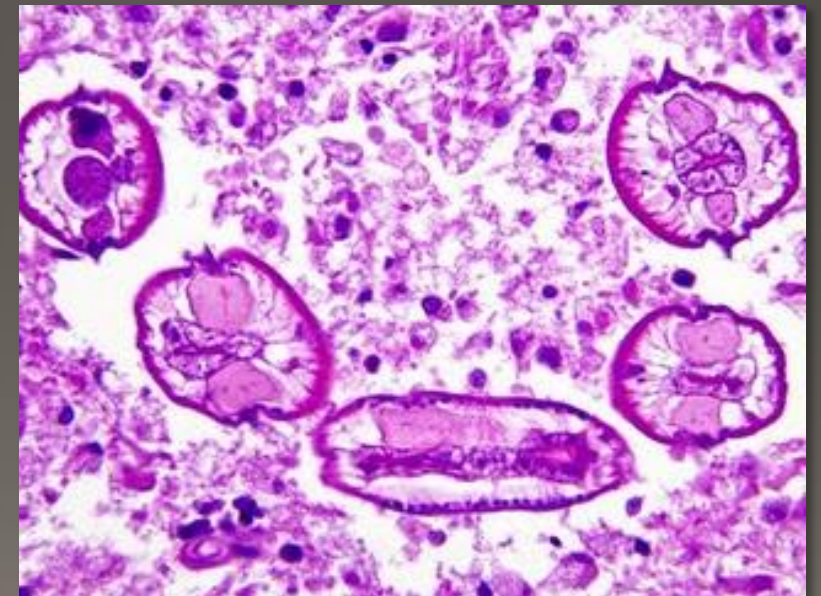
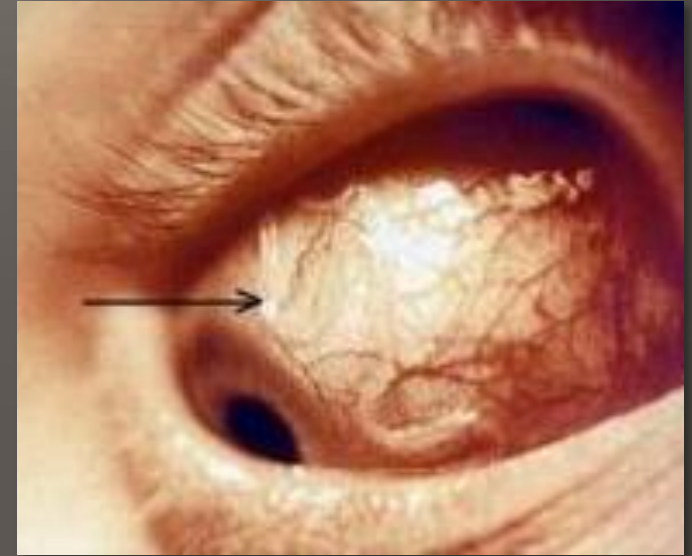
- Raccoon roundworm
- Raccoon (*Procyon lotor*) definitive host
- Broad intermediate host range
  - 135 species of mammals and birds
- Considered an emerging zoonotic disease
  - Human, Veterinary, and Wildlife





# Human Baylisascariasis

- Reported ~30 times in medical literature
- Visceral Larva Migrans (VLM)
  - Migration through organs of host (Lung, Liver, etc)
- Neural Larva Migrans (NLM)
  - Invasion of brain and spinal cord
  - Eosinophilic meningitis
  - Treatment usually ineffective
- Ocular Larva Migrans (OLM)
  - Invasion of eye tissues
  - Can lead to blindness



# Human Baylisascariasis

- Major risk factors: Male, pica, <18 mos old, high prevalence within state
- Neurologic complications or death in >50% of cases
  - Only one full recovery
- Likely directly ingested raccoon feces
  - 16,000-26,000 eggs/gram feces
  - What happens if smaller dose ingested?



TABLE 1. Summary of published cases of human *Baylisascaris procyonis* neural larva migrans

| Yr <sup>a</sup> | Age <sup>b</sup> | Location     | Risk factor(s)                      | Treatment  | Outcome(s)   |
|-----------------|------------------|--------------|-------------------------------------|--|--|
| 1980            | 10 mo            | Pennsylvania | Pica                                | None   | Died   |
| 1984            | 18 mo            | Illinois     | Down syndrome and pica              | Thiabendazole                                    | Died   |
| 1986            | 21 yr            | Oregon       | Developmental delay, pica/geophagia | Not recorded                                     | Persistent residual deficits                               |
| 1990            | 13 mo            | New York     | Pica                                | Thiabendazole, ivermectin, and prednisone        | Severe residual deficits and cortical blindness            |
| 1993            | 9 mo             | Michigan     | Pica                                | Not recorded                                     | Severe residual deficits and cortical blindness            |
| 1993            | 13 mo            | California   | Pica/geophagia                      | Solumedrol and prednisolone                      | Severe residual deficits, visual impairment, and epilepsy  |
| 1996            | 6 yr             | Illinois     | Developmental delay, pica/geophagia | Albendazole and prednisone                       | Severe residual deficits and epilepsy                      |
| 1996            | 13 mo            | Minnesota    | Unknown                             | Methylprednisolone, vincristine, and thioguanine | Died   |
| 1997            | 19 mo            | Minnesota    | Klinefelter syndrome                | Prednisone, vincristine, and thioguanine         | Died   |
| 1998            | 11 mo            | California   | Pica                                | Albendazole and methylprednisolone               | Severe residual deficits, visual impairment and epilepsy   |
| 2000            | 17 yr            | California   | Developmental delay and geophagia   | Albendazole and anti-inflammatories              | Died   |
| 2000            | 2.5 yr           | Illinois     | Pica/geophagia                      | Albendazole and solumedrol                       | Severe residual deficits and visual impairment             |
| 2002            | 11 mo            | California   | Pica/geophagia                      | Albendazole and antiinflammatories               | Severe residual deficits, cortical blindness, and epilepsy |

<sup>a</sup> Year patient first presented.  
<sup>b</sup> All patients were male.

# As a zoonosis

- As rare as we think?
- Canine Roundworm (*Toxocara canis*)
  - Closely related species causing VLM and OLM in humans and others
  - 14% seroprevalence in USA
- Asymptomatic or milder clinical presentations possible
- Dose-related?
  - Many thousands or millions of eggs versus low numbers
- Reliable serologic testing only recently developed



# Epidemiological approach

- Study population: wildlife rehabbers
  - A good candidate for an “at risk” population

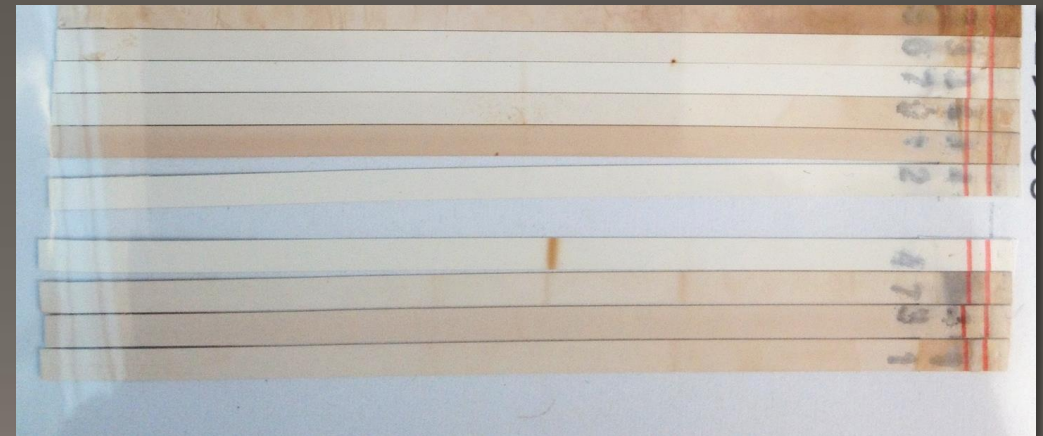
## Study Questions:

- What is the prevalence in this at-risk population?
- What are the risk factors associated with exposure?
- Other patterns?



# Study Design

- Enroll wildlife rehabilitators
  - With and without raccoon contact
- Administer a questionnaire to assess risk factors
  - Location (low, medium, or high risk)
  - Rehab history and practices
    - Raccoon specific contact and practices
  - PPE Use
  - Deworming
- Test a serum sample
  - Antibodies to *B. procyonis*
  - Immunoblot protocol - CDC
  - 2% false positive rate



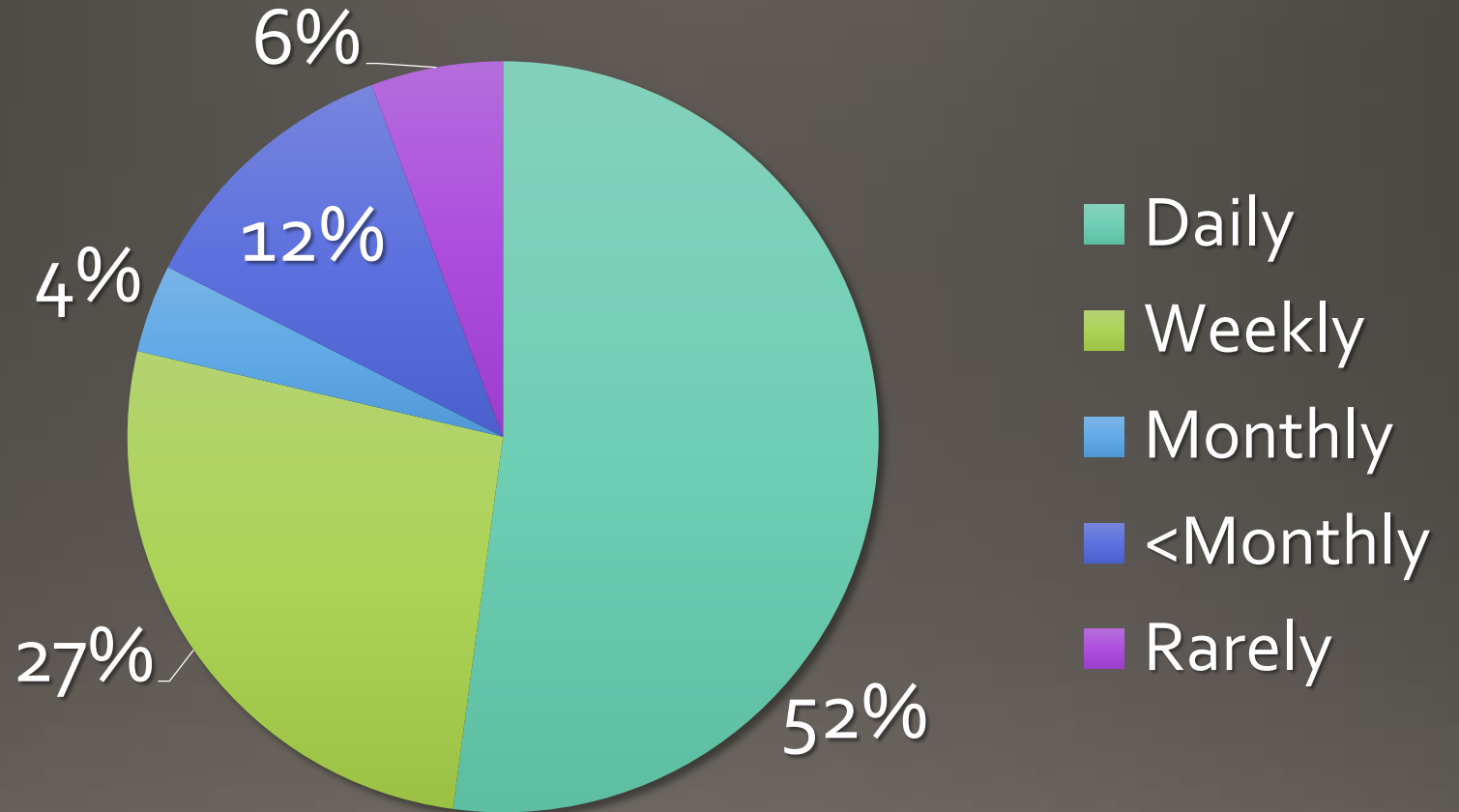


# Wildlife rehab

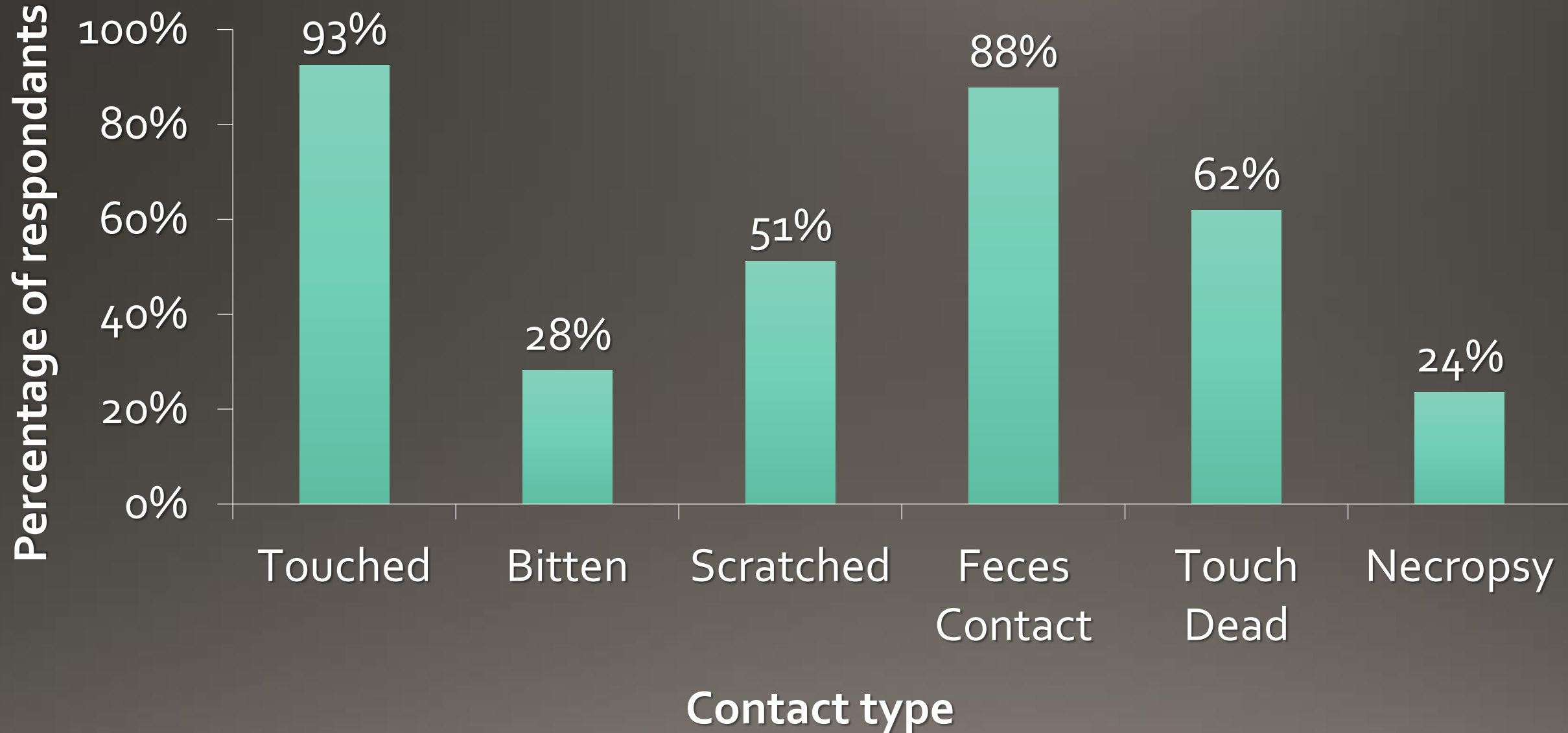
- 69% of participants reported active raccoon rehab in past year
  - 48% have ever rehabilitated raccoons
- 67% reported some kind of non-rehab contact with raccoons in past year
- Median time in rehabbing activities: 6 years (average 9.9 years)
- Average of 14 adults, 35 juveniles, and 26 neonates per rehabber per year



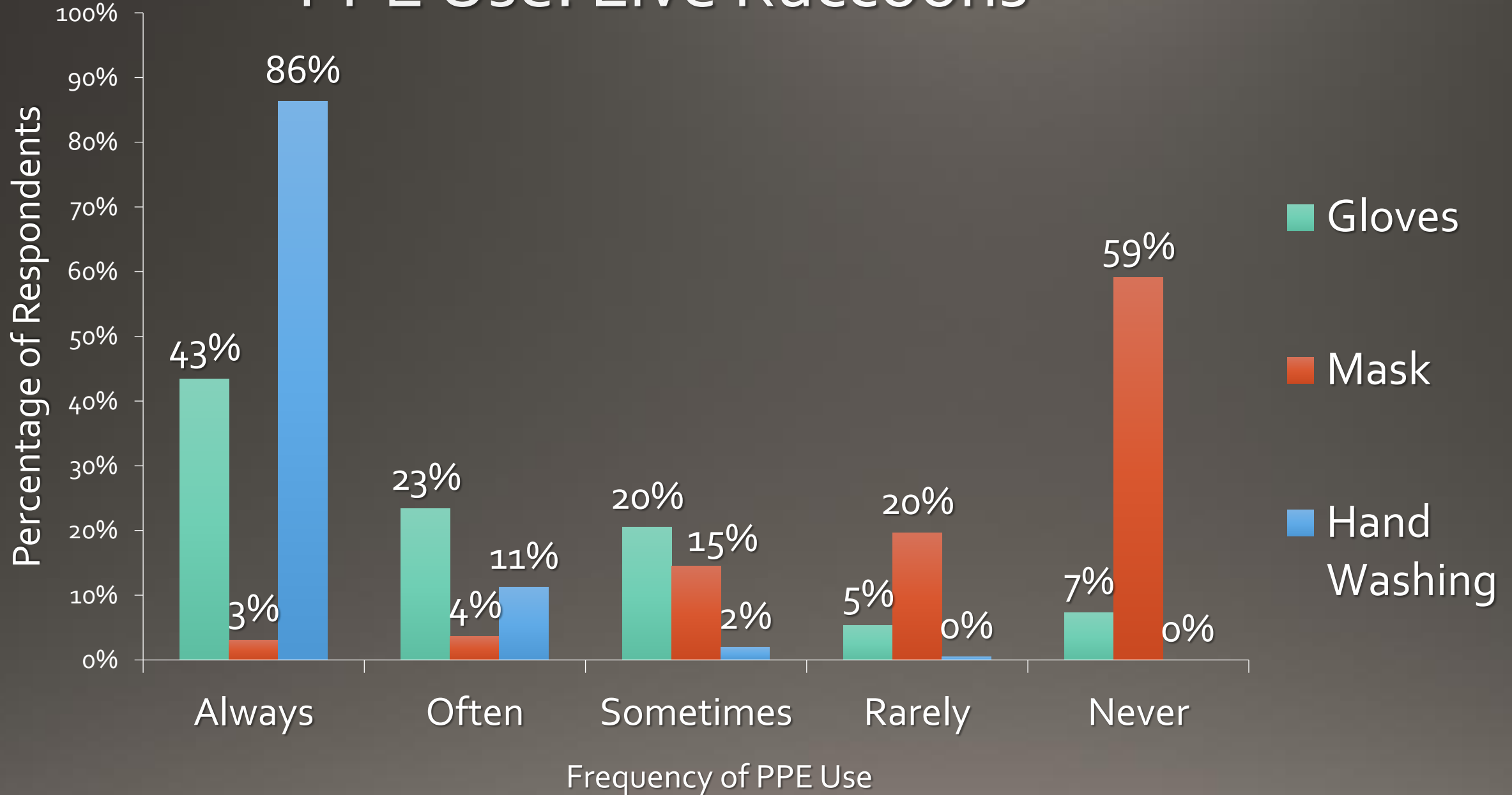
# Raccoon Contact Frequency



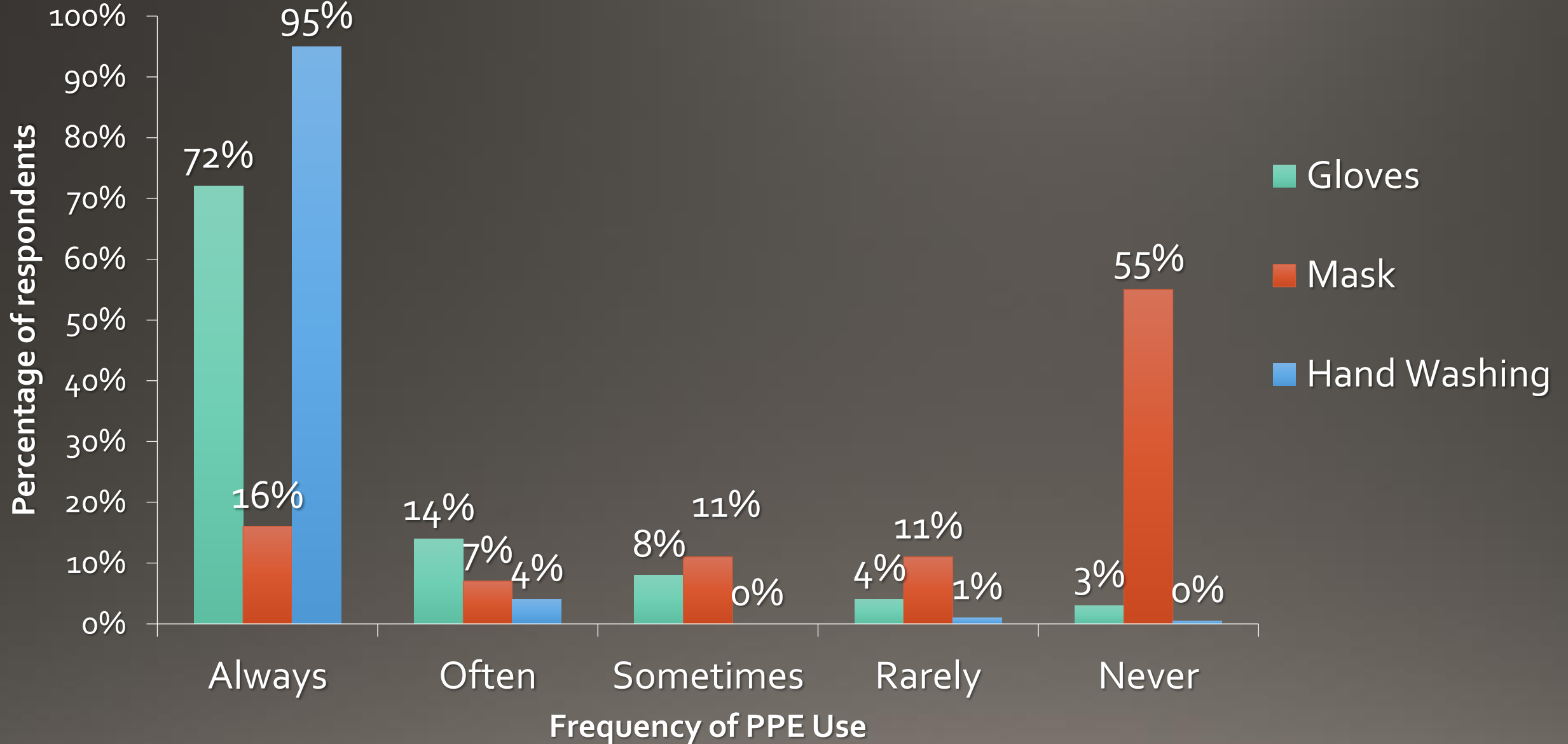
# Nature of contact



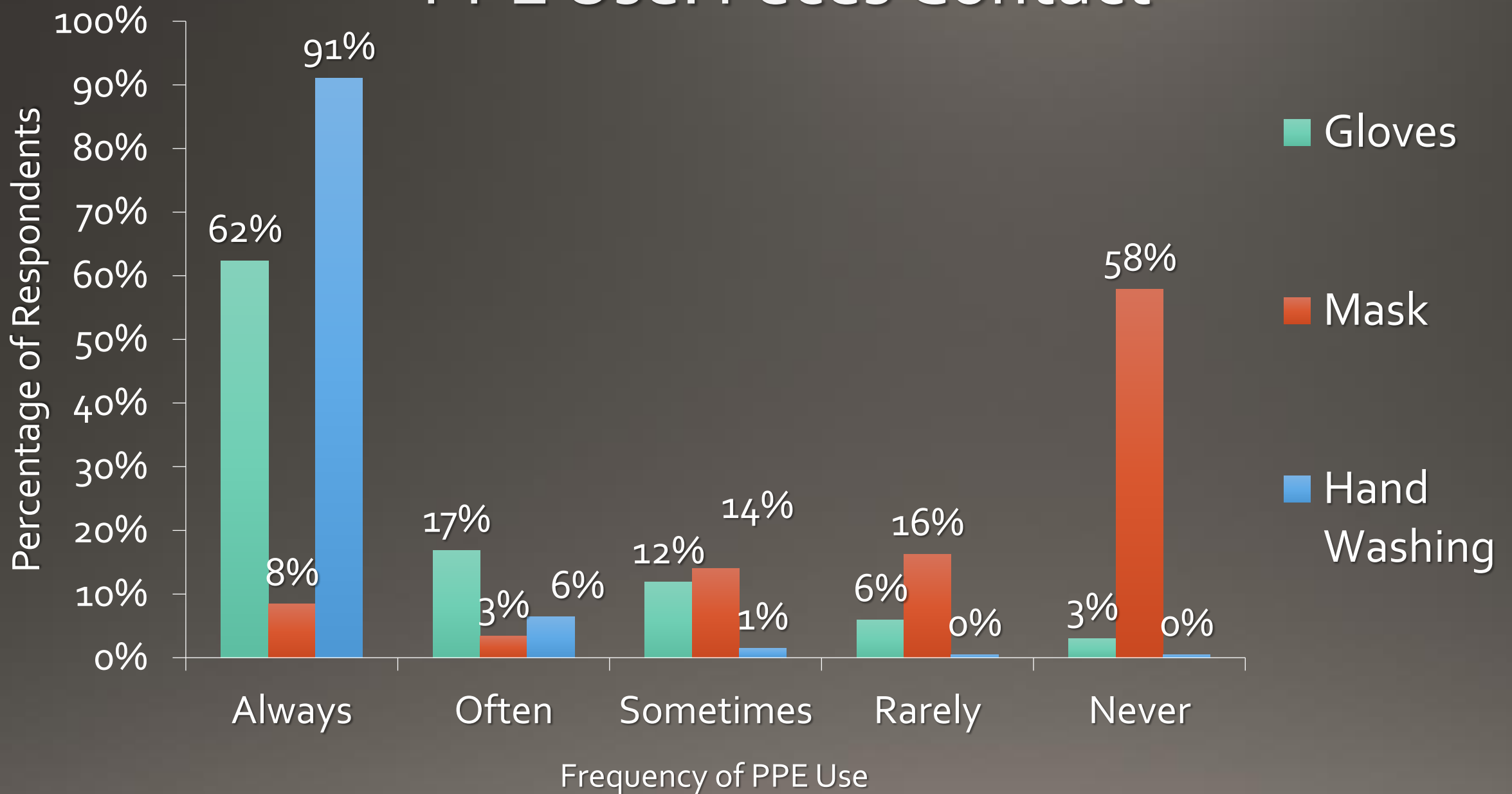
# PPE Use: Live Raccoons



# PPE Use: Dead Raccoons



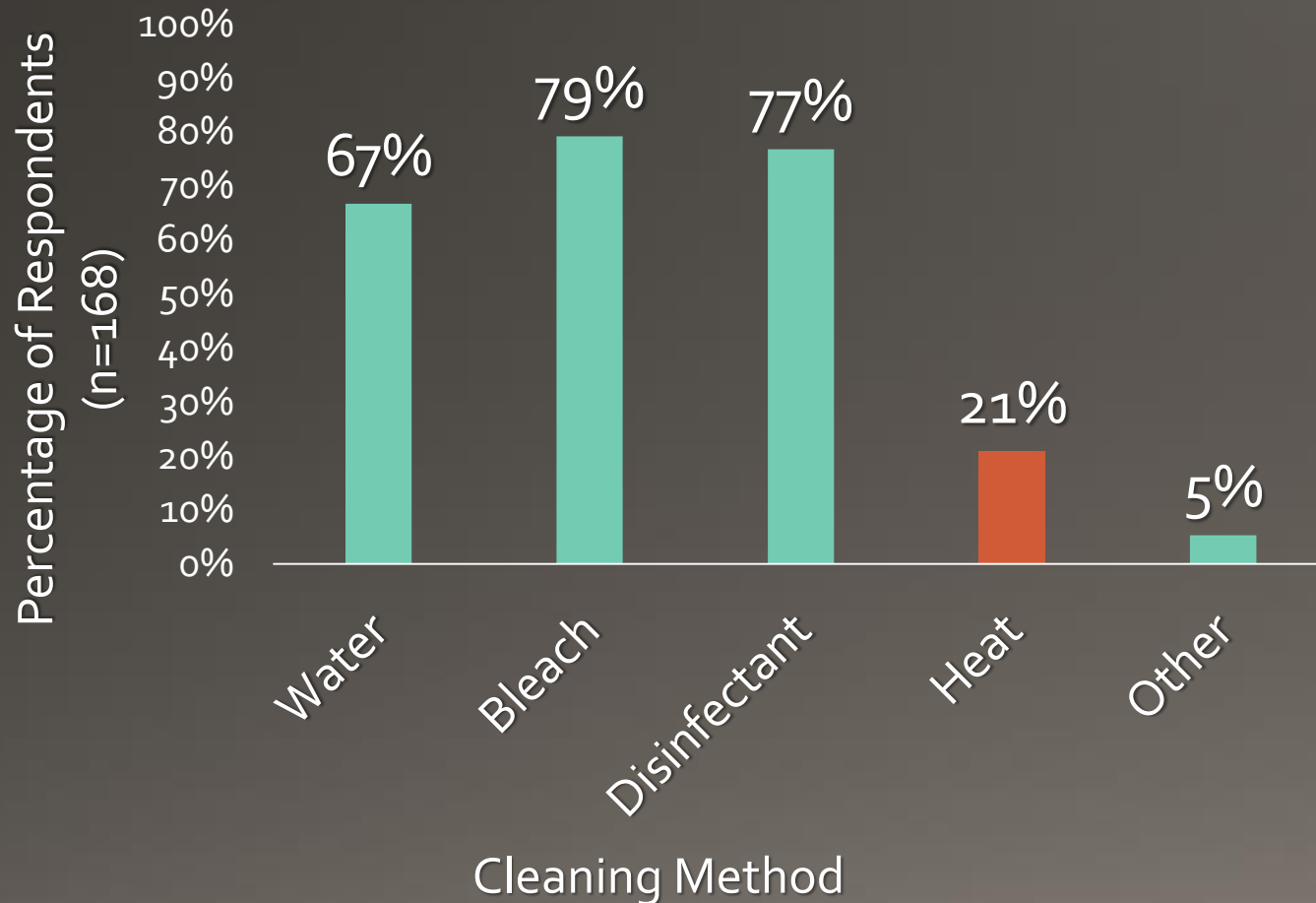
# PPE Use: Feces Contact





# Rehab practices

## Enclosure Cleaning



## Enclosure Materials

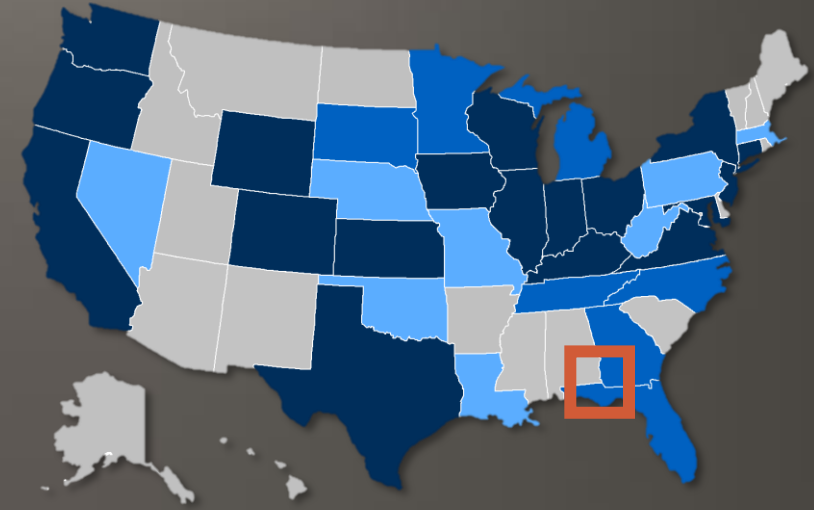
- 32% report using plastic or wood containing enclosures

## Deworming

- 88% deworm regularly with an anthelmintic (ivermectin, pyrantel, etc.)
- 11% deworm semi-regularly or as-needed

# Serologic Results

- 19 of 273 (7%) participants tested positive for antibodies to *B. procyonis*
  - 68% reported active raccoon rehabilitation in the past year
- 14 (74%) from “high-risk” states/provinces
  - BC, CA, IL, IN, KY, NJ, NY, VA, WA, WI
- 4 (21%) from “moderate-risk” states
  - FL, GA, TN
- 1 (5%) from unknown/no risk state
  - AL
  - However, prevalence in a neighboring FL county is 50%



# Findings

- 4/19 (21%) reported diagnosed *B. procyonis* infections in rehabilitated raccoons
- 26% reported washing hands less than “always” after handling feces
  - Compare to 7% overall
- Glove use was similar to sero-negative group

# What if you're positive?

- **Don't panic!**
- Positive test result = antibodies to *B. procyonis*
  - NOT necessarily active infection (and probably not)
- 2% false positive rate
- CDC does not recommend any specific action

# Prevention

- Wear gloves, wash hands!
- De-worm appropriately
- Sterilize enclosures often and with heat
- Minimize the presence of wild raccoons around homes



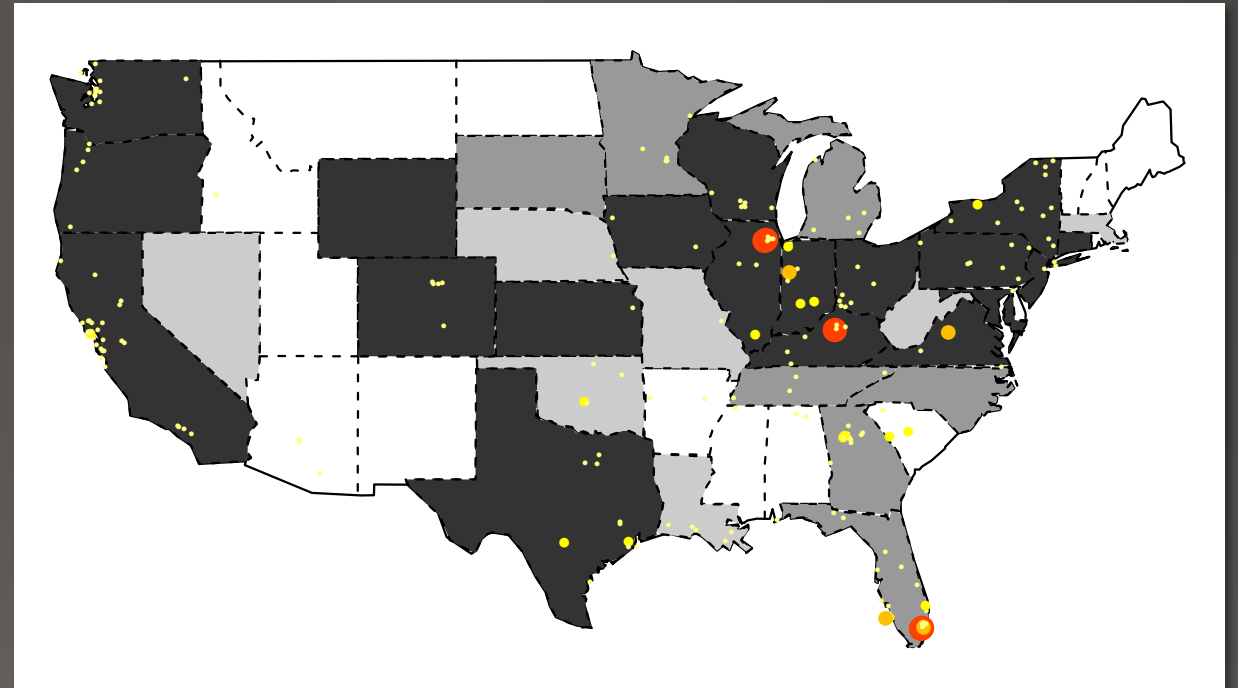
# Future Directions

- Continuation of human sero-survey
- Mouse studies to better understand antibody response in mammals
- Role of domestic dogs as *B. procyonis* hosts
- **Assessment of knowledge base and educational needs of the wildlife rehab community**



# Participation: Knowledge Survey

- Participation is very much appreciated!
- Raccoon rehabbers AND those who do not rehab raccoons
  - We really need non-raccoon rehabbers!
- Please make a note on the survey that you attended this talk
- Pick up in Board Room



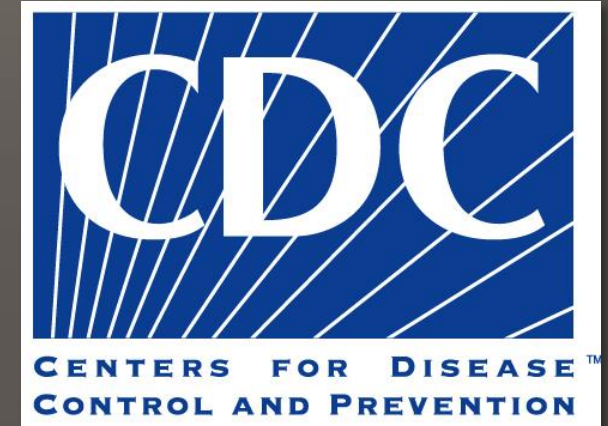
# Participation: Sero-survey

- What we need:
  - Consent form
  - Questionnaire
  - Blood sample
- Thursday: 1 – 3 PM
- Friday: 11 AM – 1 PM; 2 PM – 5 PM
- Saturday: 10 AM – 2 PM
- Board Room 1 on Mezzanine floor



# Acknowledgements

- Special thanks to...
  - CDC Parasitic Diseases Branch
  - SCWDS
  - IWRC, NWRA, FWRA, Wildlife Center of Virginia
  - You all!



# Questions?

