- 6,381 rabies cases (incl. 1 human in MO)
- 92% of rabies cases in wildlife
- Up to 40,000 people exposed each year
- >$300 million annually

- Potential host shift event

Why Manage Rabies?
- Protect Human Health
- Protect Animal Health/Food Supply
- Protect Biodiversity/Rare Species
- Economics

Economics of Raccoon Rabies Management
- Negative impacts of raccoon rabies spread...
- By 2035, raccoon variant rabies would be...
- ~ $1.1 billion negative economic impact
- ~ $55 million/year
- >20 million livestock at risk

Wildlife Rabies Management
- "A worldwide strategy that promotes interdisciplinary collaboration recognizing that human and animal health, including wildlife, are inextricably linked."

NRMP Goals and Components
- I. Prevent the spread of specific terrestrial rabies variants in the United States
- II. Eliminate specific rabies variants at the local, regional, and national level

ORV Bait Distribution in the U.S.
- >166 million baits

Federal Funding Sources for WS NRMP
- Appropriated Funds
- Emergency Funds
- Sequestration

* Beginning in 2013, oral rabies vaccination zone targets expanded to 16 states
* Sequestration cut of $862,000
FY 2015 ORV Operations

- Baits Distributed: 10,616,424
- Distance Flown: 364,618 km
- Area baited: 192,421 km²
- Hours of Flight: 1,443

Across 15 States

ORV Distribution in the U.S. (FY 2015)

Management with RABORAL V-RG® ORV

- RABORAL V-RG® is the only licensed ORV in the U.S.
- >160 million V-RG baits distributed in U.S. since 1992
- Coordinated ORV with V-RG has resulted in 3 major accomplishments in the U.S.
  1. No canine rabies in U.S. since 2004, declared free in 2007
  2. One gray fox rabies case in Texas since May 2009
  3. No appreciable spread of raccoon rabies west

Rabies Management Accomplishments (1997-2014)

- No canine rabies in U.S. since 2004, declared free in 2007
- One gray fox rabies case in Texas since May 2009
- No appreciable spread of raccoon rabies west

Strategies for Raccoon Rabies Elimination

Raccoon Response to V-RG (1997-2012)

- Grand National Mean = 30.0%

First ONRAB Field Trial: 2011 West Virginia


J Wildl Dis, 50:582-595.

2011-2015 ONRAB Field Trial Summary

- 2011-2013 West Virginia: Concluded
- 2012-2014 NY/VT/NH: Concluded
- 2012-2014 Ohio: Concluded
- 2013-2015 NY – St. Lawrence: Final year
- 2013-2015 NY – Niagara Frontier: Cornell; Final year?
- 2014-2016 West Virginia (skunks)
- Very high density and close flight lines
- Low bait density and low raccoon density
- 2015-2017 Vermont – Burlington
- Urban, high bait density, high raccoon density

2011-2013 WV ONRAB Trial Summary

Wadsworth ≥0.0625 IU/ml represents RVNA positive

75 baits/km² – Rural

2011-2013 WV ONRAB Trial Summary

% RVNA in Raccoon Sera

75 baits/km² – Rural
### 2012-2014 NY/VT/NH ONRAB Trial Summary

- **% RVNA in Raccoon Sera**
- **75 baits/km² – Rural**
- **Pre-ONRAB**
- **Post-ONRAB**

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-ONRAB</th>
<th>Post-ONRAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>27</td>
<td>66</td>
</tr>
<tr>
<td>2013</td>
<td>61</td>
<td>65</td>
</tr>
<tr>
<td>2014</td>
<td>71</td>
<td>72</td>
</tr>
</tbody>
</table>

### 2012-2014 Ohio ONRAB Trial Summary

- **% RVNA in Raccoon Sera**
- **150 baits/km² – Suburban**
- **Pre-ONRAB**
- **Post-ONRAB**

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-ONRAB</th>
<th>Post-ONRAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>43</td>
<td>36</td>
</tr>
<tr>
<td>2013</td>
<td>46</td>
<td>29</td>
</tr>
<tr>
<td>2014</td>
<td>50</td>
<td>38</td>
</tr>
</tbody>
</table>

### 2013-2014 NY STLAW ONRAB Trial Summary

- **% RVNA in Raccoon Sera**
- **75 baits/km² – Rural**
- **Pre-ONRAB**
- **Post-ONRAB**

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-ONRAB</th>
<th>Post-ONRAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>42</td>
<td>53</td>
</tr>
<tr>
<td>2014</td>
<td>70</td>
<td>60</td>
</tr>
</tbody>
</table>

### West Virginia ONRAB Field Trial: Background
- 75 ONRABs/km² and 750 m flight line spacing for 2011-2013
- No raccoon rabies case since 2012
- Skunk rabies cases persisted

### 2014 ONRAB Field Trial West Virginia - Skunks

- 3 buffered ONRAB cells (127 km² each)
- Targeting skunks
- 150 traps/cell
- Sampling Pre and Post-ORV for 10 consecutive days
- Study areas – fixed-wing except villages (ground)
- 250 m flight line spacing at 300 baits/km²
- ONRAB: 418,500 baits
- Skunk telemetry

### 2014 ONRAB West Virginia Skunk Telemetry

- Calculated overall and core home ranges before and after ONRAB
- Estimated potential bait locations using georeferenced flight lines

### ONRAB Transects Relative to Skunk Home Ranges

- **75 baits & 750 m**
- **300 baits & 250 m**

### 2014 WV ONRAB Results

- % RVNA in Raccoon and Skunk Sera
- **300 baits/km² – Rural**

<table>
<thead>
<tr>
<th>Year</th>
<th>Raccoons</th>
<th>Skunks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-Raccoons</td>
<td>59</td>
<td>83</td>
</tr>
<tr>
<td>2014-Skunks</td>
<td>17</td>
<td>47</td>
</tr>
</tbody>
</table>

### 2015 Northeastern VT ONRAB Trial

- 37.5 ONRAB baits/km²
- Standard flight lines (750 m)
- Rural coniferous forest
- 2-3 raccoons/km²
- Can bait still RVNA?
High Density ORV Baiting with RABORAL V-RG®

Objectives:
- Determine RVNAs in ORV naïve area
- Determine RVNAs after initial baiting of 150 baits/km² over ORV naïve area
- Determine if RVNAs are higher in 150 zone compared to historic 75 zone
- Determine effect of 150 baits/km² on RVNA levels over time (3-yr study)

2014 VA RABORAL V-RG® Study Area

2014 VA RABORAL V-RG® Study Results


Enhanced Surveillance: Sampling Emphasis
- No human or pet exposure history
- Strange behaving animals
- Animals with suspect lesions
- Animals removed – “hot rabies focus”
- Road kills/other dead animals
- Nuisance control or hunter harvested
- Proximity to ORV zones

Program Metrics: Sampling (2005-2014)

Serology
Virus Neutralizing Antibodies
(blood samples) Avg. >5,700

Surveillance
Virus Antigen Detection
(brainstem samples) Avg. >7,200

2015 ONRAB Sera

* Other includes: gray and red foxes, coyotes and fishers.

<table>
<thead>
<tr>
<th>Year</th>
<th>Rabies Surveillance Samples Tested</th>
<th>dRIT Tested</th>
<th>Rabid by dRIT</th>
<th>Percent Rabid by dRIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>3,788</td>
<td>2,848</td>
<td>59</td>
<td>2.1%</td>
</tr>
<tr>
<td>2006</td>
<td>6,930</td>
<td>6,072</td>
<td>109</td>
<td>1.8%</td>
</tr>
<tr>
<td>2007</td>
<td>10,999</td>
<td>8,790</td>
<td>153</td>
<td>1.8%</td>
</tr>
<tr>
<td>2008</td>
<td>12,736</td>
<td>10,131</td>
<td>160</td>
<td>1.5%</td>
</tr>
<tr>
<td>2009</td>
<td>9,212</td>
<td>7,944</td>
<td>101</td>
<td>2.0%</td>
</tr>
<tr>
<td>2010</td>
<td>11,062</td>
<td>9,046</td>
<td>143</td>
<td>1.6%</td>
</tr>
<tr>
<td>2011</td>
<td>7,769</td>
<td>6,045</td>
<td>117</td>
<td>1.8%</td>
</tr>
<tr>
<td>2012</td>
<td>5,738</td>
<td>4,643</td>
<td>103</td>
<td>2.2%</td>
</tr>
<tr>
<td>2013</td>
<td>5,013</td>
<td>3,928</td>
<td>90</td>
<td>2.3%</td>
</tr>
<tr>
<td>Total</td>
<td>86,395</td>
<td>71,886</td>
<td>1,337</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

dRIT samples comprise 6-8% of all annual submissions.

dFA from CDC’s Rabies surveillance in the United States (2006-2013)

dRIT Contribution to Rabies Surveillance

2015 ERS Initiative: Why Change Now?

- Need to increase surveillance in all states
- State WS programs approach and effort variable
- Program metrics under scrutiny
- Re-energize, refocus and provide BMPs to WS State programs
- Pilot Projects (ME, OH, WV, AL)

MABs Shortage…. Problem Solved?

- Cooperative Agreement with The Wistar Institute
- Provided 50 bottles of MABs to WS
- Held 2 dRIT trainings in Philadelphia
- 9 WS staff attended
- WS continues dRIT confirmation at CDC and Wistar

Renewed Focus and Intensified ERS

2015 Maine Surveillance Pilot Project

- Focus Map
- Network Effort
- Accessibility
- Mailing Package
- Maine Rabies Listserv
- Office Personnel:
  - Designated Phone #
  - Flow Chart/Employee Availability
- Google Earth (.KMZ)
- GPS Track Logs

Communication!

Network Comparison in Maine

Alabama Contingency Action 2014
**North American Rabies Management Plan: Update**

- **Chair:** Kathy Nelson, WS NRMP
- **International Committee Formed**
- **Canada Revising National Plan**
- **Proposed Action Plan at NARMP Meeting at RITA 26**

**Build on Successful DELPHI Process in 2016**

- **Define landscape level strategies for elimination**
- **BioCon model to estimate the costs associated with raccoon rabies elimination scenarios**

**Raccoon Rabies Elimination: Urban Challenges**

- **Raccoon and skunk ecology?**
- **Baiting strategies?**

**Where Are We Going?**

- Maintain U.S. Canine Variant Rabies Free
- Focus on Raccoon Rabies Elimination
- Eliminate Texas Gray Fox Variant
- Mongoose Rabies Control in the Caribbean
- Explore Options for Skunks

**Summary of the “State of the State”**

- **25 Years of program success, outlook remains good**
- **Methods work, but measured risk required**
- **Metrics and monitoring drive program**
- **Science-based; expectations management required**
- **Knowledge gaps**
  - Oral rabies vaccine and baiting strategies
  - Complexities of urban habitats
- **Applied research ongoing and key to success**
- **Focus on enhanced surveillance and raccoon rabies elimination**

---


<table>
<thead>
<tr>
<th>Year</th>
<th>Rabid</th>
<th># Baits</th>
<th>Baits/km²</th>
<th>% RVNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>12</td>
<td>143,786</td>
<td>75 6</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>17</td>
<td>194,388</td>
<td>75 14</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>23</td>
<td>193,774</td>
<td>75 26</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>28</td>
<td>199,440</td>
<td>75 44</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>10</td>
<td>191,000</td>
<td>125/175 9</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>25</td>
<td>230,733</td>
<td>150 16</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>35</td>
<td>230,319</td>
<td>150 ---</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>16</td>
<td>230,377</td>
<td>150 ---</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>21</td>
<td>228,516</td>
<td>150 Pending</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>11</td>
<td>228,998</td>
<td>150 Pending</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>215</td>
<td>2,187,458</td>
<td>75-175 Avg 20%</td>
<td></td>
</tr>
</tbody>
</table>

**New Vision: “Raccoon Rabies Free by 2043”**