Topics for Wildlife Rabies Management

- Background
- Raccoon Rabies Management
- Vampire Bat Surveillance
- Mongoose on Puerto Rico
- Next Steps?
Goal of Managing Rabies at its Source
Canine Rabies Overshadows Wildlife Rabies

Canine Rabies has Greater Impact on Public Health
.....But Wildlife Impacts Remain
Positive Rabies Cases in U.S

5,500-6,500 Rabid Animals Reports Annually

“Living in a sea of rabies”

2015:
- CDC
- 5,508: animal rabies
- 5,088 : wildlife (92.4%)

[Source B. Monroe CDC/RITA 2016]
Management at: Human-Domestic Animal-Wildlife Interface
Current Management and Research Focus

“Managing Rabies at the Source in U.S.”

Focus of Terrestrial Rabies Management

- Raccoons
- Skunks
- Coyotes
- Gray Fox
- Red Fox
- Arctic Fox
- Opossum
- Mongoose
- Vampire bats
- (Feral Dogs)

REDIPRA 16 – Nov. 2017
Big Ideas, Big Goals

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

National Wildlife Rabies Management Goals
Operational Wildlife Rabies Management Since 1995

Cooperative and Coordinated
Key Program Components

- Coordination & Collaborative Planning
- Oral Rabies Vaccination
- Contingency Actions
- Applied Research
- Enhanced Surveillance
- Public Health Surveillance
- Program Monitoring

Artemis Technologies Inc.

**ONRAB**
*(experiment use)*
Recombinant – Human adenovirus Type 5

Merial RABORAL V-RG®
Fish Meal Polymer (FMP)

Merial RABORAL V-RG®
Coated Sachet (CS)
Recombinant - Vaccinia
<table>
<thead>
<tr>
<th>Enzootic Rabies</th>
<th>ORV Zone</th>
<th>Rabies Free</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Rabid Raccoons" /></td>
<td><img src="image2.png" alt="Vaccinated Raccoons" /></td>
<td><img src="image3.png" alt="Susceptible Raccoons" /></td>
</tr>
</tbody>
</table>

- **rabid**
- **vaccinated**
- **susceptible**
US ORV Distribution by Species Since 1992

>177 million total vaccine – baits distributed

>168 million V-RG vaccine- baits

Year

ORV Baits Distributed (Millions)

Raccoon  Coyote  Gray fox  Skunk

REDIPRA 16 – Nov. 2017
ORV Distribution by Method

<table>
<thead>
<tr>
<th>Bait Totals by Method</th>
<th>FY2015</th>
<th>% Total</th>
<th>FY2016</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIXED WING</td>
<td>9,504,050</td>
<td>89</td>
<td>9,622,725</td>
<td>87</td>
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<tr>
<td>HELICOPTER</td>
<td>556,144</td>
<td>5</td>
<td>777,257</td>
<td>7</td>
</tr>
<tr>
<td>GROUND</td>
<td>524,033</td>
<td>5</td>
<td>545,383</td>
<td>5</td>
</tr>
<tr>
<td>BAIT STATION</td>
<td>101,720</td>
<td>1</td>
<td>96,490</td>
<td>1</td>
</tr>
</tbody>
</table>

- FY 2015: FIXED WING = 9,504,050, HELICOPTER = 556,144, GROUND = 524,033, BAIT STATION = 101,720
- FY 2016: FIXED WING = 9,622,725, HELICOPTER = 777,257, GROUND = 545,383, BAIT STATION = 96,490

REDIPRA 16 – Nov. 2017
Strategies: Bait Density and Flight Line Spacing

• Bait Density = 37.5/75/150/300 baits per km²
• Flight Line Spacing = 750/500/250 meters
• Minimum ORV Zone width = 25 miles (40 km)
Support from Congress and Tax Payers for ~ 20 Years
Focus on Efficiency, Effectiveness and Wise Use of Resources

Need for sustained political and financial support
Vaccine Bait Prices (2002-2017)

CS=$1.23; FMP=$1.46; ONRAB $1.40 USD
Wildlife Rabies Program Budgeting

Vaccine-Bait 50%
Air/Fuel 9%
WS State Programs 26%
Coordinator’s Account 8%
Cooperative Agreements 3%
NWRC 4%

$28M
Management with Raboral V-RG® in U.S.

- Raboral V-RG® is the only licensed ORV in the U.S.
- >170 million V-RG baits distributed in U.S. since 1992
- Coordinated ORV with V-RG® has resulted in some major accomplishments in the U.S.
Cooperative Rabies Management Program Accomplishments

- 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 to the West
2017 ORV Distribution in the US*

- **RABORAL V-RG**: 7,215,753 baits; 122,756 km²
- **ONRAB**: 2,742,240 baits; 37,993 km²

*Projected data for CY2017*
FY 2017 ORV Operations in the US

- Baits Distributed: 10,420,249
- Distance Flown: 385,000 km
- Area baited: 161,098 km²
- Hours of Flight: 2,000
- Across 17 States

REDIPRA 16 – Nov. 2017
Canine Rabies in Coyotes (South Texas)

- Eliminated a second time in 2007 with ORV targeting coyotes

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>166</td>
</tr>
<tr>
<td>1995</td>
<td>58</td>
</tr>
<tr>
<td>1996</td>
<td>21</td>
</tr>
<tr>
<td>1997</td>
<td>6</td>
</tr>
<tr>
<td>1998</td>
<td>5</td>
</tr>
<tr>
<td>1999</td>
<td>10</td>
</tr>
<tr>
<td>2000</td>
<td>0</td>
</tr>
<tr>
<td>2001</td>
<td>1</td>
</tr>
<tr>
<td>2002</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>0</td>
</tr>
<tr>
<td>2004</td>
<td>1</td>
</tr>
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<td>2005</td>
<td>0</td>
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<td>2006</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>0</td>
</tr>
<tr>
<td>2009-2017</td>
<td>0</td>
</tr>
</tbody>
</table>

Last Canine Rabies Case

Declared Canine Rabies Free

ORV begins

Needs:
* Surveillance along border
* Contingency Plans
The Big Challenge.....

Elimination of raccoon rabies

New Vision: “Raccoon Rabies Free by 2043”

Stopping the spread of raccoon rabies

Elimination through strategic management
DELPHI II: Refinement of Elimination Strategies

30-year Planning Horizon

DELPHI II Meeting
March 9-11, 2016; Fort Collins, Colorado

REDIPRA 16 – Nov. 2017
Delphi II Targeted Outcomes

- **Expert Opinion**: Define landscape level strategies for raccoon rabies variant elimination

- **Risk Models**: Develop risk models to fully evaluate the effectiveness of potential strategies

- **Economics**: Apply results to BioEcon and REMI model to estimate benefits and costs associated with potential strategies
DELPHI II Raccoon Rabies Elimination
Diversity of Collaboration Essential

- State Public Health Agencies
- County Health Departments
- State Agriculture Agencies
- Industry
- State Fish and Wildlife Agencies
- Universities
- Others Federal Agencies
- Navajo Nation
- Mexican Agencies
- Canadian Agencies
- Local Agencies

Global – North American – National – Regional – State – County - City - Town - Individuals

One Health

- Animal Disease
- Human Disease
- Environment
Strategic Planning = U.S. National Plan

STRATEGIC PLAN


(Revised Strategies: March 30-April 1, 2010
National Rabies Management Team Meeting Nashville, TN)

REDIPRA 16 – Nov. 2017
The North American Rabies Management Plan

- Information transfer
- Surveillance and monitoring
- Rabies control
- Research
Large Scale, Intensive Program Monitoring

Key Program Metrics

Serology

• **RFFIT**: Rapid Fluorescent Focus Inhibition Test
  • **RVNA** as index to vaccine induced immunity
    • Direct measure of IgG

Rabies Cases

• **DFA**: Direct Fluorescent Antibody Test
• **dRIT**: Direct, Rapid Immunohistochemical Test
Serology
Virus Neutralizing Antibodies
(blood samples)
Avg. >5,600

Surveillance
Virus Antigen Detection
(brainstem samples)
Avg. >7,200
Key Program Metrics (“Tower of Power”)

**Serology**
- **High RVNA seroprevalence (≥ 60% with adequate sample size)**
- **Moderate RVNA seroprevalence (≥ 40 to 59% with adequate sample size)**
- **Low RVNA seroprevalence (≥ 20 to 39% with adequate sample size)**

**Goal**
- **Low Risk**
- **Moderate Risk**
- **High Risk**

- Moving ORV Zones-

**Surveillance**
- **High quality ERS (good spatial-temporal samples with no rabies cases)**
- **Moderate quality ERS (fair spatial-temporal samples with no rabies cases)**
- **Low quality ERS (poor spatial-temporal samples with no rabies cases)**

**Surveillance**
- **Low RVNA seroprevalence (≥ 20 to 39% with adequate sample size)**

**Surveillance**
- **Moderate RVNA seroprevalence (≥ 40 to 59% with adequate sample size)**

**Surveillance**
- **High RVNA seroprevalence (≥ 60% with adequate sample size)**

REDIPRA 16 – Nov. 2017
# Animals Handled* by NRMP 2006-2015

<table>
<thead>
<tr>
<th>Species</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TARGETS</strong></td>
<td></td>
</tr>
<tr>
<td>Bats</td>
<td>1,259</td>
</tr>
<tr>
<td>Bobcats</td>
<td>222</td>
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<tr>
<td>Coyotes</td>
<td>2,185</td>
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<tr>
<td>Foxes, arctic</td>
<td>256</td>
</tr>
<tr>
<td>Foxes, gray</td>
<td>1,381</td>
</tr>
<tr>
<td>Foxes, kit</td>
<td>13</td>
</tr>
<tr>
<td>Foxes, red</td>
<td>1,418</td>
</tr>
<tr>
<td>Mongooses, Indian</td>
<td>38</td>
</tr>
<tr>
<td><strong>Raccoons</strong></td>
<td>151,717</td>
</tr>
<tr>
<td>Skunks, hog-nosed</td>
<td>32</td>
</tr>
<tr>
<td>Skunks, hooded</td>
<td>398</td>
</tr>
<tr>
<td>Skunks, spotted</td>
<td>71</td>
</tr>
<tr>
<td><strong>Skunks, striped</strong></td>
<td>14,039</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>173,029</td>
</tr>
<tr>
<td><strong>NONTARGETS</strong></td>
<td></td>
</tr>
<tr>
<td>Alligators</td>
<td>4</td>
</tr>
<tr>
<td>Armadillos</td>
<td>92</td>
</tr>
<tr>
<td>Badgers</td>
<td>9</td>
</tr>
<tr>
<td>Bears (black &amp; grizzly)</td>
<td>18</td>
</tr>
<tr>
<td>Beavers</td>
<td>33</td>
</tr>
<tr>
<td>Birds (28 different spp.)</td>
<td>120</td>
</tr>
<tr>
<td>Cats</td>
<td>3,426</td>
</tr>
<tr>
<td>Coatis</td>
<td>2</td>
</tr>
<tr>
<td>Deer/caribou/elk</td>
<td>20</td>
</tr>
<tr>
<td>Dogs</td>
<td>459</td>
</tr>
<tr>
<td>Ferrets</td>
<td>1</td>
</tr>
<tr>
<td>Fishers</td>
<td>266</td>
</tr>
<tr>
<td>Frogs/toads/snakes/turtles</td>
<td>184</td>
</tr>
<tr>
<td>Goats</td>
<td>6</td>
</tr>
<tr>
<td>Horses</td>
<td>1</td>
</tr>
<tr>
<td>Lions, mountain</td>
<td>4</td>
</tr>
<tr>
<td>Lynx</td>
<td>8</td>
</tr>
<tr>
<td>Martens, pine</td>
<td>17</td>
</tr>
<tr>
<td>Mice/voles/rats/squirrels/chipmunks</td>
<td>1,385</td>
</tr>
<tr>
<td>Minks</td>
<td>121</td>
</tr>
<tr>
<td>Moose</td>
<td>11</td>
</tr>
<tr>
<td>Muskrats</td>
<td>73</td>
</tr>
<tr>
<td>Opossums, virginia</td>
<td>16,846</td>
</tr>
<tr>
<td>Otters, river</td>
<td>44</td>
</tr>
<tr>
<td>Peccaries, collared (javelina)</td>
<td>24</td>
</tr>
<tr>
<td>Pocket gophers, Botta's</td>
<td>1</td>
</tr>
<tr>
<td>Porcupines</td>
<td>182</td>
</tr>
<tr>
<td>Rabbits/hares (6 spp.)</td>
<td>841</td>
</tr>
<tr>
<td>Ringtails</td>
<td>6</td>
</tr>
<tr>
<td>Sheep</td>
<td>3</td>
</tr>
<tr>
<td>Swine</td>
<td>2</td>
</tr>
<tr>
<td>Weasels</td>
<td>14</td>
</tr>
<tr>
<td>Wolverines</td>
<td>4</td>
</tr>
<tr>
<td>Wolves (gray/timber)</td>
<td>44</td>
</tr>
<tr>
<td>Woodchucks</td>
<td>1,723</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25,994</td>
</tr>
</tbody>
</table>

* Trapped and/or sampled

―Too much surveillance is not enough!―

- high quality,
- spatial-temporally distributed sample
- “Early detection, early response”
- Science-based decision making

Dennis Slate,
WS Former WS Rabies Management Coordinator
Another way? Enhanced Rabies Surveillance

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

- Supplement public health surveillance
- Covers 80km west of zone
- Includes ORV zone 80 km to east

NON-EXPOSURE
RABIES SPECIMEN
DATE FOUND: ____________________________
SPECIES: ____________________________
TOWN + ADDRESS FOUND OR NEAREST LANDMARK:
________________________________________

CAUSE OF DEATH (PLEASE CIRCLE ONE):
STRANGE ACTING FOUND DEAD (NOT ROADKILL)
ROADKILL N/R/O/THER UNKNOWN

CONTACT INFORMATION:
________________________________________

PLEASE ATTACH THIS LABEL TO THE SPECIMEN BEFORE BAGGING
IF YOU HAVE ANY QUESTIONS OR CONCERNS PLEASE CALL 1-800-223-4697
direct Rapid Immunohistochemical Test (dRIT)

Antigen Detection

dRIT +

DFA +

Collaboration:
- CDC
- Wistar Institute
- Lyssa LLC

<table>
<thead>
<tr>
<th>Year</th>
<th>ERS Samples</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>2.10%</td>
</tr>
<tr>
<td>2006</td>
<td>6,930</td>
<td>6,072</td>
<td>109</td>
<td>1.80%</td>
</tr>
<tr>
<td>2007</td>
<td>9,959</td>
<td>8,136</td>
<td>157</td>
<td>1.90%</td>
</tr>
<tr>
<td>2008</td>
<td>10,999</td>
<td>8,790</td>
<td>142</td>
<td>1.60%</td>
</tr>
<tr>
<td>2009</td>
<td>12,256</td>
<td>10,534</td>
<td>160</td>
<td>1.50%</td>
</tr>
<tr>
<td>2010</td>
<td>9,231</td>
<td>7,294</td>
<td>145</td>
<td>2.00%</td>
</tr>
<tr>
<td>2011</td>
<td>9,492</td>
<td>7,574</td>
<td>141</td>
<td>1.90%</td>
</tr>
<tr>
<td>2012</td>
<td>7,783</td>
<td>6,605</td>
<td>117</td>
<td>1.80%</td>
</tr>
<tr>
<td>2013</td>
<td>6,774</td>
<td>5,485</td>
<td>142</td>
<td>2.60%</td>
</tr>
<tr>
<td>2014</td>
<td>7,068</td>
<td>5,799</td>
<td>104</td>
<td>1.90%</td>
</tr>
<tr>
<td>2015</td>
<td>7,346</td>
<td>6,222</td>
<td>94</td>
<td>1.90%</td>
</tr>
<tr>
<td>2016</td>
<td>8,387</td>
<td>6,603</td>
<td>136</td>
<td>2.10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100,013</strong></td>
<td><strong>81,962</strong></td>
<td><strong>1,506</strong></td>
<td><strong>1.80%</strong></td>
</tr>
</tbody>
</table>

*Through 3/13/17*  
**direct Rapid Immunohistochemical Test (dRIT)**
2017 Enhanced Rabies Surveillance & ORV in the US

- 7,625 ERS Samples; 138 rabies positives
- 15 raccoon rabies management states
- AZ, TX, AK (not shown)
Models Suggest >60% Population Immunity Needed for Raccoon Rabies Elimination

“Herd Immunity”

> 60% seroconversion rate?
Grand National Mean = 29.6%

V-RG helped stop the spread, but elimination requires increase seroconversion rates

50,245 samples
15 states
18 years

% Positive rabies virus neutralizing antibodies at ≥0.05 IU/ml
V-RG works very well in Coyotes and Gray Fox

Coyote = 58% annual antibody response

Gray Fox = 71% annual antibody response
“Experiment Fearlessly”

Applied Research
# Current and Candidate Vaccine-Baits

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>V-RG®</th>
<th>ONRAB</th>
<th>SAG2</th>
<th>SPN GASGAS “RABITECH M”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recombinant</td>
<td>yes</td>
<td>yes</td>
<td>no, mod.-live</td>
<td>yes, reverse genetics</td>
</tr>
<tr>
<td>Vaccine Platform</td>
<td>vaccinia virus</td>
<td>human adeno virus</td>
<td>NA (rabies)</td>
<td>rabies</td>
</tr>
<tr>
<td>Lic. in U.S.</td>
<td>yes</td>
<td>no*</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Lic. Outside U.S.</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Interest in U.S.</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Proprietor</td>
<td>Merial</td>
<td>Artemis</td>
<td>Virbac</td>
<td>IDT</td>
</tr>
<tr>
<td>Country</td>
<td>US</td>
<td>Canada</td>
<td>France</td>
<td>Germany</td>
</tr>
</tbody>
</table>

*used experimentally in U.S.
ONRAB (Artemis Technologies; Canada)
2011-2017 ONRAB Field Trial Summary

- 2011-2013 West Virginia: Concluded
- 2012-2014 NY/VT/NH: Concluded
- 2012-2014 Ohio: Concluded
- 2013-2015 NY – St. Lawrence: Concluded
- 2013-2015 NY – Niagara (Cornell): Concluded
- 2014-2016 West Virginia (skunks): Concluded
- 2015-2017 Vermont – Burlington: Concluded

**Additional Use**
- 2015-2017 NY – Franklin Co. (contingency action)
- 2015-2017 Ohio (operational)
- 2016-2017 NY – Buffalo Area (Delauney analysis)
- 2017 Ohio – Stark Co. (contingency action)
2012-2014 NY/VT/NH ONRAB Trial

- ONRAB baiting at 75 baits/km² in an ORV naïve rural area to compare to WV (southern cells)
- ONRAB baiting at 75 baits/km² over an area historically baited at 75 baits/km² with RABORAL V-RG® (northern cells)

- 8 ONRAB sampling cells (132 km² each)
- 150 traps/cell
- Sampling Pre and Post-ORV for 10 straight days
- Study areas = fixed-wing except villages (ground)
- 750 m flight line spacing at 75 baits/km²
% RVNA in Raccoon Sera

2012-2014 NY/VT/NH ONRAB Trial Summary

Wadsworth ≥0.0625 IU/ml represents RVNA positive

Pre-ONRAB Post-ONRAB

2012 66 27
2013 61 72
2014 73 72

3-Yr Mean (Post) = 70.0%

75 baits/km² – Rural
Raccoon Response to ORV (1997-2015)

VRG Mean = 29.6%  
ONRAB Mean = 58.2%

% Positive rabies virus neutralizing antibodies at ≥0.05 IU/ml
A Way Forward, But Challenges Remain
Understanding Urban-Suburban Challenges

Urban Areas in U.S. = 81% of human population
Better Understanding Oral Rabies Vaccination in Skunks
Intentional and Unintentional Translocation

- Hundreds of thousands animals moved each year
- Nuisance Wildlife Control Trappers?
- General Public?
- Rehabilitators?

Options for reducing translocation?
Vaccine - Bait Competition with Opossums?
Bait Acceptability and Handling by Dogs Since 2005

Chinle, AZ Navajo Nation
April 18, 2005

Coated Sachets--Raboral V-RG®
Bait Acceptability and Handling by Dogs – Navajo Nation (USA) (2016)

Oral Rabies Vaccination (ORV) Targeting Dogs?
Understanding Characteristics of Dog Population

**Ownership**
- Community: 7%
- Owned: 9%
- Stray: 84%

**Confinement**
- Restricted: 55%
- Free-roaming: 45%

**Gender**
- Male: 41%
- Female: 59%

**Age**
- Puppy: 5%
- Juvenile: 12%
- Adult: 83%

**Body Condition**
- Poor: 5%
- Fair: 30%
- Good: 65%

**Body Size**
- Small: 25%
- Medium: 22%
- Large: 53%

*unknowns not included

Bait Preference? Vaccine Field Effectiveness? Integrated Strategies

REDIPRA 16 – Nov. 2017
Vampire Bats in the U.S?
Current Range of the Vampire Bat (Desmodus rotundus)

Vampire bats have been documented within 50 km of Texas.
Modeling to Predict Range Expansion of Vampire Bats

Ecological Niche Modeling
Hayes and Piaggio (2017)

- Modeling based on more than 7000 vampire bat occurrence records. Five models map potential distribution along the Mexico-U.S. border through 2070
- Highest variable importance: Minimum temp. of the coldest month
- Two potential future routes for vampire bat dispersal including TX and FL.
- Models suggest current suitable habitat exist in extreme southern portions of TX and southern FL.
Cattle Surveys in Florida and Texas

Texas 2017 Statewide Cattle Survey (as of January 1): 12,300,000

Florida 2017 Statewide Cattle Survey (as of January 1): 1,700,000
• An economic analysis by Anderson, Shwiff & Shwiff indicated a total annual economic impact of $7.0 million to $9.2 million under two different scenarios of US invasion.
Avoid the Repress and Deny Strategy
Begin the Discussion “Entrance Strategy?”

- Introduction of Novel Wildlife Species
- Introduction of Novel Rabies Variant

Opportunity

- Gather Relevant Available Information
- Conduct Enhanced Surveillance
- Cooperative Strategic Planning
- Coalition Building
- ID Jurisdictional Issues
- ID Potential Rabies Management Strategies
“Surveillance is the systematic, continuous collection, analysis and interpretation of data and their dissemination to appropriate people in order that action be taken.” (WHO 2013)
USDA is monitoring for evidence of vampire bats in areas predicted to have suitable habitat including south Texas, Florida and Arizona.
Vampire Bite Surveillance Targeting Cattle
Cattle Sales Barns TX, AZ, FL, Dairies in AZ, Feedlots FL
FY16-17 VBB Surveillance Accomplishments

- Conducted 561 surveys examining 132,932 livestock at sales barns
- Distributed 1,228 copies of “Vampire Bats and Cattle” DVD
- No evidence of vampire bat bites were observed on any of the livestock examined

<table>
<thead>
<tr>
<th>State</th>
<th>FY2017</th>
<th># Surveys</th>
<th># Livestock Examined</th>
<th># DVDs Distributed</th>
<th># Collaborators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td></td>
<td>144</td>
<td>34,546</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Texas</td>
<td></td>
<td>200</td>
<td>14,868</td>
<td>340</td>
<td>17</td>
</tr>
<tr>
<td>Florida</td>
<td></td>
<td>47</td>
<td>46,251</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Targeted Outreach (DVD) for Ranchers Along Border

Mike and Hunter Bodenchuk

Dr. Luis Lecuona

REDIPRA 16 – Nov. 2017
Thanks to Our Colleagues in Mexico

- SAGARPA/SENASICA
- State Committees of Animal Health
  - Hidalgo (2016)
  - Campeche (2017)
• Significant wildlife management challenge
• Focus on managing the impact (Rabies!)
• Need to refine surveillance efforts (denominator!)
• **Communicate, Coordinate, Collaborate and Cooperate** across jurisdictions
Mongoose Rabies in Puerto Rico

Is Island-wide rabies elimination feasible?
Puerto Rico ORV Baiting for Mongoose
Rabies Case and Public Health

• ~6,000 annual animal bite reports investigated by Puerto Rico Dept. of Health
• ~10% reported for rabies PEP
• Approximately 287 mongoose bite injuries/year

• No compulsory vaccination of domestic/companion animals
• Human rabies case in 2015 – mongoose bite
• No wildlife vaccination program
Regular strategic planning and collaboration meetings
Year-long Regulatory (NEPA) process (EA) to conduct a live-vaccine field trial in late 2018? (IDT Vaccine)
NWRC Research on baits, non-targets (rats), biomarkers
Placebo Bait Field Trial Targeting Mongoose

- First Placebo Bait Trial (September 28, 2016) (World Rabies Day!)
- Second Placebo Trial March 2017
- 3 Study Sites. 1 km² Plots (USFWS Cabo Rojo Refuge; Private land)
- Target density = 200 baits/km²
- Biomarker: Fall 2016: 2.8mg et-IPA/Spring 2017: 2.8 mg met-IPA
- Post bait trapping sample collection for 10 days
- Serology (IPA analysis) to evaluate bait uptake
Refuge ORV Bait and Trap Transects
# Results

<table>
<thead>
<tr>
<th>Trial</th>
<th># Sampled</th>
<th># Positive</th>
<th>Proportion marked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2016 Ethyl-iophenoxic acid</td>
<td>87</td>
<td>55</td>
<td>63%</td>
</tr>
<tr>
<td>Spring 2017 Methyl-iophenoxic acid</td>
<td>123</td>
<td>84</td>
<td>68%</td>
</tr>
<tr>
<td>Pooled (accounting for recaptures)</td>
<td>180</td>
<td>134</td>
<td>74%</td>
</tr>
</tbody>
</table>
Future of Mongoose Rabies Management?
(Post Hurricane)

Emergency Rabies Response?
Before and After Hurricane Maria

Impact on mongoose and mongoose rabies?
Moving Forward?

- **29 islands** with mongoose populations; **4 with mongoose rabies**
  - Puerto Rico, Cuba, Grenada, Hispaniola
- Matter of time before it *spreads to other islands* putting more at risk.
- Potential spread of mongoose rabies to mainland sites in N. South America.

- Need **enhanced rabies surveillance** to:
  - better characterize scope
  - establish baseline (only on four islands?)

- Mongoose rabies is a **canine rabies virus lineage**.
  - and potential source to *re-infect dogs*.

- Been discussing this **key issue at REDIPRA** for a decade
  - white paper requested for REDIPRA by Fernando Leanes at last Antigua meeting
  - white paper provided at REDIPRA in 2009 Buenos Ares (Slate and Rupprecht)

**Thoughts on a Surveillance and Potential Management Strategies?**