A Novel Outbreak of Skunks Infected with a Bat Variant of Rabies Virus

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Acknowledgements

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Rabies Reservoirs in Arizona
Animals
Flagstaff

Biome: Ponderosa Pine
Elevation: 7000 ft.
Population 60,000

SKUNK
Flagstaff, January 2001

- January 7: Resident reports dead skunk
- Animal control submits skunk for surveillance
- Jan 9: Rabies test = Positive
Unusual Location: What Variant?

- Tissue sent to regional rabies lab in Texas for antigenic and genetic rabies tests

- Result= Bat virus variant
Prediction: Self-limiting Event

- Bat variants of rabies have infected horses, dogs, cats, humans, foxes and other terrestrial mammals, however interspecies transmission has rarely lead to successful secondary transmission.
January 9 - February 15

- Three additional skunks test positive - all with bat variant. N=4
- Consider common source exposure? Common den?
Site Visit, Late February

- No common den/source identified
- Excellent habitat with numerous den sites, wildlife corridors, water, food sources.
- County/city meeting- rabies update
Jan. 9- March 31, 2001

13/63 skunks test positive

- **Emphasize surveillance and prevention**
  - Notify wildlife agencies, veterinarians, pest control
  - Prohibit translocation - test trapped skunks & road kill

- **Public awareness:**
  - Door to door, mailout, media
  - Pet vaccine clinics
Rabid Skunks by Date
April 3, 2001 - 3 cases

Rabies in Skunks
Flagstaff, Arizona
2001

Arizona Department of Health Services
Wildlife Rabies: Control Options

- Trap-Vaccinate-Release
- Depopulation
- Combination

Oral recombinant vaccine baits are not effective in skunks.
Intervention: Factors to Consider

• Ecology:
  – Urban area surrounded by forest
  – Community safety and acceptance
  – Abundant wildlife including fox, raccoon, skunk, squirrel, prairie dog…
  – No baseline density data

• Epidemiology:
  – Temporal and spatial distribution- movement

• Logistics:
  – Vaccine efficacy?
  – Funding for equipment and staff

• Goals and objectives
Trap, Vaccinate, Release Program

- Objective: To protect human and animal health by reducing or eliminating rabies virus transmission among skunks in Flagstaff.
Live Traps
Bait

- Sardines
- Peanut butter and molasses
- Eggs
Vaccinate

Off label use of a commercially licensed, parenterally administered rabies vaccine.
Ear-tag
Weight and GPS location
Release
Media Day
Phase 1 - May:
Trapping Grids, Flagstaff

1 trap/ .25 mile
Phase 1 June:
Grids + Wildlife Corridors
Phase 2 and 3:
Peridomestic Trapping/ Off site Release
Trap Locations

Flagstaff

1st stage (May 16 to May 25)
2nd stage (May 29 to June 8)
3rd stage (June 11 to June 22)
TVR Project

- May 16- Nov. 15, 2001 (3 phases)
- > 7000 trap nights
  - 1-18% trap success
- 218 skunks vaccinated, ear tagged and released
- 54 skunks captured > once
- 27 skunks euthanized
- 74 cats, 16 squirrels, 2 raccoons, 2 foxes
- Trapping was most effective:
  - peridomestically
  - during July when the young were dispersing
- Various baits were equally effective
Rabies in Flagstaff, 2001

N=26

- Rabid bats: 7 cases
- Rabid skunks: 19 cases

Rabies in Flagstaff, 2000: 1 bat in June
Flagstaff:
19 Rabid skunks Jan- July, 30 2001
Laboratory Results

- The 19 rabies virus samples shared a monoclonal antibody pattern associated with Western *E. fuscus* bats.

- PCR amplicons produced a single restriction digest pattern which did not match patterns seen in terrestrial mammals in the U.S.
• The Flagstaff skunk samples shared $\geq 97\%$ homology with 7/8 *E. fuscus* (ef), 4/15 *Myotis* (my), 1/6 *L. ega* (le) from Arizona.
Laboratory Results

• Compared to terrestrial animals from Western states that had been infected with bat virus variants, the Flagstaff skunk samples shared lineage with 15/119 samples including:

- 1 skunk/ CO; 1 cat /CA;
- 1 cat and 1 bovine/ OR;
- 1 raccoon, 1 skunk, 1 cat, 1 fox/ NM;
- 1 horse, 1 skunk and 5 foxes/NV.
The Flagstaff skunk samples were \( \geq 99\% \) homologous (over a 300 bp region of the nucleoprotein gene) and shared \(<78\%\) homology with other terrestrial mammal rabies viruses in AZ.

Two phylogenetic clades formed.
Laboratory Results

- Bat variant rabies virus was identified in the salivary glands of skunks, adding to the epidemiologic evidence that skunk to skunk transmission was occurring.
Results

• There were no human or pet exposures to the 19 rabid skunks in Flagstaff.

• The observed behavior of the Flagstaff rabid skunks was not similar to that in rabid skunks in southern AZ.

• There have not been any new rabid skunk cases in Flagstaff or the surrounding area since July 27, 2001
Conclusions

• Rabies epizootics may be associated with fluctuations in wildlife populations, translocation, changing ecologic conditions.

• Recognition of this epizootic was facilitated by the location--- urban, non enzootic area.

• The apparent movement from the east to west side of town may have been due to human translocation or natural disease spread.
Conclusions

• This epizootic may not have been recognized if we excluded the testing of animals without human or pet exposure. Surveillance testing of sick and dead wildlife is routine in AZ.

• Lower threshold for variant testing even in enzootic hosts.

• There is a need to develop more efficient rabies control methods for skunks.

• The TVR program will be very difficult to evaluate.
• What factors allowed this virus to adapt in skunks?

• Was this the initial event? … or had this been smoldering undetected?
  – The divergence into two phylogenetic clades may indicate two introductions or a more longstanding adaptation.

• Is this type of event more common than is recognized?
# Three phase TVR project

<table>
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<th>Staff</th>
<th>May/June 6 weeks</th>
<th>July 3.5 weeks</th>
<th>Oct/Nov 6 weeks</th>
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<tr>
<td>4-USDA/WS</td>
<td>4-USDA/WS</td>
<td>1-CDC/ADHS</td>
<td>2-NAU/ADHS</td>
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<tr>
<td>Trap nights</td>
<td>6475</td>
<td>511</td>
<td>+/- 60</td>
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<td>Trap success</td>
<td>2.6%</td>
<td>18%</td>
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<tr>
<td>TVR skunks</td>
<td>115</td>
<td>72</td>
<td>31</td>
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<tr>
<td>N=218</td>
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<td>Recaptures</td>
<td>36</td>
<td>13</td>
<td>4</td>
</tr>
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<td>N=53</td>
<td></td>
<td></td>
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<tr>
<td>Euth (28)</td>
<td>19</td>
<td>8</td>
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<tr>
<td>Method</td>
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Task Force(s)

• **State:**
  – Arizona Dept. Health - Lab and Epi
  – Arizona Game and Fish
  – Northern Arizona University

• **Local:**
  – Flagstaff City-Police/Animal Control
  – Coconino County Health Dept. and Community Services
  – Coconino Humane Society
  – Veterinary Community

**Federal:**
– Animal Defense League - Centers for Disease Control
– Coconino Pest Control - USDA/Wildlife Services

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