

An Integrated Wildlife Damage Management
Program in Response to a Raccoon Rabies Epizootic
in Bath, Maine

Final Report

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INTRODUCTION

Rabies is caused by a virus that infects the central nervous system in mammals. It is almost always transmitted through the bite of a rabid animal. The majority of rabies cases in the United States occur in wildlife including raccoons, skunks, foxes and bats. Rabies is invariably fatal, however, effective vaccines are available to protect people, pets and livestock. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (APHIS WS) is a cooperative wildlife management program that provides Federal leadership in resolving conflicts between people and wildlife including the prevention and control of rabies in wildlife populations. The primary goal of the APHIS WS National Rabies Management Program in the Eastern U.S. is to prevent the spread and eventually eliminate the raccoon rabies virus variant through an integrated management program involving the use of oral rabies vaccine targeting wildlife. Coordinated oral rabies vaccination (ORV) programs in the U.S. and Canada are conducted by government agencies and are focused on managing rabies at the landscape scale. The successful implementation of an ORV program requires that agencies have clear management objectives and conduct intensive, enhanced rabies surveillance and post vaccine distribution monitoring including the live capture and sampling of rabies reservoir species. However, ORV programs are complex and may not always be the most appropriate strategy for management of wildlife rabies at the local level. In specific cases, alternative measures to reduce the immediate disease threat in localized areas may be more appropriate as a short-term mitigation strategy to reduce risk and directly address a human wildlife conflict in real-time.

In raccoon rabies enzootic areas it is common to see a periodic increase in the number of rabies cases at the local level. These localized epizootics can last for many years. In more developed urban-suburban areas where there is an increased density of both humans and some wildlife species, sick or strange acting wildlife are more likely to be reported and requests for assistance from the public are common. In 2019, the City of Bath, with a population of over 8,000 people, received 72 suspicious animal calls, 26 sick animals were dispatched by officers or citizens, and 16 animals tested positive for rabies. In that same year, 18 foxes attacked people or pets, and 11 of those attacks resulted in a person being bitten or scratched. This unusual number of aggressive attacks on people and domestic pets raised human health and safety concerns, and prompted an effort to reduce the density of rabies vector species (Press Release, 2/13/2020, accessed at <https://www.cityofbath.com/news/post/489/>).

In most northern states, the number of rabies positive animals tends to decline during winter months when animals become less active and reduce movements; however, that did not occur in Bath during the winter of 2019-20. As the winter progressed, sick animals and attacks on humans continued, and many Bath residents contacted city offices requesting the City to take action. In December 2019, these actions prompted City administrators to engage government officials from Maine Department of Inland Fisheries and Wildlife (MDIFW), Maine Department of Agriculture, Conservation and Forestry (MDACF), and Maine Centers for Disease Control (CDC) to assist in a solution. As discussions and positive rabies cases continued, agency experts and City representatives mutually agreed on a management approach that would involve a targeted reduction of local rabies vector species densities as an immediate response to the ongoing disease threat. In late January, it was recommended that APHIS WS be consulted to implement a management strategy designed to provide short-term relief from rabid animals within the City of Bath. APHIS WS submitted a work plan and cost estimate for implementing an

integrated wildlife damage management action to the City of Bath on February 5, which was approved by the City Council later that evening. City officials decided that a public information meeting would be held to address residents' concerns, and that meeting was conducted on March 5. A special meeting of the Bath City Council was held on March 9. At the conclusion of this meeting, City Council voted to proceed with the APHIS WS' proposed plan.

WORK AREA

The work area was defined as the City of Bath; however, our areas of management focus were determined by the following considerations: 1) locations where attacks on humans and pets had occurred; 2) preferred habitats of target species; 3) landowner permission; 4) potential travel corridors of target species in close proximity to human habitation; and 5) wherever there was an increased likelihood of capturing target animals while decreasing conflict with landowners and the public.

OBJECTIVE

The objective of this project, which was determined through collaboration among the City of Bath, MDIFW, and APHIS WS, was to reduce population densities of locally abundant rabies vector species to mitigate the ongoing human-wildlife conflict. Target animals were defined as gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), raccoons (*Procyon lotor*), and striped skunks (*Mephitis mephitis*). This short-term objective is one part of a larger, long-term, integrated approach being conducted by the City of Bath to address important health and safety concerns related to rabies. To accomplish this objective, we defined specific activities that included:

- 1) Outreach and Education;
- 2) Identification of wildlife attractants;
- 3) Identification of target animal occupancy;
- 4) Use cage traps to capture target species;
- 5) Collect samples and conduct rabies testing on target species; and
- 6) Utilize specimen collections to aid other research.

METHODS

Outreach and Education was conducted through a public presentation session held on March 5, 2020 and by in-person discussions during our field activities. Printed pamphlets were used to disseminate relevant rabies information - these documents were made available at Bath City Hall, as well as the City's website. To identify wildlife attractants, ground reconnaissance, landowner contacts, and other personal communications were utilized. Areas containing preferred natural habitat or anthropogenic attractants were identified by personnel on data collection forms. During field activities and communications, areas of high wildlife activity were documented and indicated on data collection forms. Animal sign (tracks, scats, burrows, etc.) were used to make determinations whether target animals were present.

To capture the target animals, three different sizes of cage-type traps (i.e. "box trap") measuring 11"x12"x30", 15"x18"x42", and 15"x22"x48" were used. Cage traps were set with intentions to capture

any of the target animals, although some traps were more suited for specific species due to the bait and lure types used. Every attempt was made to use lures and baits most attractive to the target species while attempting to avoid non-target captures. Landowner permissions were obtained before any traps were placed. All feral and free-ranging cats captured were relinquished to the Bath Animal Control Officer who promptly took actions to locate the pet's owner. All other non-target animals captured were released on site. The overall trapping effort was based on numerous factors, including landowner permission, wildlife activity, property size, and the property's proximity to higher wildlife population densities. Other activities and conditions included:

- 1) Cage traps were set in sheltered habitats with covered top and sides to protect captured animals from wind and precipitation.
- 2) All traps were checked a minimum of two times per day and traps were closed if ambient temperature, or a combination of temperature and wind chill, fell below 0° Fahrenheit.
- 3) All target animals were chemically immobilized and humanely euthanized following guidelines established by the American Veterinary Medical Association.
- 4) Brainstem samples were collected from all target species and the direct rapid immunohistochemistry test (DRIT) was performed on all samples to test for rabies.
- 5) Blood samples were collected from all target species and submitted to the Wadsworth Center, New York Department of Health where they were analyzed for rabies neutralizing antibodies (RVNA).
- 6) Rabies-positive samples detected by DRIT were sent to the Wadsworth Center, New York Department of Health for confirmation utilizing the direct fluorescent antibody (DFA) test, which is currently the gold-standard for rabies testing in animals, and variant typing.
- 7) All gray fox specimens were provided to MDIFW for additional fox disease research.
- 8) All capture efforts will conclude by March 31, 2020; specifically to avoid capture of individuals with dependent young.

RESULTS and DISCUSSION

APHIS WS began working closely with the City of Bath in February 2020. After several weeks of collaborative discussions with partnering agencies, it was mutually agreed USDA WS would enter into a Cooperative Service Agreement with the City of Bath to provide additional support to mitigate the unique rabies situation. This financial commitment was approved by the City Council February 5, 2020, and the Cooperative Service Agreement was later signed by the City Manager March 2, 2020. USDA began a close partnership with the city of Bath during this time, providing additional, specific technical assistance along the way. Field efforts were initiated on March 12, 2020 with initial reconnaissance to locate suitable work areas, including obtaining the appropriate permissions required to set cage traps. Traps were set initially on March 16 and were removed on March 30.

Outreach and Education

Outreach and education efforts were conducted before, and during field operations. A public meeting was held on March 5, 2020 at the Fisher Mitchell School, where three APHIS WS employees participated in an expert panel and provided detailed information regarding raccoon rabies, the situation in Bath, and the proposed plan to reduce rabies vector species. Although the exact number of attendees is unknown, it is estimated to have been over 200 people. In addition, the City of Bath made APHIS WS' messages publicly available through Bath Community Television and video on demand on the City's

website. Rabies brochures were made available at the public meeting and at City Hall. During field operations, contact was established with a minimum of 23 private landowners, 18 city representatives, and 3 public institution representatives. In seeking permission to trap, many landowners were eager to learn more about the operations, so this provided suitable opportunities to present information.

Identification of Wildlife Attractants

A total of 15 distinct and notable wildlife attractants were identified (Table 1). These attractants ranged from backyard bird feeders to direct and purposeful feeding of fox. Prime denning habitats were identified on several occasions including dilapidated buildings and abandoned equipment as well as brush piles and construction debris. This is likely similar to other Maine communities, but is important to identify, as these types of habitats can increase carrying capacity for wildlife, reduce normal home-range sizes, and encourage wildlife occupancy in areas close to human habitation.

Table 1. The general location and attractant types identified by APHIS WS during field operations, March 16-30, 2020.

General Location	Attractant Type
Spruce St	Bird Feeders
Weeks St and High St	Compost in buckets
Mitchell Rd	Old buildings, abandoned equipment, and construction debris
High St	Food waste on ground
High St	Person feeding foxes
Getchell St	Outbuildings on posts/pillars offering animal shelter
High St	Abandoned structures, rubble, and brush
LeMont St	Community Compost Facility
Middle St	Open dumpsters
High St	Open dumpsters
Landfill	Open dumpsters
Bowery St	Person feeding foxes
Bowery St	Construction debris/rubble piles
High St	large dilapidated building in woods
Sheridan and Lincoln St	Unsecured trash; animals feeding

Identify Areas of High Wildlife Presence

Because wildlife have specific needs to meet daily energetic and biological functions, they normally use specific habitats disproportionately to what is available. Attempts were made to identify and document these preferred habitats during management activities. A significant snowfall on the night of March 23 allowed WS Specialists to use wildlife tracks as evidence of species activity and composition and potential wildlife travel corridors. Other signs of wildlife were documented and multiple direct observations of animals were made during the normal course of work. These observations are presented in Table 2.

Table 2. The general location of wildlife observations made by APHIS WS during field operations, March 16-30, 2020.

General Location	Observation
Oak Grove Ave	located and collected skunk remains
Tarbox St	gray fox tracks
Oak Grove Ave	2 gray fox observed
Oak Grove Ave	2 sets of gray fox tracks
Landfill	located and collected skunk remains
North St	1 gray fox observed crossing road
Dike-Newell School	multiple gray fox tracks observed surrounding this property
Oak Grove Ave	1 gray fox observed crossing parking lot
Bowery St	1 gray fox observed crossing vacant lot

Use Cage Traps to Capture Target Species

A significant aspect of APHIS WS involvement in this program was to capture and sample target species using cage traps. The decision to trap and euthanize wildlife was not taken lightly; rather, the decision to implement specific management activities was the result of lengthy collaboration among experts representing public administration, wildlife, domestic animal, public health, and resource management professionals at local, state, and federal levels. The final decision was made as a result of a detailed analysis of potential options that included discussions of all viable alternatives and expected outcomes.

Cage traps were initially deployed on March 16. Additional cage traps were added throughout the trapping period, although most all traps were set within the first four days of the operation. Cage traps were deployed for a total of 14 nights, the total number of traps set per night ranged from 34-119, with the average number of traps set per night at 100. Climatic conditions remained above the established criteria; therefore, all traps remained open for the entirety of the trapping event. All traps were removed on March 30. The results of the trapping efforts are provided in Table 3.

Table 3. The number of each species captured from March 16-31, 2020 and the corresponding disposition.

SPECIES	Number Captured	Disposition
Raccoon	24	Euthanized
Skunk	4	Euthanized
Gray Fox	0	NA
Red Fox	0	NA
Cat	3	Relinquished to Bath ACO
Gray Squirrel	10	Released at Capture Site
Woodchuck	1	Released at Capture Site
Opossum	10	Released at Capture Site
Red Squirrel	2	Released at Capture Site
Rat	1	Released at Capture Site
Porcupine	2	Released at Capture Site

The results of this cage-trapping event had both expected and some unanticipated results. APHIS WS was successful in capturing two of the four target species. The lack of gray fox captures was unanticipated based on previous trapping events and experience. While there were many unknowns

when work was initiated, wildlife biologists used professional experience to predict expected outcomes. Specifically, it was believed that the relative population densities of target animals had been impacted by rabies, but it was unknown to what degree the disease had reduced local numbers. Secondly, due to the timing, operations were limited to the month of March – a period when animal capture operations are seldom conducted. Capture methods were also limited, which likely had the most significant impact on capture rate of gray and red fox. Because trapping was conducted near human structures, capture methods were implemented that reduced potential concern for companion animal safety due to unpredictable weather conditions. While foothold traps would have likely improved capture success for red and gray fox, it was not considered a viable option for this specific operation. Although foothold traps are a safe alternative for both target and non-target animals, their use in residential areas is not recommended, especially during the month of March when temperatures may fall below freezing. Because APHIS WS had previously used cage traps to capture gray fox (33% of all gray fox taken by ME WS were in cage traps), it was believed cage traps could be a viable alternative to foothold traps. Unfortunately, capture success with cage traps in Bath were unexpectedly low. Field observations of gray fox behavior during this time-period, coupled with abundant food resources, likely caused gray fox to avoid cage traps. Gray fox tracks in the snow revealed two independent visits to cage traps. In one instance, the trap had sprung so it was not available for capture, while during the other visit, the fox only entered partially into the trap.

While red fox were identified as a target animal, their capture with cage traps was unlikely, although some red fox have been captured in cages by APHIS WS during other trapping events. Despite this expectation, it was not considered an obstacle to meeting the management objectives of the program because: 1) few red fox were believed to be present in the area; 2) documented cases of rabid red fox in Bath was relatively low; and 3) the focus was on the other three species due to the higher local densities and the current disease threat. Field observations did not result in any documented red fox sightings.

Efforts to obtain landowner permission resulted in a moderate intensity of trapping effort. Landowner compliance was a significant barrier to success because efforts could not be uniformly applied across the landscape. The landowners who did allow access were a significant help in achieving our mission; however, a longer duration and additional cooperators would have undoubtedly led to further success.

The timing of this management action was suitable for reducing target species densities but also presented some logistical challenges. Significant effort was taken to safeguard all captured animals relative to weather conditions. All traps were checked at least two times per day, and all traps were covered to improve thermoregulatory functions of captured animals. Plastic tarpaulin material, burlap, and in some cases boughs, leaves, and bark were used to cover traps and create some additional protection from the weather for animals in the traps. These coverings may have had a negative effect on capture success, particularly for gray fox. While cage traps were kept open in the back, the side coverings could have caused gray fox to avoid entering the traps. Furthermore, burlap and other foreign material may have introduced novel odors that increased this trap avoidance behavior.

Another significant event that altered the successful reduction of gray fox, was the inability to use firearms as a method of take. In early plan discussions, APHIS WS included firearms as a method of take. This is a method used safely and effectively by the APHIS WS program in Maine and around the country to resolve conflicts, and was an important component of the proposed plan. In hindsight, and based on direct observations, it is believed some fox could have been removed by safely using this method.

Perform Rabies Testing on Collected Animals

SEROLOGY

A blood sample was collected from each target animal captured. Blood samples were subjected to centrifugation to extract sera, which were then shipped to the Wadsworth Center in New York to detect rabies virus neutralizing antibodies. The presence of rabies virus specific antibodies in wild carnivores from unmanaged populations may indicate subclinical exposure (i.e., abortive infection) to the rabies virus. At the time of this report, APHIS WS expects the serology results from the cooperating laboratory to be completed in the fall of 2020.

DIRECT RAPID IMMUNOHISTOCHEMISTRY (DRIT) TESTING

Any strange acting animal or animal found dead within the city of Bath was collected and tested for rabies. The results are provided in Table 4. Brainstem samples were collected from every target animal that was captured and euthanized. Each sample was preserved and DRIT testing performed. The results are provided in Table 5. The removal of these animals achieved the objective of this program for reducing local densities of rabies vector species. Of note, all animals captured in cage traps during this program tested negative for rabies. This information improves the understanding of local animal densities and the potential for rabies transmission. Additional monitoring will reveal new information and guide future decisions for managing this disease.

Table 4. Testing results of animals which were found dead or were strange-acting and euthanized.

DATE	SPECIES	COMMENTS	TEST RESULTS
2/20/2020	RACCOONS	Found dead, quills in face	POSITIVE
3/12/2020	SKUNKS, STRIPED	Was acting strange on someones lawn, and euthanized by local PD.	POSITIVE
3/15/2020	FOXES, GRAY	High Street and Beacon	NEGATIVE
3/15/2020	FOXES, GRAY	Found dead	NEGATIVE
3/15/2020	FOXES, GRAY	Was strange acting and euthanized by ACO, had porcupine quills in face	POSITIVE
3/17/2020	RACCOONS	Roadkill	NEGATIVE
3/17/2020	RACCOONS	Strange acting, euthanized by local PD	POSITIVE
3/17/2020	SKUNKS, STRIPED	Found dead and fully decomposed by WS staff. Entire skull was submitted.	NEGATIVE
3/17/2020	SKUNKS, STRIPED	This skunk was found dead by WS staff in the City of Bath.	POSITIVE
3/20/2020	FOXES, GRAY	Strange acting, euthanized by local PD	POSITIVE
3/24/2020	RATS, NORWAY (BROWN)	Strange acting, euthanized by local PD	NEGATIVE
3/28/2020	BATS, BROWN, BIG	ACO collected from resident's garage. Broken radius and fractured jaw.	NEGATIVE
3/28/2020	MUSKRATS	Roadkill	NEGATIVE
3/30/2020	BATS, BROWN, BIG	Strange acting, lethargic bat received from the ACO	NEGATIVE
4/2/2020	FOXES, GRAY	Strange acting, euthanized by local PD	POSITIVE
4/24/2020	BEAVERS	Was attacking divers	NEGATIVE
5/8/2020	RACCOONS	Strange acting. Captured with a net by WS and euthanized	NEGATIVE
5/18/2020	FOXES, GRAY	Showed no fear of humans or dogs	NEGATIVE
5/18/2020	FOXES, GRAY	No more information on this individual is known at this time.	POSITIVE

Table 5. Testing results of target animals captured.

DATE COLLECTED	SPECIES	TEST DATE	TEST RESULTS
3/17/2020	RACCOONS	3/23/2020	NEGATIVE
3/18/2020	RACCOONS	3/23/2020	NEGATIVE
3/18/2020	RACCOONS	4/3/2020	NEGATIVE
3/18/2020	RACCOONS	3/23/2020	NEGATIVE
3/19/2020	RACCOONS	4/3/2020	NEGATIVE
3/19/2020	RACCOONS	4/3/2020	NEGATIVE
3/19/2020	RACCOONS	4/3/2020	NEGATIVE
3/20/2020	RACCOONS	4/3/2020	NEGATIVE
3/20/2020	RACCOONS	4/3/2020	NEGATIVE
3/21/2020	RACCOONS	3/23/2020	NEGATIVE
3/22/2020	RACCOONS	3/23/2020	NEGATIVE
3/22/2020	RACCOONS	3/23/2020	NEGATIVE
3/23/2020	RACCOONS	4/3/2020	NEGATIVE
3/23/2020	RACCOONS	4/3/2020	NEGATIVE
3/23/2020	RACCOONS	4/3/2020	NEGATIVE
3/23/2020	RACCOONS	4/3/2020	NEGATIVE
3/25/2020	RACCOONS	4/3/2020	NEGATIVE
3/25/2020	RACCOONS	4/3/2020	NEGATIVE
3/25/2020	RACCOONS	4/3/2020	NEGATIVE
3/27/2020	RACCOONS	4/3/2020	NEGATIVE
3/27/2020	RACCOONS	4/3/2020	NEGATIVE
3/27/2020	RACCOONS	4/3/2020	NEGATIVE
3/27/2020	RACCOONS	4/3/2020	NEGATIVE
3/30/2020	RACCOONS	4/3/2020	NEGATIVE
3/25/2020	SKUNKS, STRIPED	4/3/2020	NEGATIVE
3/26/2020	SKUNKS, STRIPED	4/3/2020	NEGATIVE
3/27/2020	SKUNKS, STRIPED	4/3/2020	NEGATIVE
3/30/2020	SKUNKS, STRIPED	4/3/2020	NEGATIVE

VARIANT TESTING

Brain tissue samples collected from confirmed rabies positive animals were shipped to New York Department of Health Wadsworth Center Rabies Laboratory for confirmation and variant determination. All animals tested during this program were confirmed as raccoon variant. Importantly, all terrestrial rabies documented in 2019/2020 in Sagadahoc County has been raccoon rabies virus variant.

Recommendations

The following set of recommendations are designed to identify specific, easily attainable actions as well as broad scale activities for long-term planning to reduce conflicts with rabies vector species in the City of Bath.

1. Landfill
 - a. Close all dumpster lids between uses
 - b. Pick up trash around dumpsters

- c. Establish policy to address reoccurring incidents of wildlife stuck in a dumpster (e.g., locking covers, moving dumpsters, etc.)
2. Discontinue feeding wildlife at the Wastewater Treatment Plant
3. Encourage rubble pile removal next to Wastewater Treatment Plant
4. Encourage dilapidated buildings and other structures to be removed
5. Encourage residents to secure garbage, both in storage and during street side pickup
6. Consider establishing City policies or ordinances to improve negative, wildlife attracting behaviors:
 - a. Backyard chicken operations should be fenced (chickens not free-ranging)
 - b. Composting operations should be conducted in a contained system (no exposed piles of compost material)
 - c. Those compost piles not containing food items may be uncovered
 - d. All dumpsters within the city must be closed at all times to prevent access by wildlife
 - e. Discourage all bird feeding or at least reduce the number of feeders to one per household. Bird feeders present should have exclusion devices to dissuade non-avian species from using them.
 - f. Consider establishing an ordinance to prohibit intentional feeding of rabies vector species or all wildlife
 - g. Consider establishing a policy specific to town employees feeding wildlife, or specifically, rabies vector species
 - h. Address dilapidated buildings, rubble, abandoned equipment and other structures that are attractive to wildlife.
 - i. Restrict relocation of rabies vector species, in accordance with existing state policy.
7. Personal/town gardens should be fenced or have deterrents to reduce the attractiveness to certain species including raccoons.
8. Police Department and/or ACO should continue to maintain a log of all strange acting animal calls and locations for future analysis.
9. The City of Bath should provide outreach and extension materials to residents that includes methods to maintain property free of attractants.
10. The City of Bath should encourage residents to never feed wildlife or provide other activities that encourage wildlife to live close to people. Wildlife should be expected to be fearful of humans; losing their natural fear of people leads to increased human-wildlife conflicts that includes zoonotic disease transmission.

Conclusion

APHIS WS would like to thank the partnership of professionals that help guide and support the work in Bath. Rabies prevention and control to protect human and animal health is complex. Future communication and careful consideration of all decisions, including a fully integrated management program to manage the disease, is encouraged moving forward to provide the best public policy to safeguard area residents and visitors of/to the City of Bath. APHIS WS is grateful for the opportunity to assist in providing a balance between humans and wildlife so healthy, sustainable populations can be enjoyed by all.