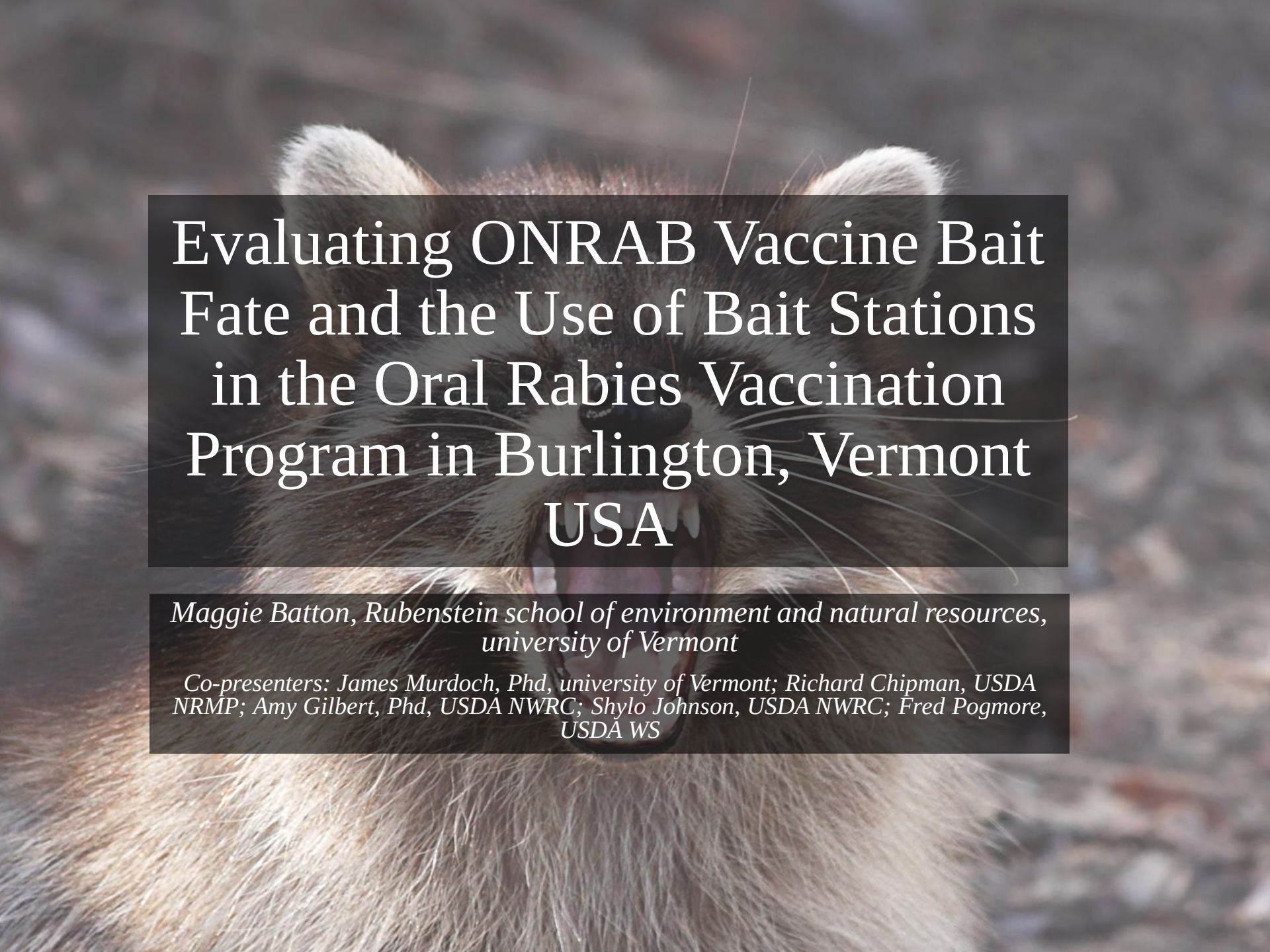
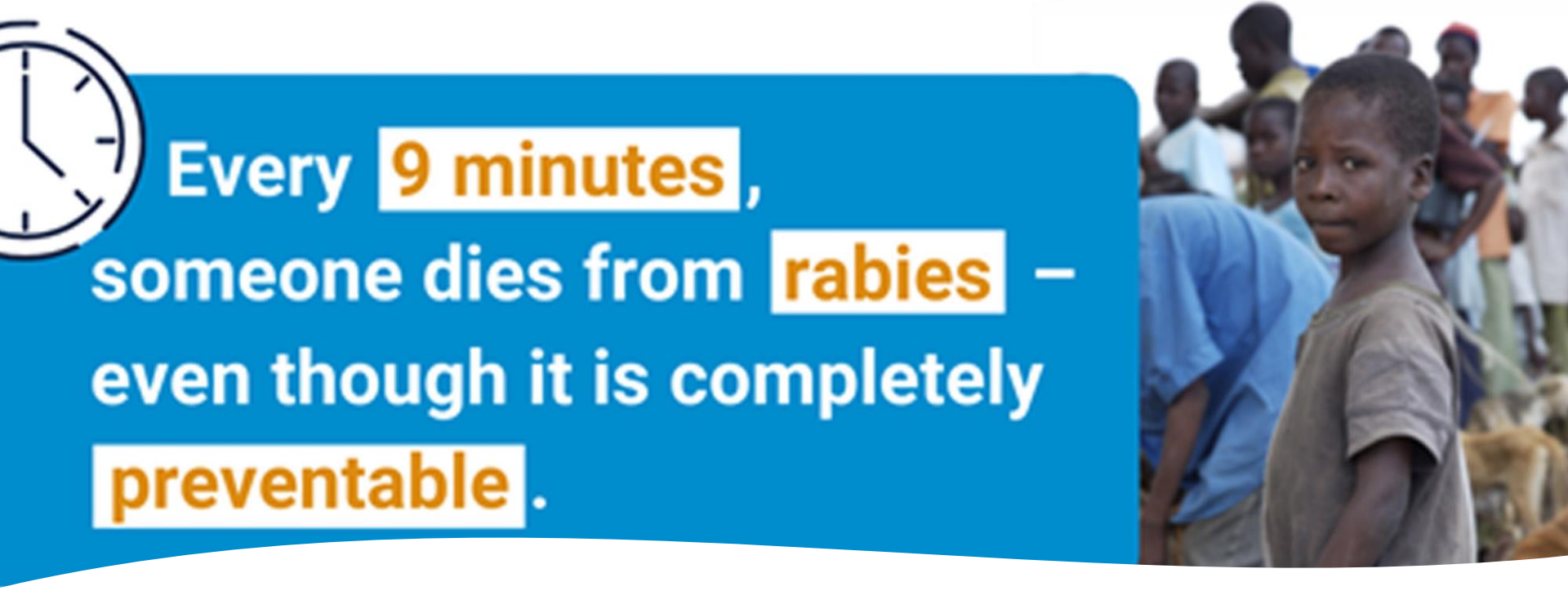


Evaluating ONRAB Vaccine Bait Fate and the Use of Bait Stations in the Oral Rabies Vaccination Program in Burlington, Vermont USA

Maggie Batton, Rubenstein school of environment and natural resources, university of Vermont

Co-presenters: James Murdoch, Phd, university of Vermont; Richard Chipman, USDA NRMP; Amy Gilbert, Phd, USDA NWRC; Shylo Johnson, USDA NWRC; Fred Pogmore, USDA WS



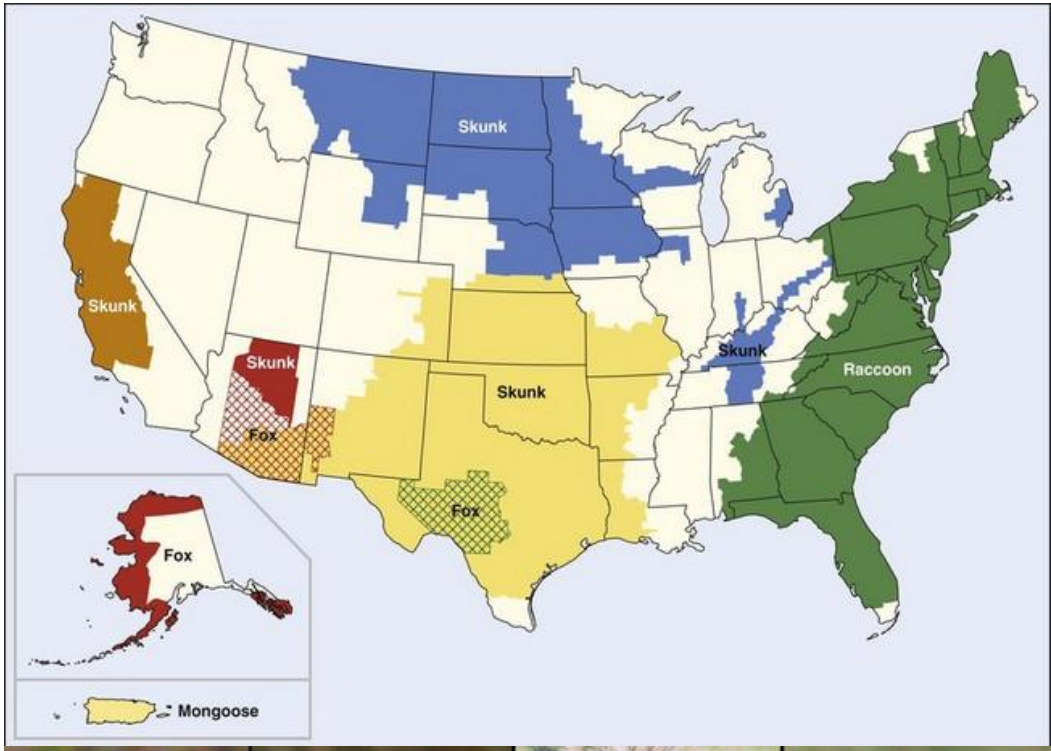
What is Rabies virus?

- Rabies virus is a fatal zoonotic disease
- Spread through bite or scratch of an infected animal
- Global effort to eliminate **dog mediated** rabies virus by 2030

Managing Rabies in North America

- Canine variant (eliminated)
- Raccoon variant
- Fox variant
- Skunk variant
- Bat variant
- Mongoose Variant

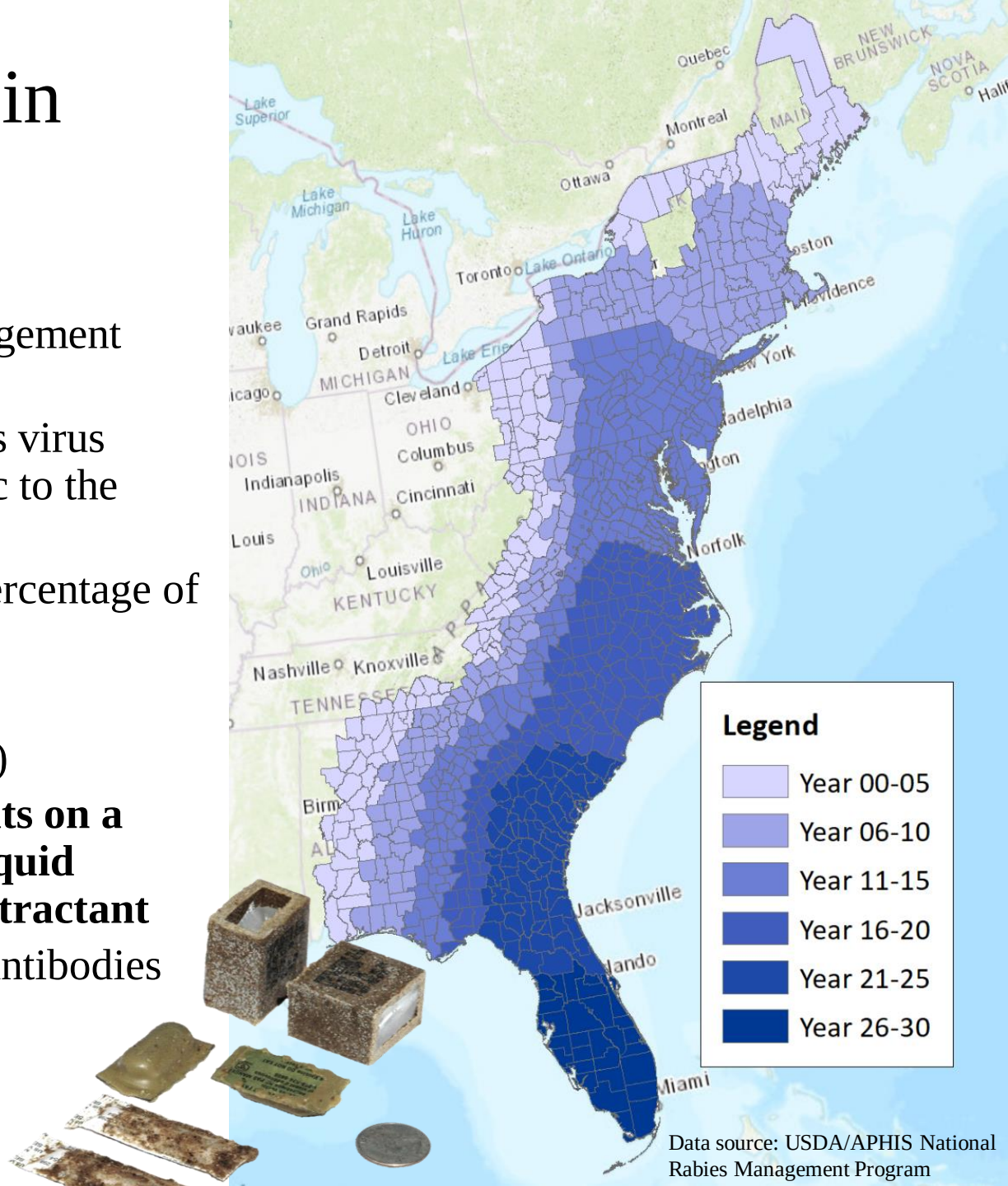
55,000 human exposures per year



Managing Rabies in North America

- USDA National Rabies Management Program (NRMP)
  1) Stop the spread of rabies virus outside of areas enzootic to the disease
  2) Vaccinate a sufficient percentage of target populations

- Oral rabies vaccination (ORV)
  - **Involves distributing baits on a landscape that contain liquid vaccines covered in an attractant**
  - Rabies virus neutralizing antibodies (RVNA)



Data source: USDA/APHIS National Rabies Management Program

Oral Rabies Vaccination Strategies

Methods:

- Fixed Wing aircraft
- Helicopter
- Hand baiting
- Bait stations

- **> 9.5 million Baits distributed**
- **ORV in 18 states**

ORV Considerations

Important factors

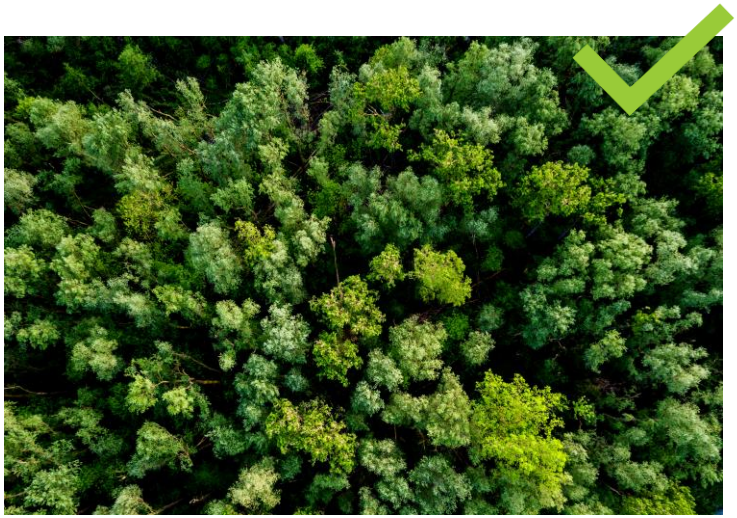
- Landscape
- Distribution patterns
- Time of year
- Bait density

Data source: USDA/APHIS National Rabies Management Program

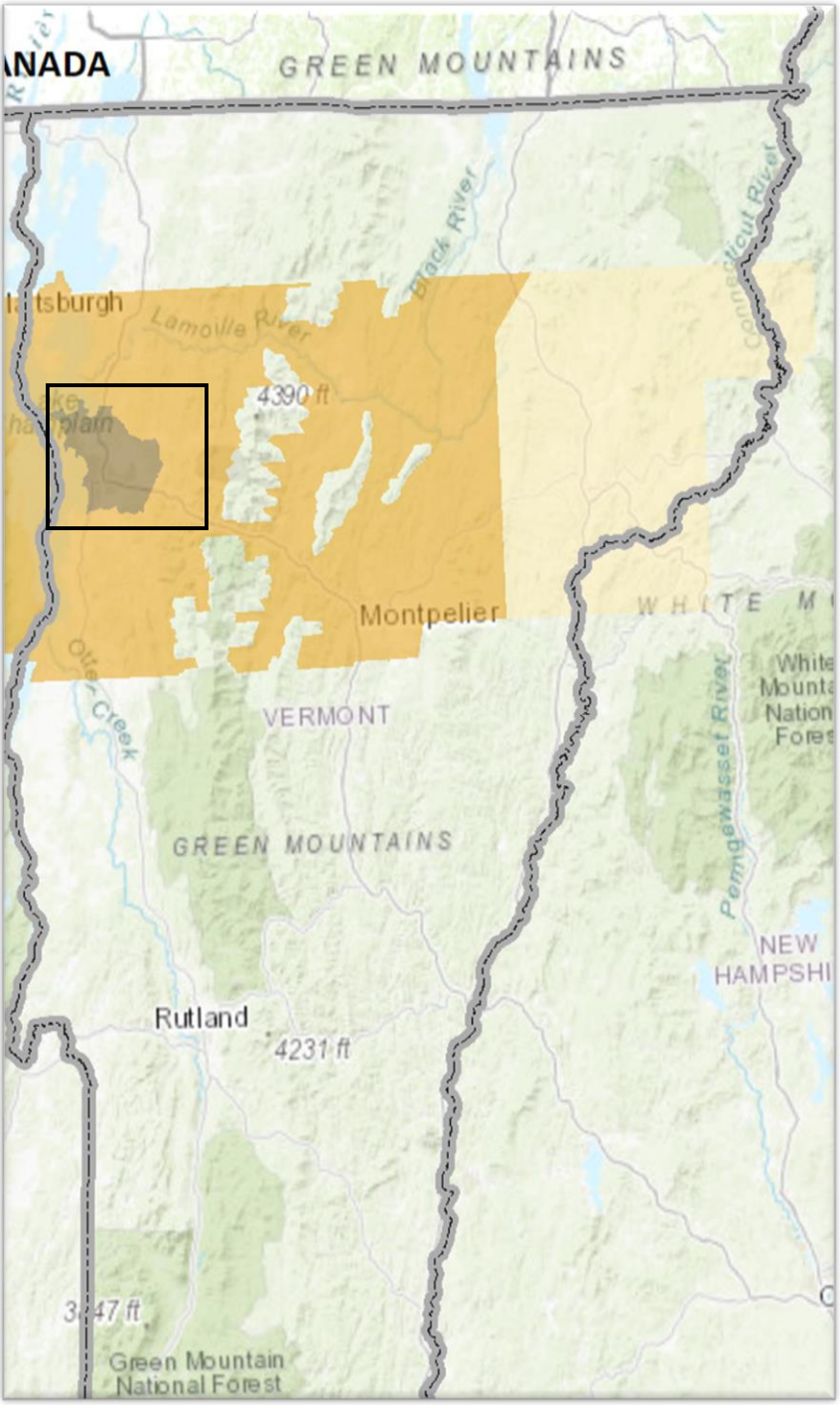
Off-time calculator adjusts the target # of baits on a landscape

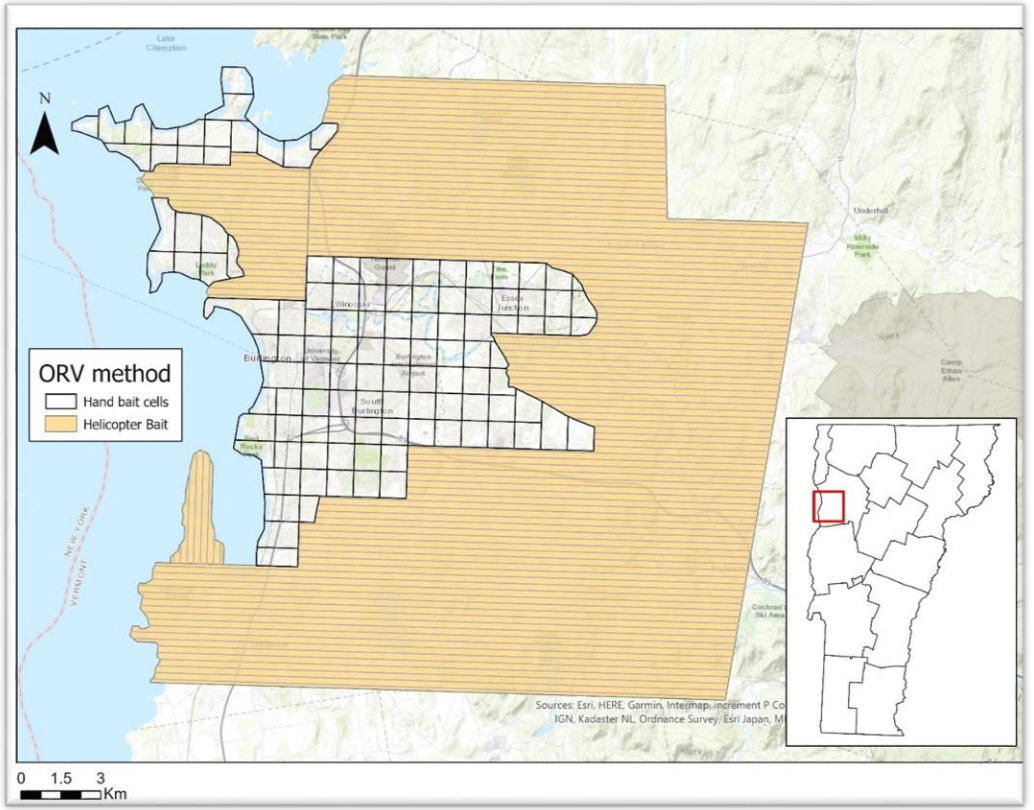
ORV Considerations

- ORV has been effective in rural settings, but % is much lower in urban areas



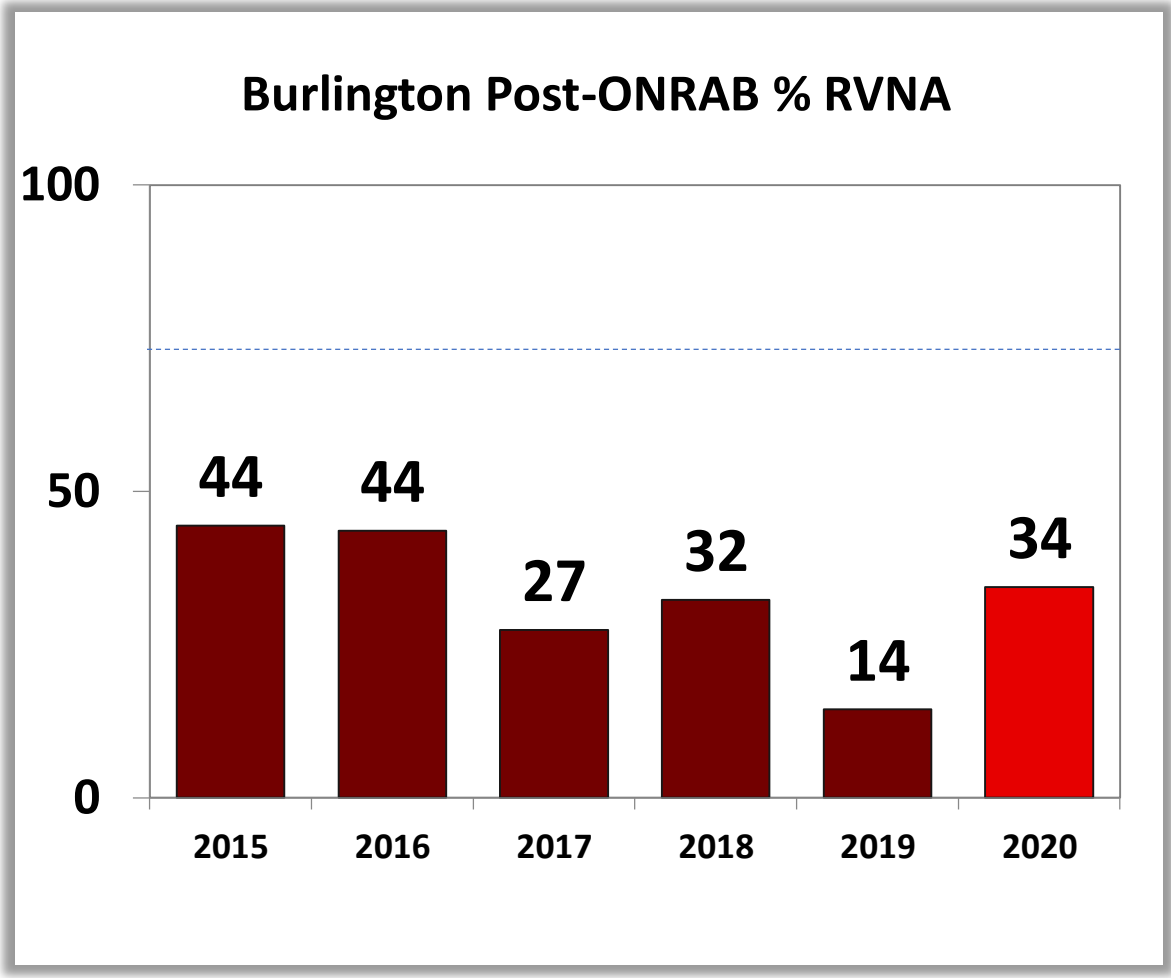
- Baiting in urban areas has many challenges
  - Abundant alternative food sources
  - Non-target bait competitors
  - Hand baiting limitations
    - Mainly occurs on roads, sidewalks, trails


ANADA
GREEN MOUNTAINS
Black River
Lamoille River
4390 ft
Montpelier
VERMONT
GREEN MOUNTAINS
Rutland
4231 ft
Green Mountain
National Forest


N
ORV method
Hand bait cells
Helicopter Bait
0 1.5 3
Km

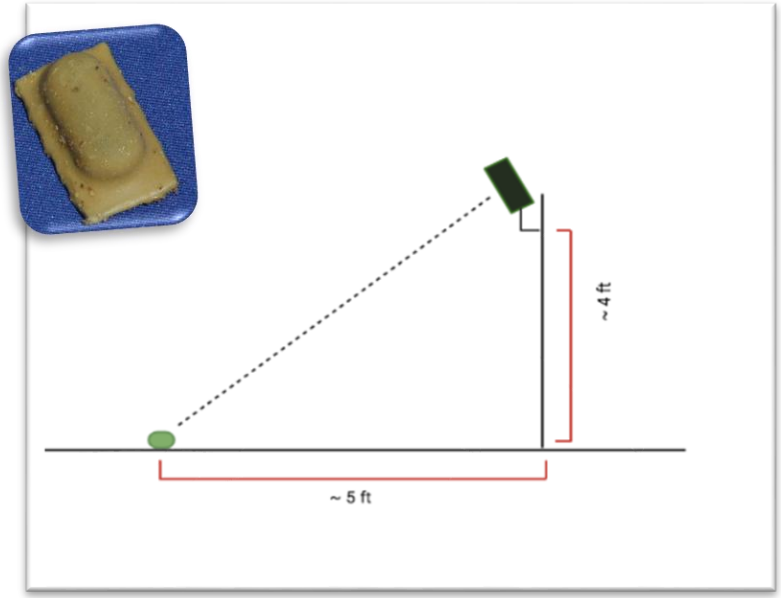
ORV in Vermont

- RVNA seroprevalence conversion rates remain low in Burlington
- Hand baiting has been the only ground baiting strategy used in Vermont
- Hand baiting methods have been refined to get a more even bait distribution across the area



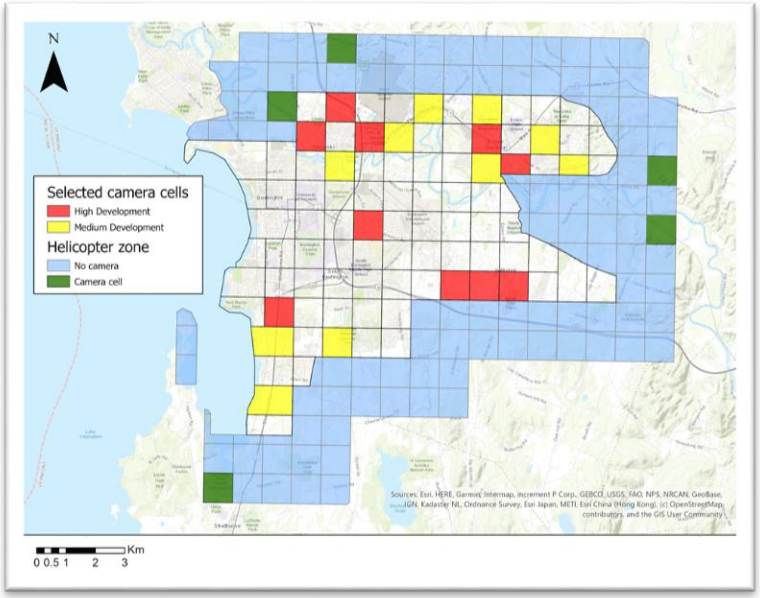
Data source: USDA/APHIS National Rabies Management Program

Objective 1: Camera Trapping



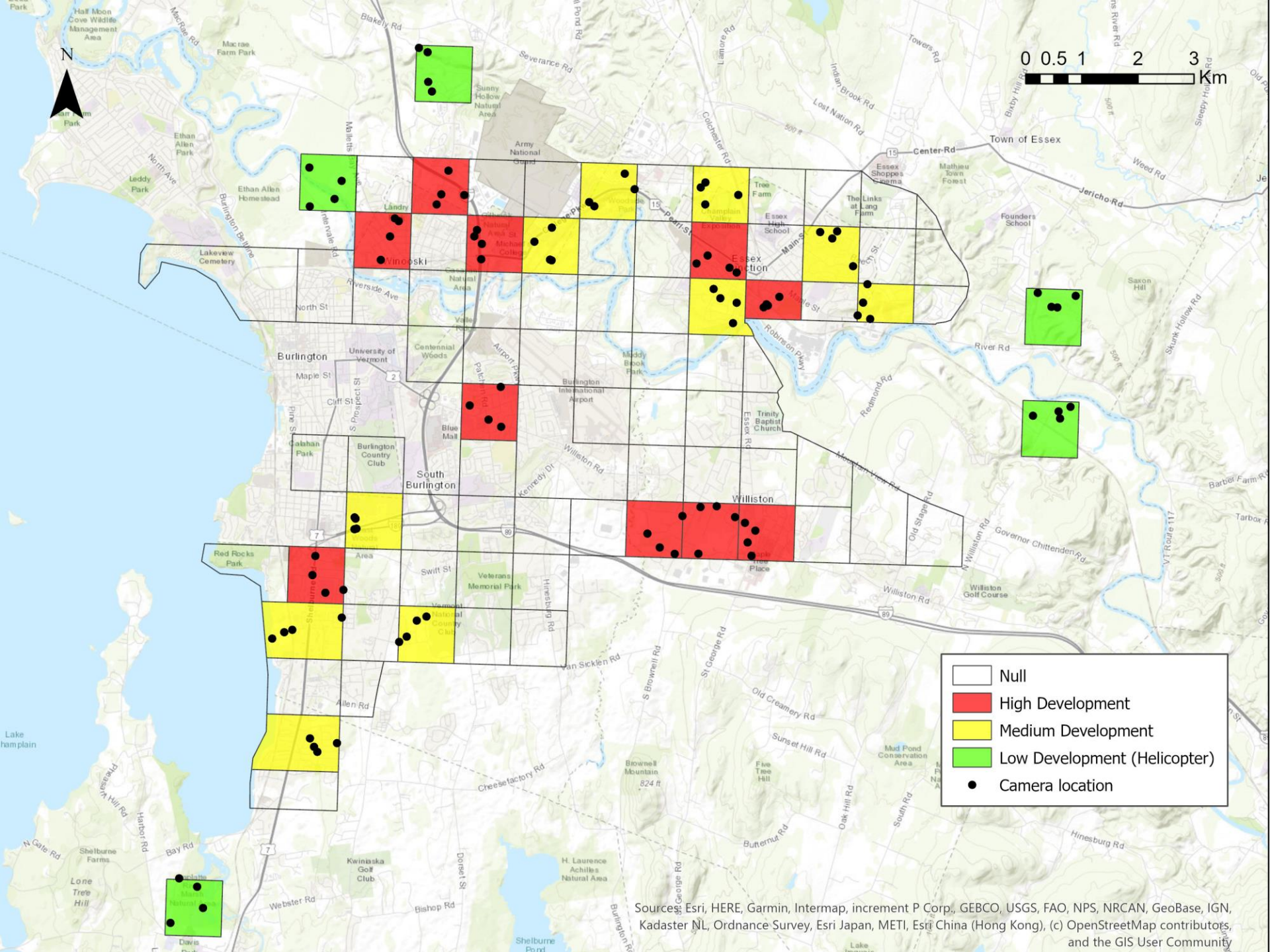
- **Improve the effectiveness of current ORV baiting strategies in urban environments by understanding factors driving bait survival on the landscape.**

- Cameras monitor ONRAB baits and mimic hand baiting strategy



Study Area

- High human development (Hand baiting)
- Medium development (Hand baiting)
- Low development (Helicopter zone)


N
0 0.5 1 2 3
Km
Null
High Development
Medium Development
Low Development (Helicopter)
Camera location
Burlington
South Burlington
Williston
Essex Junction
Winooski
Town of Essex
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Study 1: Objectives

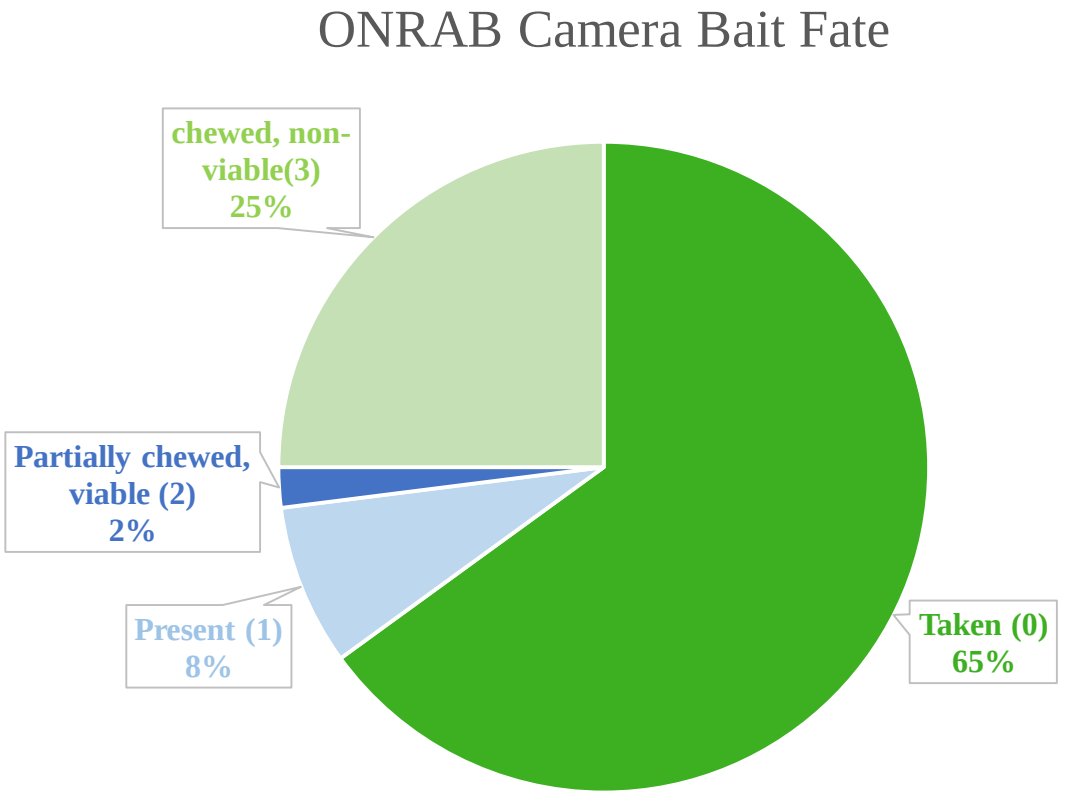
Monitor	Monitor the fate of ONRAB vaccine baits using camera traps
Summarize	Summarize the fates of baits (e.g., average persistence time, causes of bait loss/consumption)
Model	Model the probability of bait uptake as a function of several site-level and landscape-level characteristics

Methods: Monitor and Summarize

(1)

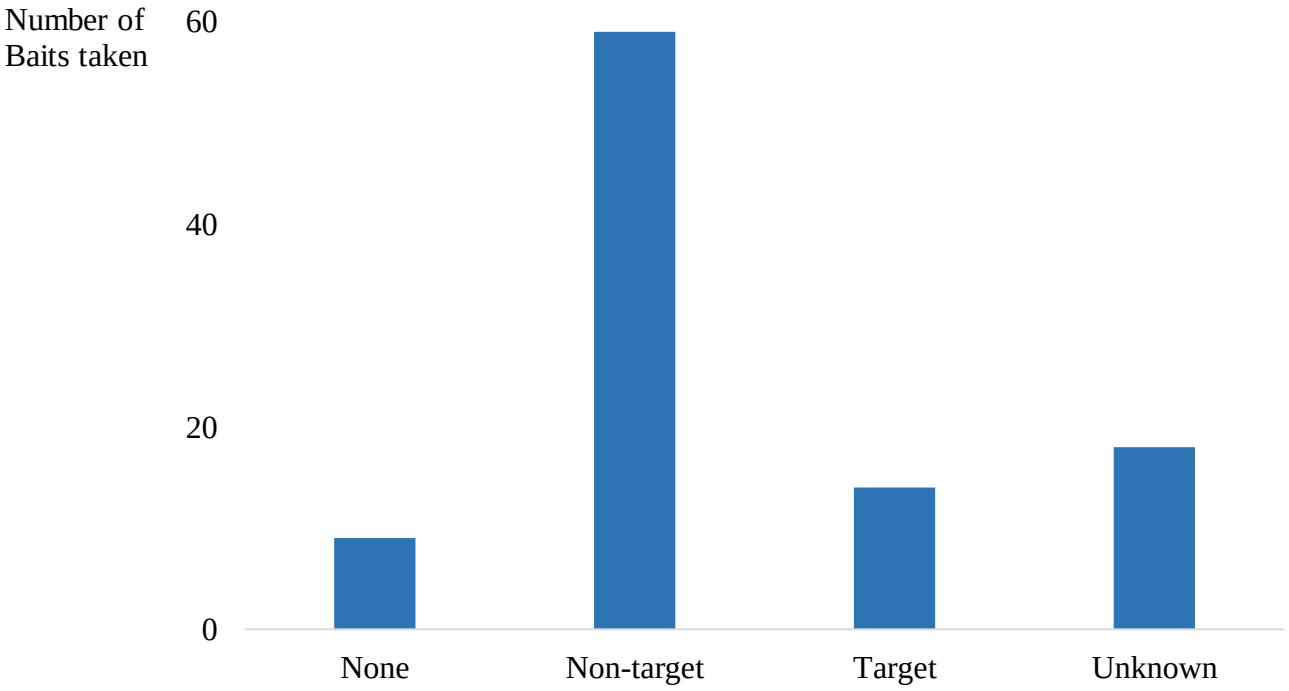
(2)

(3)



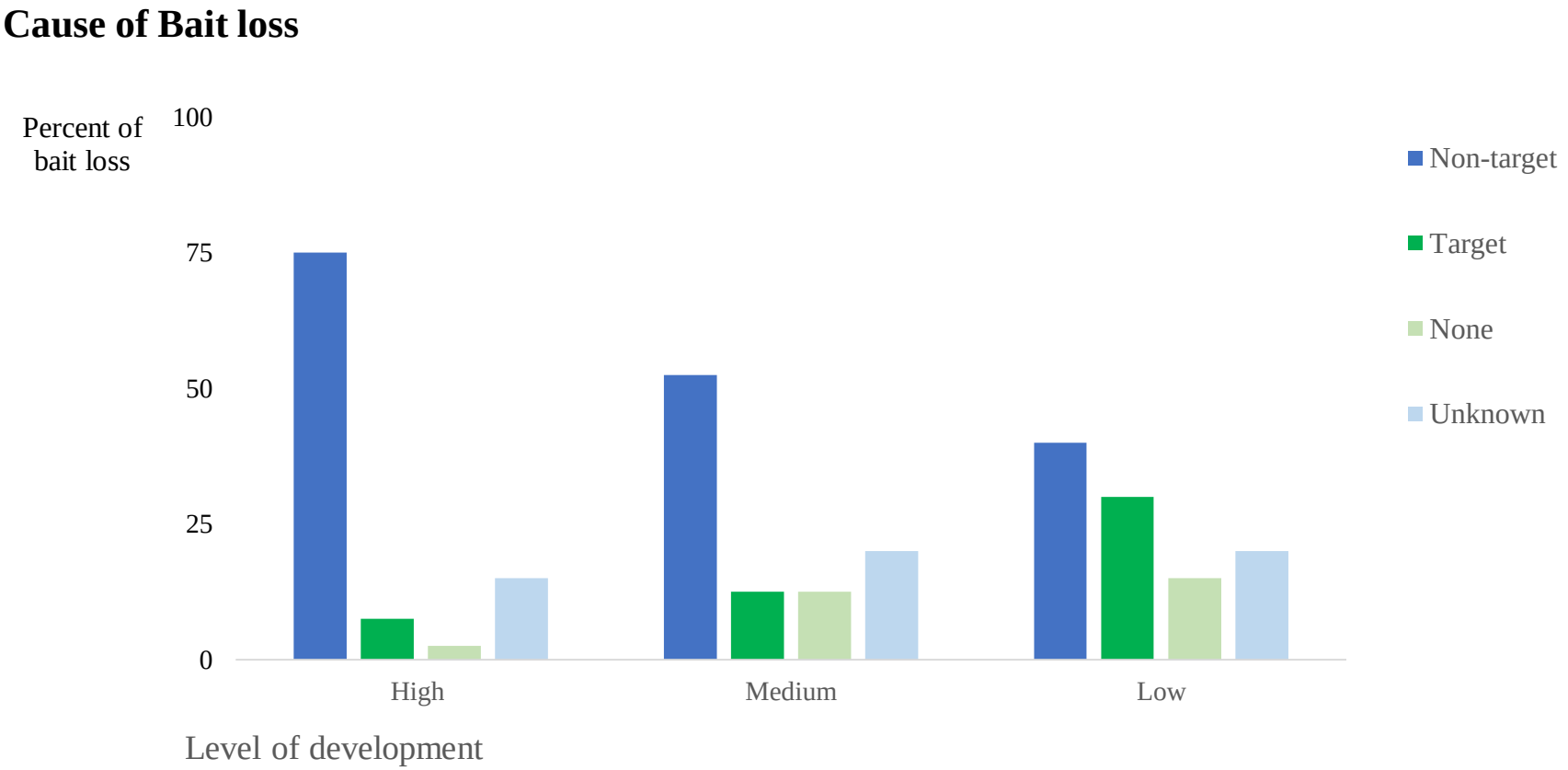
Results: Summarizing bait fate

Bait loss across study area

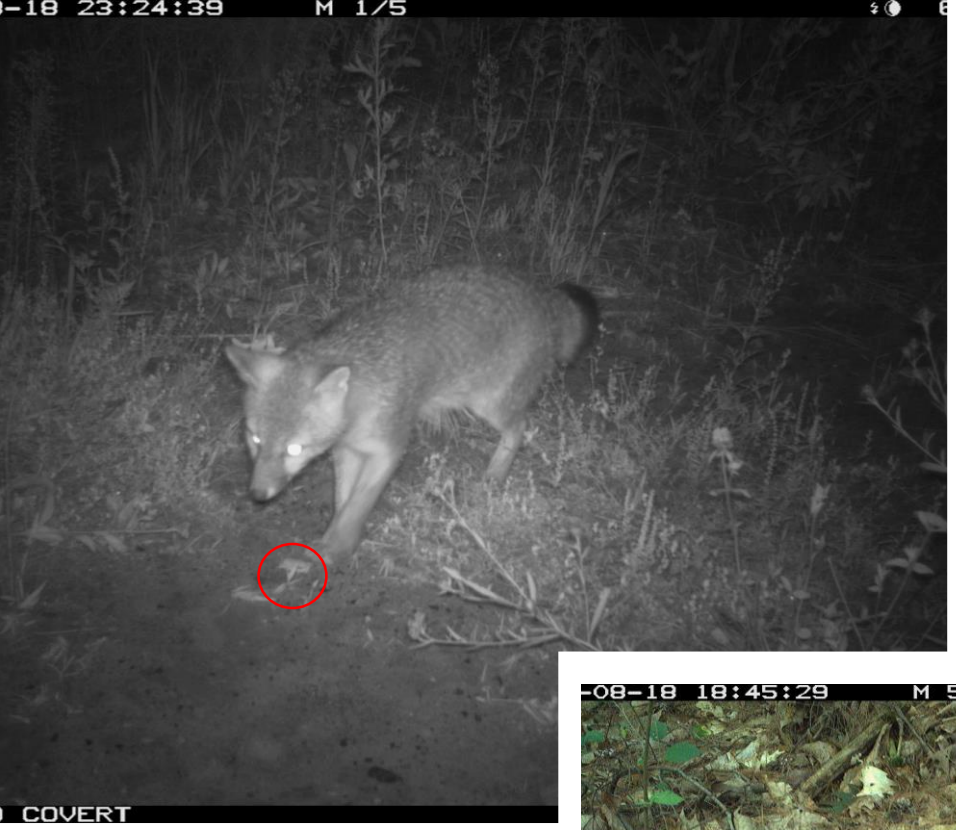


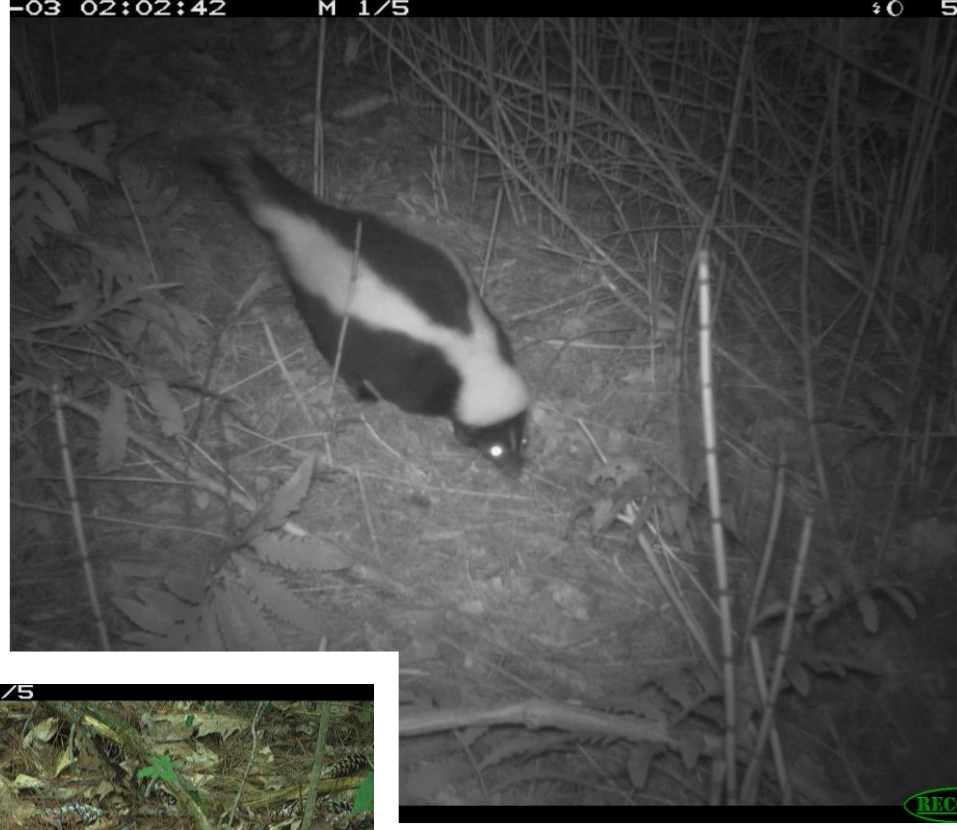
Cause	% of Baits
Lawn mower	28
Squirrel	14
Bait present	9
Raccoon	8
Bird	6
Human	3
Skunk	3
Dog	2
Fox	2
Opossum	2
Cat	1
Coyote	1
Deer	1
Fisher	1
Mouse	1

Summarizing bait fate



Days on the landscape		
Development	Maximum	Average
High	15	4
Medium	21	7
Low	9	2


-18 23:24:39 M 1/5
COVERT


-03 02:02:42 M 1/5


22:10:38 M 1/5

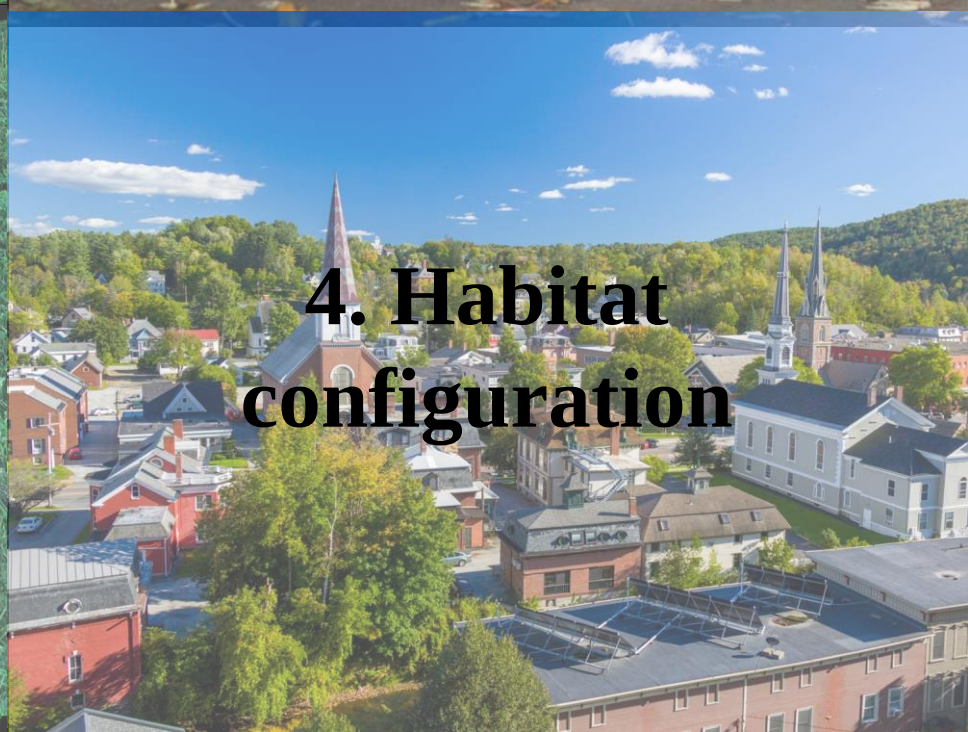

-08-18 18:45:29 M 5/5
PRO COVERT


:04:37 M 1/5


021-08-13 23:22:54 M 1/5 75°F
1. Chance of bait encounter
RECONYX


2. Food abundance


T2 PRO COVERT
1-08-21 10:32:32 M 1/5 80°F
3. Bait competitors
PRO COVERT
RECONYX


4. Habitat configuration

Objective 2: Bait Stations

- **Assess the effectiveness of adding bait stations to hand baited areas at improving seroprevalence conversion rates in urban areas**

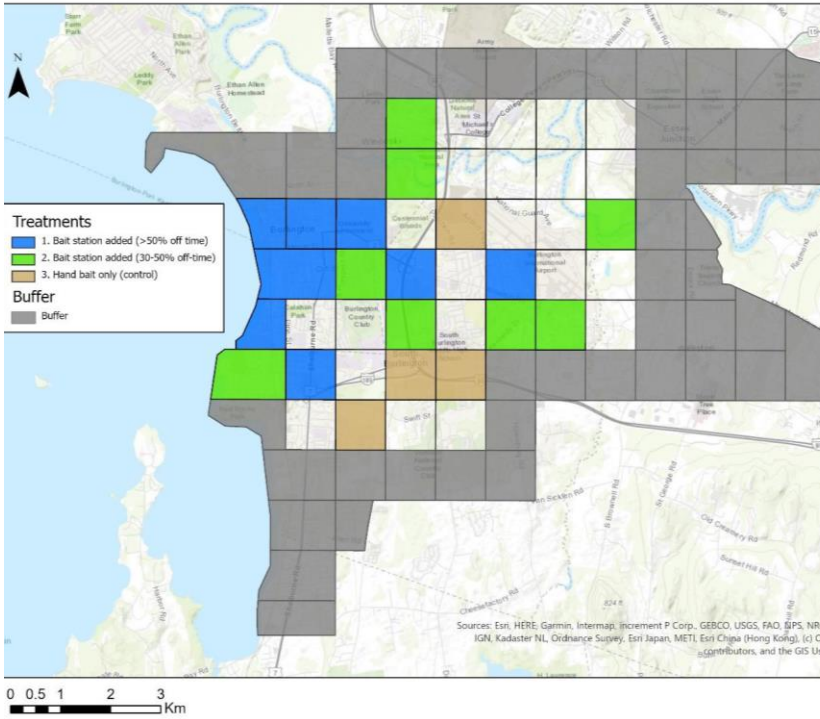
- Benefits
  - Targeted deployment
  - Bait away from roads
  - Reduced non target bait competitors

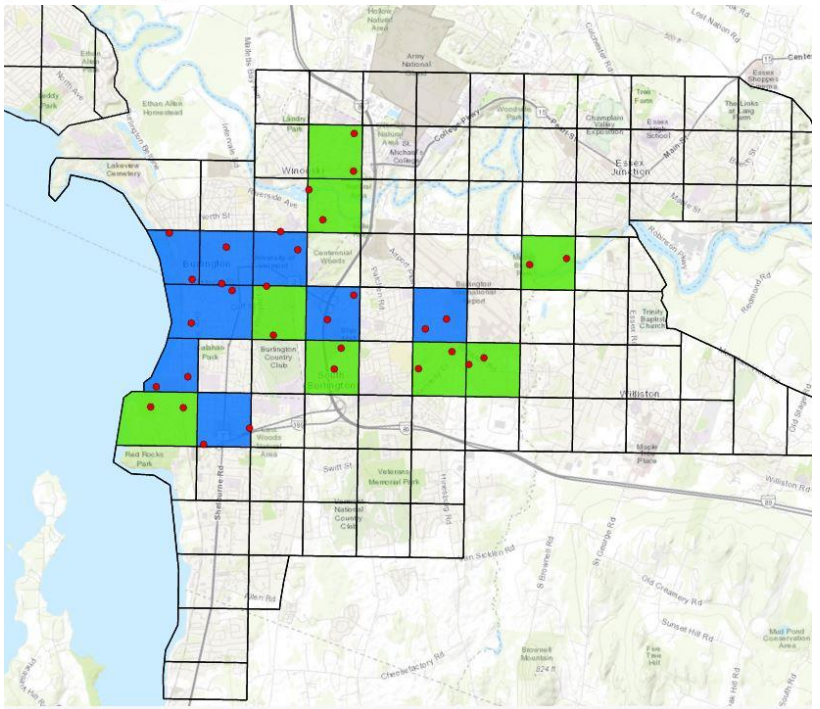
Compost

Bait Station Methods

Treatments:

1. Bait stations added to hand baited cells where off-time > 50%
2. Bait stations added to hand baited cells where off-time 30-50%
3. Hand baited cells only (control)





Bait Station Methods

- Unique biomarkers used to identify where animal ingested bait
- Pre and post-bait trapping to collect biological data from target species
- Blood serum from all captured animals will be analyzed for evidence of an RVNA response

Field Summary

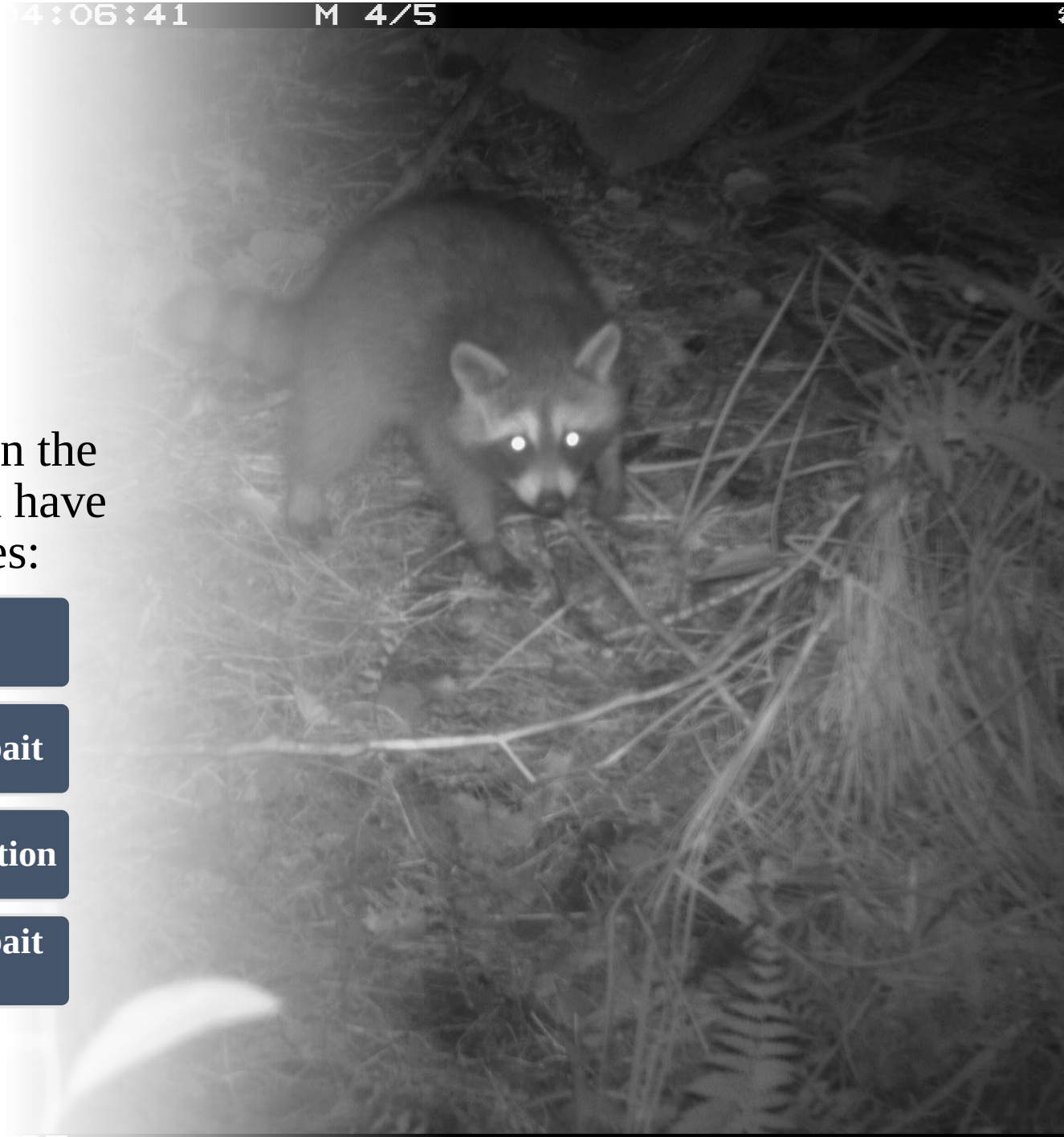
Pre Bait Captures by Treatment (July)				
	Treatment 1	**Treatment 2**	**Control**	**Grand Total**
FOXES, GRAY	5	1		6
FOXES, RED	0	0	0	0
RACCOONS	213	117	95	425
SKUNKS, STRIPED	39	18	1	58
Grand Total	**257**	**136**	**96**	**489**

Post Bait Captures by Treatment (October)				
	Treatment 1	**Treatment 2**	**Control**	**Grand Total**
FOXES, GRAY	4	0	0	4
FOXES, RED	0	1	0	1
RACCOONS	146	167	96	409
SKUNKS, STRIPED	33	20	3	56
Grand Total	**183**	**188**	**99**	**470**

Model of Vaccination Probability

Each animal captured in the post-baiting period will have one of four outcomes:

- **Not vaccinated**
- **Vaccinated from a hand bait**
- **Vaccinated from a bait station**
- **Vaccinated from a hand bait and a bait station**



So What?

- Understand why seroconversion rates are low in Burlington, VT
- Identify best ORV strategy to maximize the probability of bait consumption by target species
- **~ 13%** of ORV area is urban

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Questions?