







VERMONIA

UVM Transportation Research Center

National Wildlife Federation

UNDER-ROAD WILDLIFE MOVEMENT THROUGH CULVERTS AND BRIDGES IN VERMONT:

INFLUENCES OF STRUCTURE AND SITE CHARACTERISTICS

> Paul Marangelo Vermont Chapter



Acknowledgements

- James Brady, VTRANS
- Gina Campoli, VTRANS
- Laura Farrell, Phd
- Melissa Gaydos, NWF
- Chris Hilke, NWF
- Jens Hilke, VTF&W
- Alan Howard, University of Vermont (Statistical support)
- Glenn McRae, University of Vermont Transportation Research Center
- Allan Thompson
- **Funding:**
 - Vermont Agency of Transportation (UVM TRC)
 - De Coizart Foundation/National Wildlife Federation



Mission: Safeguard and repair habitat connectivity in the Northern Appalachian region for the benefit of wide-ranging, forest-dwelling wildlife – and people.



C. Reining

Wildlife use of transportation structures to move across road corridors

Assess wildlife use of transportation structures across various structure sizes/types.

Are "Movement Guild" species groupings (VTRANS BMP manual - Cramer 2011) a helpful way to understand patterns and size/use relationships?

Other site/structural factors that might explain variation in site use

Game Camera Study Design:

- Structure-focused monitoring with 60 cameras (Reconyx PC 900) at 23 sites
- Sites representative of range of structure sizes/types
- Habitat-focused monitoring (24 cameras) at 6 of the 23 sites
- 2017:Winter tracking at 6 of the 23 sites



Busy roads separate large forest blocks



2014 Site selection (cherry picking):





- Forested roadside habitat along busy road corridors that bisect forest blocks
- No "fatal flaws" (Passage Assessment System, Kintsch and Cramer 2011)
- Structure characteristics:
 - Dry movement surfaces
 - Clear sight/ movement lines through structure

Structure-focused monitoring



Camera site locations:

16 – Northern Vermont (Worcesters to Northest Kingdom Linkage)

7 - Rutland County (Greens to Adriondacks linkage)





Habitat-focused monitoring (6 of 23 sites):

- 2-5 cameras at structures
- 4 cameras in habitat away from road, both sides, 200 ft and 1600 ft from road.

- 1. Wildlife moving through structures
- 2. Wildlife presence away from road

13 "focal" species

- Black bear
- Bobcat
- Coyote
- Deer
- Fisher
- Grey fox
- Moose
- Otter
- Red fox
- Skunk

<u>Also detected:</u> raccoon, domestic cat, domestic dog, snowshoe hare, muskrat, opossum, porcupine, woodchuck

<u>Birds:</u> grouse, great blue heron, turkey, woodcock, wood duck, mergansers

"small weasels" (mink, ermine, long tailed weasel)

Results: May 2014 – June 2016

39,940 monitoring days418K photos

• 738 focal sp. detections

• 573 focal sp. through-passages













Focal species through-passages



Through-passage frequency per site



More detections away from roads, fewer at the structures...



Structure size and species use

"Movement Guilds" of species:

- Developed to evaluate the benefit of wildlife passage mitigation solutions in terms of structure retrofit/replacement across a range of structure sizes/types:
 - Passage Assessment System (Kintsch and Cramer, 2011)

VTRANS BMP manual (Cramer 2012)

structure	species	
Small underpass (pipe, box, arch 3-6' wide)	small weasel, fox, otter, bobcat, fisher bear, coyote, lynx	<mark>> 8 - 10'</mark>
Medium underpass (Larger culverts)	small weasel, fox, otter, bobcat, fisher bear, coyote, lynx deer, moose	high
Large underpass (spans, large culverts)	small weasel, fox, otter, bobcat, fisher bear, coyote, lynx deer, moose cougar, wolf	

Through-passage data: Some species not represented

No through-passages of bear, lynx, moose, cougar, wolf

structure	species
Small underpass	small weasel, fox, otter, bobcat, fisher bear, <mark>coyote</mark> , lynx
Medium underpass	small weasel, fox, otter, bobcat, fisher bear, <mark>coyote</mark> , lynx deer, moose
Large underpass	small weasel, fox, otter, bobcat, fisher bear, coyote, lynx deer, moose, cougar, wolf

Species/movement guilds for analysis:

structure	species
Small underpass	small weasel, fox, otter, bobcat, fisher (coyoto)
Medium/Large underpass	small weasel, fox, otter, bobcat, fisher (coyoto) deer Coyote



Mean frequency of Through-Passage per Movement Guild



Mean (SE) Frequency of Through-Passage



Important site characteristics:

Local-scale (within 1KM buffer of road) structural connectivity

Nearby pens of hunting dogs

Local Structural Connectivity:

"Diffuse"

"Fragmented"

"Pinched"







Focal species mean through passage frequency vs. site-scale structural connectivity



Other potentially important site characteristics



 Elevation of roadway above structure
 Easier to go under than climb over

Traffic volume

Structure characteristics:

Dry movement surface: Pipe culverts vs. flat substrate (stream bottoms, concrete shelves)





Potentially important structural attributes

"Shelf" High structure width/bankful width ratio





Major takeaways:

- Wildlife use drainage structures to occasionally move under roads
 - Even when "cherry picking" sites, 11 of 23 were low or zero use.
- Modified guild/size class framework useful for informing efforts to increase the ability of drainage culverts to move wildlife under roadways.





Takeaways (2)

- Coyote should be assigned to HOHMC movement guild.
- Local-scale structural connectivity matters
 - "pinched" sites used most often, <u>useful way to maximize</u> <u>transportation structure investments to optimize wildlife passage.</u>
 - "fragmented" sites: little current use
 - but don't disregard *restoration* needs for connectivity across challenging but critical road corridors!!!!
- Structure design attributes probably matter, but few consistent broad patterns in our data (outside of study design)



AADT at sites

14000	
12000	
10000	
8000	
6000	
4000	
2000	
0	1222 1332 1283 1292 1142 1422 735 14192 1613 1614 3084 1823 290 1551 10125 1914 1919E 19194 1355 1576.06 7.110 4.127

7-110 deer use despite small size
Bobcat in pipes
Repeated use by individuals
No bear or moose through passages

Anticipated outcomes:

- Small scale structural connectivity appears important.
- Structure design attributes matter (shelves)
- Too many factors and too small a sample size to adequately test for the effects of most other factors/characteristics.
- Some MMSF may avoid large structures (Fisher)
- Smaller structures may be less suitable for bobcat
 <u>compared to the PASS framew</u>

limited use an be impro road corrido **cteristics.**



If our world was perfect.....



large mammals

small mammals

Herps, reptiles

Size-class classification conundrum

for interim analysis:	
large underpass	6
mis-fits (lumped with large)	2
medium underpass	2
small underpass	11

for final analysis:	
large/medium	8
small underpass	13
mis-fits	2



Structural Connectivity GIS modeling

 Interpreting results (identifying spatial priorities)





Priorities derived from modeling exercises are hypothetical

Sites with habitat-focus:

13 species (mink, ermine, and long tailed weasel = "small weasel"; not counting raccoons, woodchucks, domestic pets, mice, birds, etc.)

Species	total detections	% of detections
black bear	24	1.8
bobcat	31	2.4
coyote	180	13.9
deer	879	67.7
fisher	54	4.2
grey fox	5	0.4
moose	38	2.9
otter	22	1.7
red fox	40	3.1
skunk	13	1.0
small weasel	13	1.0
Grand Total	1299	

Wildlife species "movement guilds"

- VTRANS BMP Manual, Cramer et al 2012
- Framework focused on species use if retrofitted to encourage wildlife use; derived from structure/wildlife interactions from western US
 Different hydrology
 Different fauna

Focal species frequency vs. sitescale structural connectivity



low traffic volume; road elevation = forest elevation; lots of forest both sides, unconstricted structural connectivity



high traffic volume Road elevation >>> stream elevation more limited roadside forest cover



connectivity movement

Cost:
 If few "low cost" options, wildlife more likely to use culverts/bridges
 If lots of low cost options, wildlife will

- choose crossing through structures less
- If all options are high cost, then wildlife will be detected at structures less.

New movement guild composition simplification for analysis:

structure	species
Small underpass	<mark>small weasel, fox, otter, bobcat, fisher</mark> bear, coyoto
	small weasel, fox, otter, bobcat, fisher
Medium/Large	bear
underpass	deer, moose
	<u>coyote, puma, wolf</u>

Working hypothesis: structure size and width; Wildlife species "movement guilds" (Kintsch and



2014 Site selection (cherry picking):

- Structures most likely to be used by wildlife
- 200 structures examined for suitability
 - on highways in critical road segments
 - Minimum size/height 3'
 - "equal representation" of structure sizes (small, medium, large)

Only 1 of 10 structures were suitable for cameras (potentially usable by wildlife)

Results

 787 "passage events" of 11 species through bridges/culverts
 14 species detected (excluding rodents, raccoon, woodchuck, birds, domestic pets, humans)
 All sites used at least once

Fatal flaws:











Analytical difficulties

- Larger number of low-use sites than anticipated
- A complex set of interacting site characteristic variables likely influence through passage frequency
 - difficult to control for
 - Impracticably large sample sizes needed to fully test for effects of all possibly relevant site characteristic variables

Bobcat water avoidance

Analytical difficulties 1

Some possibly important site characteristic variables were not anticipated during project design:

Influence of small scale structural connectivity

Wildlife avoidance of hunting dog pens within ¼ mi of structure (2 sites)

Connecting Habitat across Vermont



"pinched" structural connectivity





Diffuse structural connectivity





Fragmented/discontinuous

