# PROGRESS REPORT

**for**

# COOPERATIVE BOBCAT RESEARCH PROJECT

**Period Covered:**

**1 January – 31 March 2012**

**Prepared by**

**John A. Litvaitis, Gregory Reed, Cody Merrill, and Marian K. Litvaitis**
**Department of Natural Resources**
**University of New Hampshire**
**Durham, NH**
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## SUMMARY BY STUDY OBJECTIVES

### OBJECTIVE I -- DEVELOP PROTOCOL TO ESTIMATE CURRENT ABUNDANCE OF BOBCATS AND TRACK POPULATIONS STATEWIDE.

#### *Approach #1: Use of transmitter-equipped bobcats to model suitable habitats and generate density estimate based on area requirements.*

GIS layers for habitat suitability models have been collected and edited for the southeastern study area. Comparisons between habitat suitability maps derived from both study areas and the necessity for combining data from both will be explored prior to creating the second-generation map of habitat suitability for the entire state. Preliminary use vs. availability analysis revealed that bobcats in the southeast study area used mixedwoods, scrub/shrub, and wetlands more than expected (based on availability, Fig. 1). Agricultural land, heavy development, light development, open water, and softwood stands were used less than available. Results are largely comparable to use patterns observed in the southwestern study area.

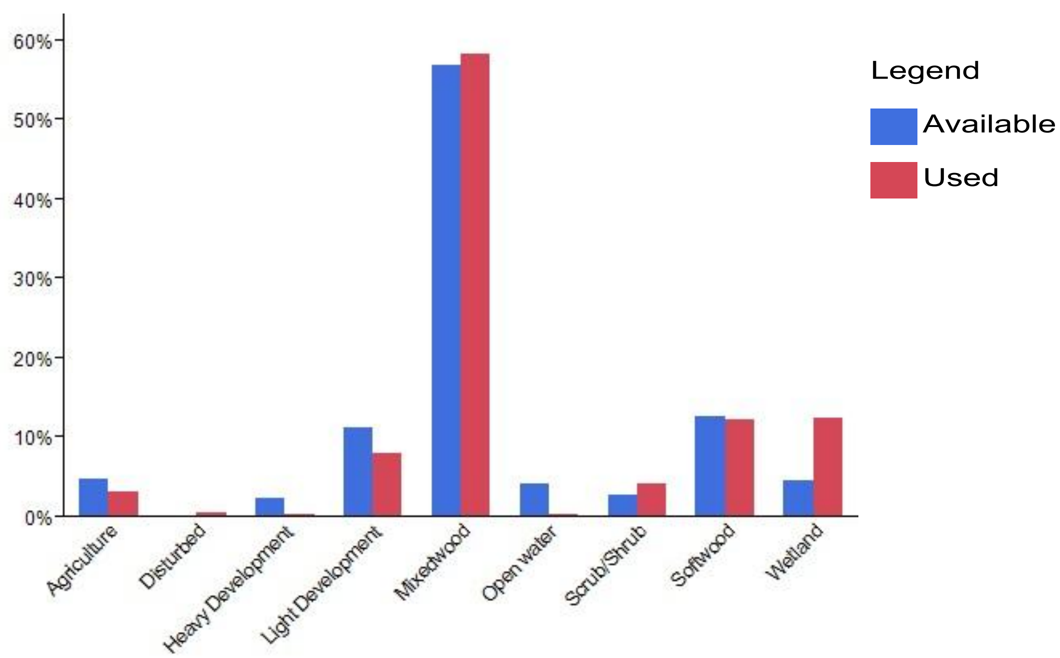


***Figure 1.*** *Preliminary habitat selection patterns by seven bobcats in southeastern New Hampshire during 2011.*

To date, collars have been recovered from 12 of the 18 marked bobcats (Appendix 1). Composite and seasonal home ranges have been estimated for all marked individuals (Appendix 2).

***Approach #2: Development of a method to monitor abundance of bobcat populations based on trail cameras and citizen scientist volunteers.***

Because it is very likely that participants in our developing "citizen scientist" monitoring program will come with a variety of trail cameras that have different configurations (especially trigger speed and zone of detection, Table 1), we continue to explore ways to standardize the performance of different cameras.

***Table 1.*** *Features of three cameras used to develop a standardized protocol to detect free-ranging bobcats in New Hampshire.*

| **Camera** | **Trigger speed (s)** | **Recovery Time (s)** | **Detection Range (ft)** | **Detection Area (sq. ft)** |
|---|---|---|---|---|
| Bushnell Trophy Cam | 1.3 | 4.7 | 52 | 1795 |
| Reconyx HC600 | 0.2 | Instant | 100 | 3516 |
| Cuddeback Capture | 0.6 | N/A | 36 | 150 |

Cameras were positioned in paired configurations and attractants (commercial lure and chicken leg) were placed 4.5 meters from the cameras. Our expectation was that the attractants would position animals directly in front of both cameras and thus eliminate any differences in capture (photographic) rates. We generated over 500 trap nights with 417 independent capture events (photos separated by ≥30 minutes, Fig. 2 and 3). Grey squirrel captures were very high (>700 squirrels/100 trap nights for Reconyx, ~ 300 squirrels/100 trap nights for Cuddeback, and 36 squirrels/100 trap nights for Bushnell cameras) and were excluded from subsequent evaluations. Paired comparisons revealed that Reconyx and Cuddeback trail cameras had different capture rates (Chi-square contingency = 64.312, $P < 0.0001$). Differences were primarily among deer and fox captures. Apparently, deer simply wandered into the wider detection zone of the Reconyx because we do not believe that they were attracted to the central post with lure and bait. Differences in captures of foxes could be due to the camera mounting frame that may have put the detection zones off center from each other. Comparisons between Bushnell and Reconyx trail cameras revealed both had similar capture rates (Chi-square contingency = 4.245, $P < 0.5147$).

Additional sampling occurred in home ranges of transmitter-equipped bobcats in Barrington during late January into February 2012. Three transects of eight Bushnell trail cameras were place in the ranges of female bobcats #45 and #46 for 14-21 days. Each transect had a base scent of coyote urine and Caven's Gusto (skunk lure) with catnip oil, Tomcat bobcat lure, or Caven's Feline Fix added. Four cameras sets in each transect had compact disks hung in a nearby tree to act as a visual lure. Each transect was operational for a week before being visited to gather photos and to change the scents.

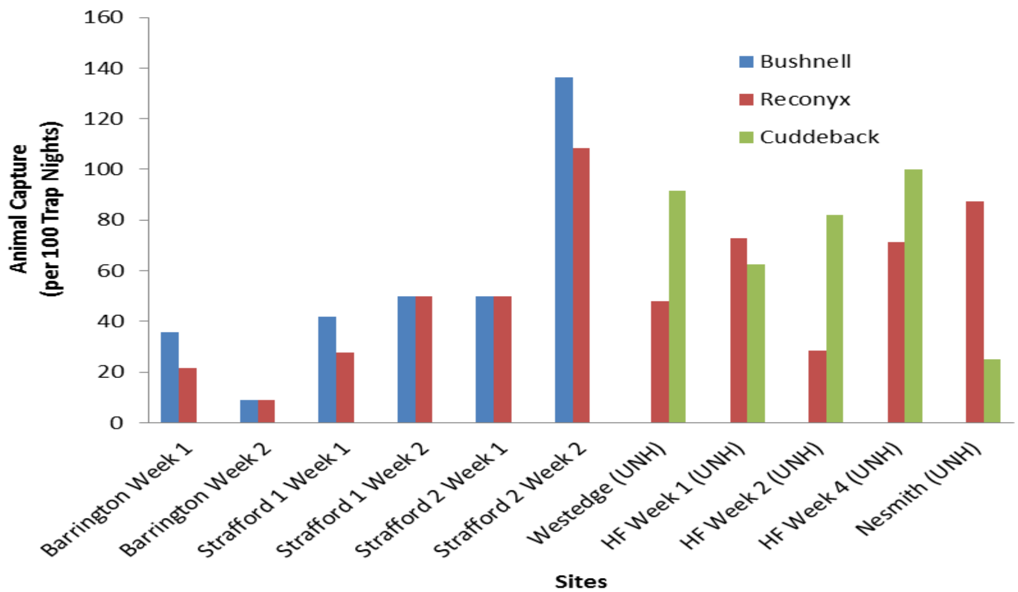


***Figure 2.*** *Comparison of three camera systems by the total count of independent captures in an effort to standardize capture rates of free-ranging mammals in southern New Hampshire.*

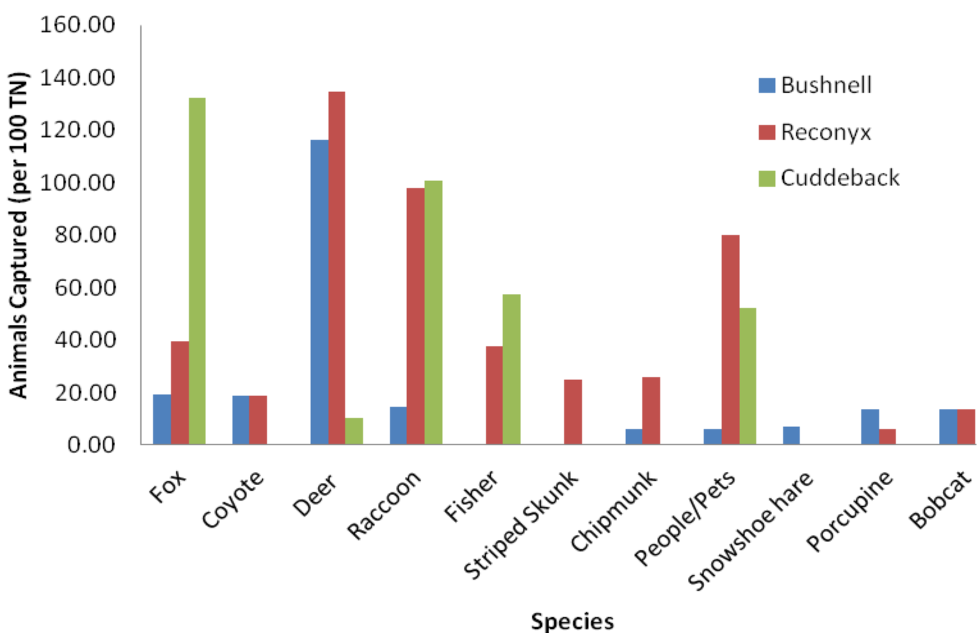


***Figure 3****. Comparison of three different cameras by species captured during efforts to standardize capture rates. Comparisons were paired (i.e., Reconyx versus Cuddeback cameras and Bushnell versus Reconyx cameras). Due to very high captures, grey squirrels were removed prior to analysis.*

During 474 trap nights, 10 bobcat captures were recorded. Captures among the three scents did not show any obvious pattern (Fig. 4). Catnip oil did generate the most captures in a single week and did have a tendency of longer detection times. Cameras with a visual attractant had twice as many bobcat captures as cameras that only had a scent station (Fig. 5).

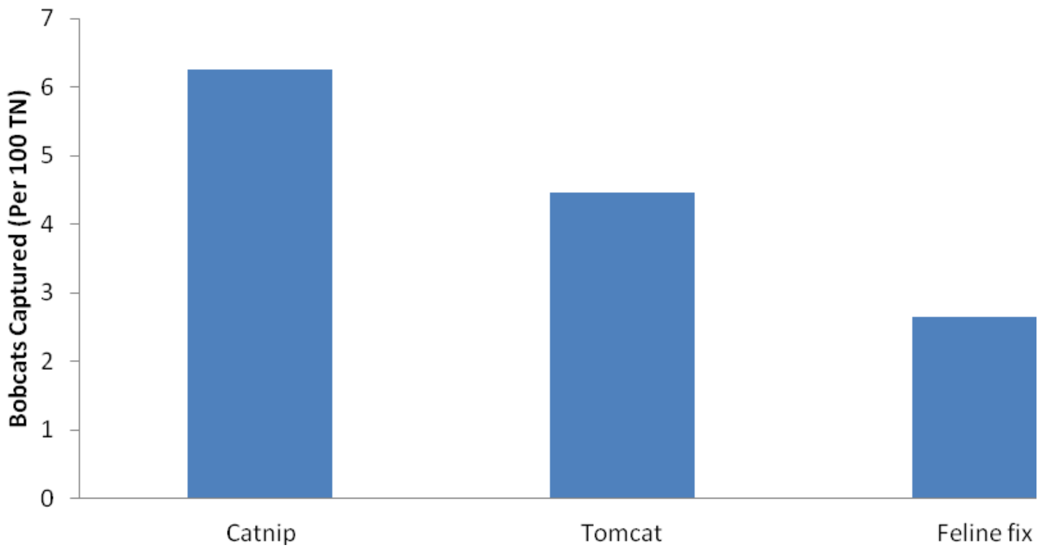


***Figure 4.*** *A comparison between three types of bobcat attractants to lure bobcats to specific location for maximizing detection rates.*

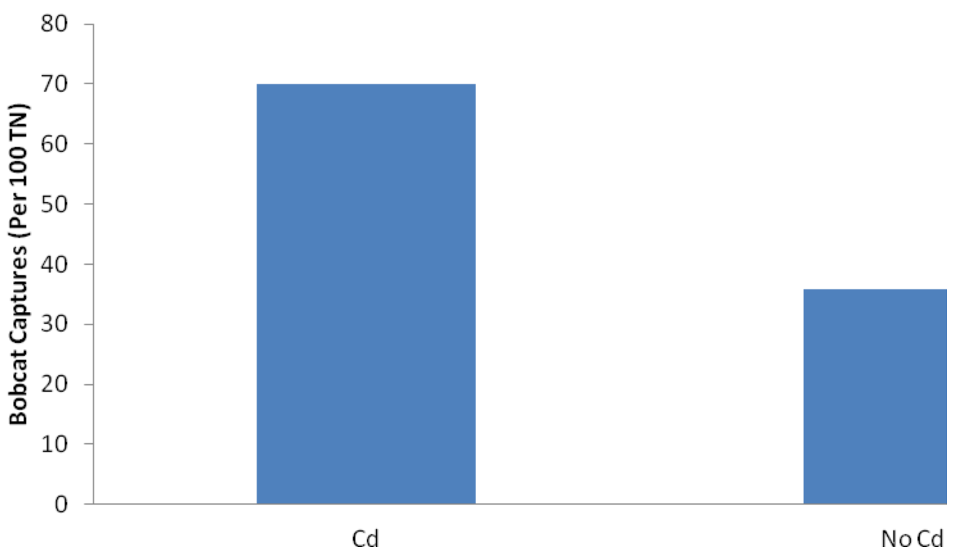


***Figure 5.*** *A comparison of bobcat capture rates using trail cameras configured with a visual lure (Cd = compact disk) in combination with scent lures versus trail cameras configured with only scent lures.*

## OBJECTIVE II -- COMPARE ABUNDANCE OF BOBCATS IN NEW HAMPSHIRE TO POPULATIONS IN ADJACENT STATES.

Additional activity on this objective will occur after completion of the second-generation habitat suitability map.

## OBJECTIVE III -- IDENTIFY POTENTIAL WILDLIFE CORRIDORS.

### *Approach #1: Use location data obtained from radio-collared bobcats in conjunction with various spatial models to identify potential corridors used by bobcats.*

The Bear Paw (www.bear-paw.org) and Quabbin-to-Cardigan (q2cpartnership.org) initiatives will serve as two landscapes to model and evaluate corridors at differing spatial extents. Both initiatives are efforts by regional conservation groups to preserve large, continuous blocks of habitat and insure functioning landscapes for a variety of organisms. GIS layers defining the Bear-Paw region and associated protected lands were obtained from Daniel Kern, Executive Director of the Bear Paw Greenways Initiative. GIS layers for the Quabbin-to-Cardigan were obtained from their web site.

Cost layers used to model corridors will consist of an expert-opinion/literature review cost layer (Callahan and Jones 2010) and the inverse of the resource selection function described in Broman (2012). Because the Quabbin-to-Cardigan landscape extends into Massachusetts, the cost layer will be extended using the habitat rankings and resistance equations outlined in Callahan and Jones (2010). Collection and editing of Massachusetts data layers has begun. The second cost layer used to model corridors will be based on the second-generation suitability map that will be based on selection patterns of transmitter-equipped bobcats in the two study areas.

Corridors will be modeled with least-cost pathways (LCP), and will utilize CorridorDesigner (Majka et al. 2007). This program is added to ArcCatalog and enables the user to model habitat suitability, habitat patches, and possible corridors. Program Circuitscape will also be used to map connectivity across the landscape (McRae and Shah 2009). Circuitscape does not produce one corridor; instead it computes the resistance of all possible pathways across a landscape and produces a map demonstrating the sum of the resistances scores (McCrae et al 2008). The output generated from Circuitscape will be overlaid with LCP corridors to assess similarities and identify "pinch-points" on the landscapes.

Initial corridor modeling has begun using the Callahan and Jones (2010) cost-surface layer for bobcats in the Bear Paw Region to test the applicability of modeling corridors (Fig. 2). Program Circuitscape has been downloaded and explored to test its feasibility for corridor mapping.

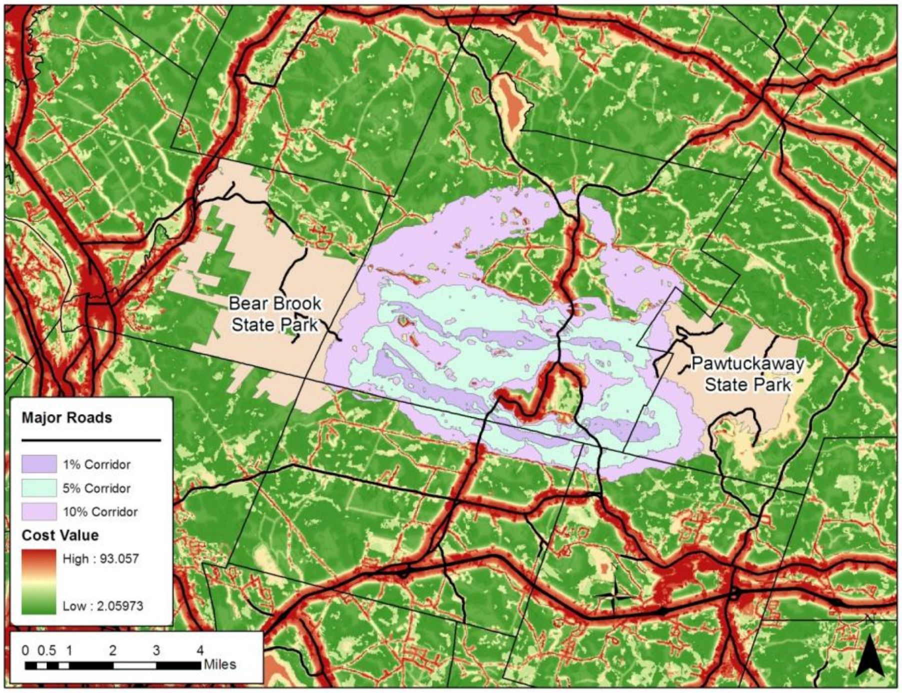


***Figure 6.*** *An example of corridors modeled with the least-cost path approach using the resistance layer developed by Callahan and Jones (2010). Corridors link Bear Brook and Pawtuckaway State Parks.*

### *Approach #2: Validate corridor modeling techniques, utility of a focal species, and compare modeled corridors to riparian zones.*

The utility of modeled corridors will be evaluated within the BearPaw landscape via two approaches: their ability to predict bobcat corridor use and the functionality of using bobcats as a focal species for other forest-dependent species. Predicted corridors will be compared to riparian corridors that may act as de facto corridors in disturbed areas (e.g., Naiman et al. 1993, Hilty and Merenlender 2004). Modeled corridors will be based on expert opinion and resource selection functions using least cost pathways. If modeled corridors overlap substantially, only one will be tested.

Modeled corridors will be examined tested at places they cross any road (Class 6 or below). Each crossing at modeled corridors will be paired with a stream/river crossing within a limited distance. Preliminary sampling protocols to explore how modeled corridors compare to riparian crossings have been developed (Fig. 3).

Methods for evaluating corridors will be implemented in winter (November 2012 – April/March 2013) via track surveys similar to Leoniak et al. (2011). Transects along the road at each corridor crossing and riparian crossing will be traveled after every snowfall. During non-winter months (May 2012 – October 2012), modeled corridors and associated riparian crossing will be monitored with remotely-triggered cameras.

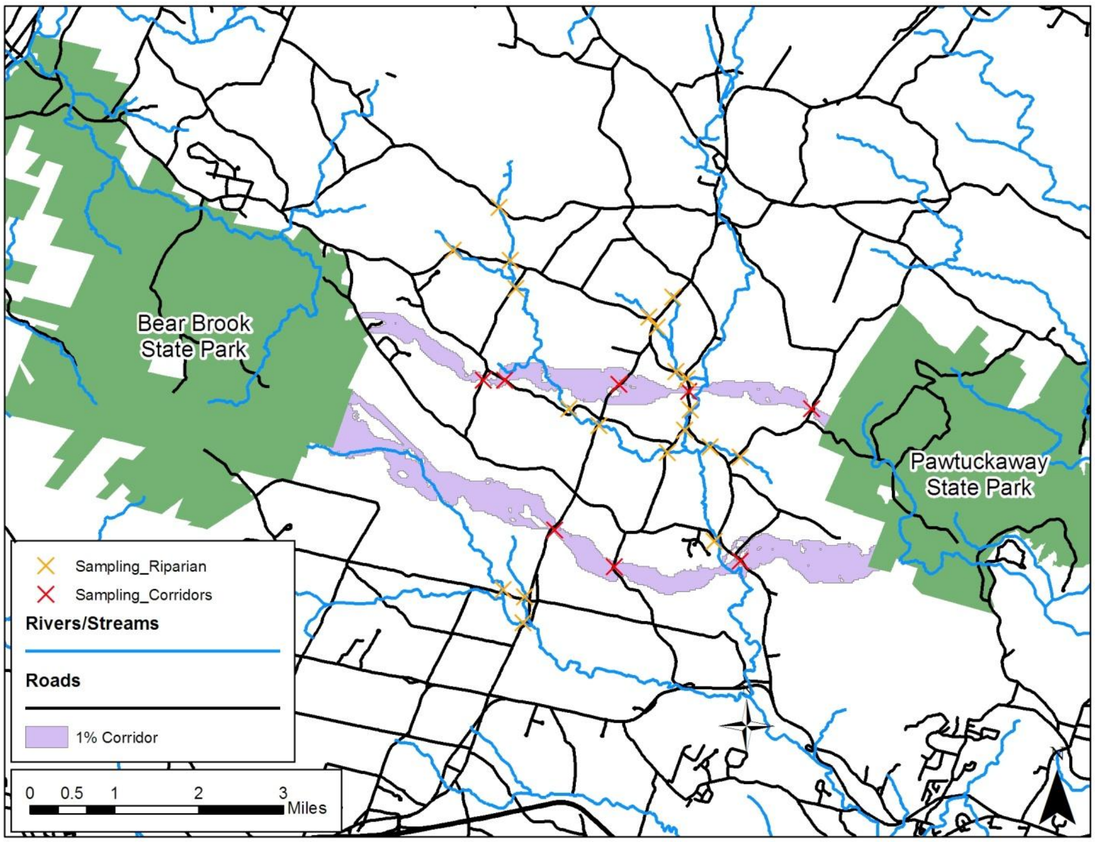


***Figure 7.*** *Potential sampling sites used to test the effectiveness of corridor modeling in comparison to de facto riparian corridors. At each sampling site, camera traps will be utilized in the summer and track transects will be used in the winter.*

Habitat features will be collected at each camera site (Table 2). These features will be sampled within a 15-m radius circular plot. Subsequent analysis will consist of univariate comparisons to identify any differences between modeled and riparian corridors. Variables will also be used as covariates when analyzing occurrence data for each animal species.

***Table 2.*** *Habitat attributes to be measured at each tested corridor within the Bear Paw region. Habitat attributes will be measured at both riparian corridors and modeled corridors during the summer and fall of 2012.*

| **Habitat Variable** | **Justification for Measurement** | **Method of Measurement** |
|---|---|---|
| Land cover class | Animals select for specific habitats | Derived from 2006 National Land Cover Dataset in GIS |
| Tree cover (%) | Index of potential vegetative cover | Estimated within 15-m plot |
| Shrub cover (%) | Index of potential vegetative cover | Estimated within 15-m plot |
| Canopy cover | Index of potential vegetative cover | Measured with densitometer at center of plot |
| Horizontal vegetation cover | Bobcats and associated prey often prefer dense understory | Measured using vegetative density board |
| Distance to nearest development (m) | Estimate of potentially fragmenting factor | Derived from 2006 National Land Cover Dataset in GIS |
| Distance from road to vegetation edge (m) | Animals may prefer to minimize amount of time without cover | Measured in the field |
| Width of road | Road class may affect crossing potential | Measured in the field (number of lanes) |
| Width of corridor at road crossing | Corridor width affects utilization | Measured in GIS |

## Literature Cited

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McRae, B. H., B. G. Dickson, T. H. Keitt, and V. B. Shah. 2008. Using circuit theory to model connectivity in ecology, evolution, and conservation. Ecology 89:2712–2724.

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*Appendix 1. Status of 18 bobcats captured and equipped with telemetry collars in southwestern and southeastern study areas in New Hampshire.*

| Bobcat ID | Study Site | Capture Location | Sex | Age at Capture | Weight At Capture (kg) | Date of Capture | Date of Collar Recovery | Usable Locations | Last Known Fate |
|---|---|---|---|---|---|---|---|---|---|
| 26 | Southwest | Gilsum | M | 4 | 13.5 | 11/22/2009 | On bobcat | 860 | Alive - Not Recaptured |
| 27 | Southwest | Westmoreland | M | 2 | 8.5 | 1/13/2010 | On bobcat | 848 | Alive - Not Recaptured |
| 28 | Southwest | Hancock | F | 10 | 12.3 | 1/16/2010 | 2/17/2011 | 433 | Recaptured and Collar Removed |
| 29 | Southwest | Antrim | M | 7 | 16.8 | 1/19/2010 | 9/26/2010 | 233 | Recaptured and Collar Removed |
| 30 | Southwest | Nelson | M | 5 | 14.5 | 2/3/2010 | ??? | 705 | Dead - Incidental Capture |
| 31 | Southwest | Harrisville | M | 9 | 12.7 | 2/13/2010 | 11/4/2010 | 94 | Alive - Collar dropped off |
| 32 | Southwest | Harrisville | M | 8 | 14.1 | 2/13/2010 | 9/9/2010 | 205 | Alive - Collar dropped off |
| 33 | Southwest | Alstead | M | 5 | 11.5 | 2/22/2010 | 9/16/2010 | 89 | Alive - Collar dropped off |
| 34 | Southwest | Jaffrey | M | 3 | 16.0 | 3/1/2010 | 1/15/2011 | 416 | Recaptured and Collar Removed |
| 39 | Southwest | Alstead | M | 3 | 11.5 | 3/8/2010 | 12/25/2010 | 381 | Recaptured and Collar Removed |
| 40 | Southwest | Walpole | M | 5 | 12.3 | 3/12/2010 | 11/4/2010 | 319 | Alive - Collar dropped off |
| 41 | Southeast | Gilamanton | M | 3 | 12.8 | 1/7/2011 | On bobcat | 252 | Alive - Not Recaptured |
| 42 | Southeast | Gilford | M | 5 | 14.5 | 1/11/2011 | On bobcat | 1138 | Alive - Not Recaptured |
| 43 | Southeast | Gilamanton | M | 4 | 11.5 | 1/23/2011 | On bobcat | 371 | Alive - Not Recaptured |
| 44 | Southeast | Gilford | F | 4 | 9.1 | 1/25/2011 | On bobcat | 884 | Alive - Not Recaptured |
| 45 | Southeast | Barrington | F | 1 | 7.8 | 1/28/2011 | 12/26/2011 | 818 | Recaptured and Collar Removed |
| 46 | Southeast | Barrington | F | 1 | 6.0 | 2/11/2011 | 3/7/2012 | 845 | Recaptured and Collar Removed |
| 47 | Southeast | Milton | F | 4 | 7.7 | 3/5/2011 | 8/4/2011 | 152 | Dead - Vehicle Collison |

*Appendix 2. Composite and seasonal home ranges for 18 transmitter-equipped bobcats in southwestern (SW) and southeastern (SE) New Hampshire.*

| | | | | Composite | | | Winter | | | Spring | | | Summer | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Site** | **Sex** | **Age** | **Locations** | **95%** | **50%** | **Locations** | **95%** | **50%** | **Locations** | **95%** | **50%** | **Locations** | **95%** | **50%** |
| 26 | SW | M | 4 | 860 | 72.59 | 5.26 | 410 | 48.79 | 3.48 | 258 | 66.76 | 2.24 | 192 | 99.12 | 4.11 |
| 27 | SW | M | 2 | 848 | 126.59 | 5.72 | 187 | 76.2 | 10.59 | 283 | 230.14 | 13.65 | 378 | 34.29 | 2.92 |
| 28 | SW | F | 10 | 433 | 29.69 | 2.47 | 258 | 24.68 | 1.54 | 175 | 31.34 | 2.17 | - | - | - |
| 29 | SW | M | 7 | 233 | 54.37 | 14.03 | 60 | 56.6 | 9.45 | 101 | 48.24 | 8.46 | 72 | 49.22 | 15.07 |
| 30 | SW | M | 5 | 705 | 103.05 | 9.79 | 164 | 59.04 | 6.99 | 251 | 81.51 | 6.7 | 290 | 116.71 | 17.66 |
| 31 | SW | M | 9 | 94 | 61.57 | 10.45 | - | - | - | - | - | - | 94 | 61.57 | 10.45 |
| 32 | SW | M | 8 | 205 | 56.41 | 2.33 | 34 | 45.39 | 4.57 | 81 | 87.16 | 17.61 | 90 | 37.62 | 2.59 |
| 33 | SW | M | 5 | 89 | 59.83 | 9.98 | 31 | 54.99 | 8.11 | 39 | 45.35 | 4.69 | 19 | 66.4 | 13.43 |
| 34 | SW | M | 3 | 416 | 80.18 | 8.59 | 43 | 53.5 | 7.21 | 102 | 81.3 | 11.33 | 198 | 90.05 | 26.37 |
| 39 | SW | M | 3 | 381 | 28.69 | 1.85 | 66 | 39.75 | 3.87 | 111 | 23.7 | 2.03 | 185 | 36.7 | 4.28 |
| 40 | SW | M | 5 | 319 | 292.07 | 47.8 | 37 | 180.43 | 17.88 | 134 | 180.43 | 17.88 | 148 | 214.9 | 27.95 |
| 41 | SE | M | 3 | 252 | 16.36 | 1.37 | 232 | 18.59 | 1.48 | 20 | - | - | - | - | - |
| 42 | SE | M | 5 | 1138 | 27.27 | 0.94 | 258 | 10.28 | 1.11 | 328 | 28.48 | 1.66 | 552 | 43.55 | 5.51 |
| 43 | SE | M | 4 | 371 | 81.95 | 7.64 | 233 | 82.84 | 9.52 | 104 | 48.31 | 2.96 | 34 | 51.25 | 5.54 |
| 44 | SE | F | 4 | 884 | 14.05 | 1.29 | 260 | 7.65 | 0.58 | 231 | 15.66 | 2.99 | 393 | 16.87 | 1.48 |
| 45 | SE | F | 1 | 818 | 24.74 | 1.2 | 189 | 10.76 | 1.4 | 287 | 20.78 | 1.81 | 342 | 35.78 | 3.79 |
| 46 | SE | F | 1 | 845 | 22.12 | 1.7 | 136 | 10.11 | 1.71 | 286 | 23.94 | 2.66 | 423 | 24.19 | 3.2 |
| 47 | SE | F | 4 | 152 | 31.46 | 5.07 | 76 | 31.56 | 3.69 | 76 | 31.87 | 3.47 | - | - | - |