Role of predators, winter weather, and habitat on white-tailed deer fawn survival in the south-central Upper Peninsula of Michigan


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Abstract We captured 68 (54 female, 14 male) white-tailed deer (*Odocoileus virginianus*) in Clover traps including 45 adults, 11 yearlings, and 12 fawns. Forty-one females were radio-collared, of which 40 pregnant females received vaginal implant transmitters. We investigated 11 deer mortalities including apparent starvation/exposure, coyote predation, wolf predation, and apparent birthing complications while aborting fetuses. We immobilized 14 adult black bear (*Ursus americanus*; 6 male, 8 female) and 4 yearlings (3 male, 1 female) in their dens and we observed 12 cubs (10 male, 2 female) from 5 females. We captured 3 bobcats (*Lynx rufus*) and fitted two with global positioning system collars. To estimate bobcat abundance, we deployed hair snares and remote cameras at 64 sites throughout the study area and obtained 179 hair samples and >620,000 images. We gave 3 presentations to the public including the Public Works Water Operators, Northern Michigan Wildlife Society, and the Red Buck Eagle Scouts. We hosted observers from the Michigan Department of Natural Resources, various universities, and local landowners to provide information on ongoing research. We updated the project website and Facebook page with information and results obtained this quarter. We began selecting applicants for 12 technician positions to begin work 1 May 2014.
Summary

- We captured 68 (54 female, 14 male) individual white-tailed deer (*Odocoileus virginianus*), including 45 adults, 11 yearlings, and 12 fawns.

- We radio-collared 41 females, of which 40 pregnant females also received vaginal implant transmitters.

- We investigated 11 deer mortalities (8 adult females, 3 fawns), with causes of mortality including apparent starvation/exposure, coyote predation, wolf predation, and apparent birthing complications while aborting fetuses.

- We immobilized 14 adult black bear (*Ursus americanus*; 6 male, 8 female) and 4 yearlings (3 male, 1 female) in their dens and observed 12 cubs (10 male, 2 female) from 5 females.

- We captured 2 female and 1 male bobcat (*Lynx rufus*) in cage traps at previously baited bobcat hair snares sites and fitted 2 with global positioning system collars.

- We deployed hair snares and remote cameras at 64 sites throughout the study area to estimate bobcat abundance. We obtained 179 hair samples and >620,000 images.


- We hosted observers representing the Michigan Department of Natural Resources, Northern Michigan University, Michigan Technological University, and local landowners. We also hosted Rick Westphal, Westphal Productions, who took photographs and video footage of project staff performing field duties.

- We updated our project website (fwrc.msstate.edu/carnivore/predatorprey/) and Facebook page (www.Facebook.com/MITpredprey) to provide the public with project results.
Introduction

Management of wildlife is based on an understanding, and in some cases, manipulation of factors that limit wildlife populations. Wildlife managers sometimes manipulate the effect of a limiting factor to allow a wildlife population to increase or decrease. White-tailed deer (*Odocoileus virginianus*) are an important wildlife species in North America providing many ecological, social, and economic values. Most generally, factors that can limit deer numbers include food supply, winter cover, disease, predation, weather, and hunter harvest. Deer numbers change with changes in these limiting factors.

White-tailed deer provide food, sport, income, and viewing opportunities to millions of Americans throughout the United States and are among the most visible and ecologically-important wildlife species in North America. They occur throughout Michigan at various densities, based on geographical region and habitat type. Michigan spans about 600 km from north to south. The importance of factors that limit deer populations vary along this latitudinal gradient. For example, winter severity and winter food availability have less impact on deer numbers in Lower Michigan than in Upper Michigan.

Quantifying the relative role of factors potentially limiting white-tailed deer recruitment and how the importance of these factors varies across this latitudinal gradient is critical for understanding deer demography and ensuring effective management strategies. Considerable research has demonstrated the effects of winter severity on white-tailed deer condition and survival (Ozoga and Gysel 1972, Moen 1976, DelGiudice et al. 2002). In addition, the importance of food supply and cover, particularly during winter, has been documented (Moen 1976, Taillon et al. 2006). Finally, the role of predation on white-tailed deer survival has received considerable attention (e.g., Ballard et al. 2001). However, few studies have simultaneously addressed the roles of limiting factors on white-tailed deer.

The overall goal of this project is to assess baseline reproductive parameters and the magnitude of cause-specific mortality and survival of white-tailed deer fawns, particularly mortality due to predation, in relation to other possible limiting mortality agents along a latitudinal gradient in Michigan. We will simultaneously assess effects of predation and winter severity and indirectly evaluate the influence of habitat conditions on fawn recruitment. Considering results from Lower Michigan (Pusateri Burroughs et al. 2006, Hiller 2007) as the southern extent of this gradient, we propose three additional study sites from south to north across Upper Michigan. Because of logistical and financial constraints, we propose to conduct work sequentially across these study areas. The following objectives are specific to the Upper Michigan study area but applicable to other study areas with varying predator suites.

**Objectives**

1. Estimate survival and cause-specific mortality of white-tailed deer fawns and does.

2. Estimate proportion of fawn mortality attributable to black bear (*Ursus americanus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), and wolf (*Canis* spp.).

3. Estimate number and age of fawns killed by a bear, coyote, bobcat, or wolf during summer.
4. Provide updated information on white-tailed deer pregnancy and fecundity rates.

5. Estimate annual and seasonal resource use (e.g., habitat) and home range of white-tailed deer.

6. Estimate if familiarity of an area to each predator species affects the likelihood of fawn predation.

7. Assess if estimated composite bear, coyote, bobcat, and wolf use of an area influences fawn predation rates.

8. Describe association between fawn birth site habitat characteristics and black bear, coyote, bobcat, or wolf habitat use.

9. Estimate seasonal resource use (e.g., habitat, prey) and home range size of black bear, coyote, bobcat and wolf.

**Study Area**

The second phase of this study spans about 1,000 km² (386 mi²) within Deer Management Unit 036 in Iron County (Figure 1). The general study area boundaries follow State Highway M-95 on the east, US Highway 41/28 on the north, US Highway 141 on the west, and State Highway M-69 on the south. The core study area, where most capture efforts and population surveys will occur, is north of the Michigamme Reservoir and includes state forest, commercial forest association, and private lands. The final study area will comprise a minimum convex polygon that will include the composite locations of all telemetered animals. We selected this study area because it occurs within the mid-snowfall range, receiving about 180 cm of snowfall annually (about 53 cm more snowfall annually than the phase 1 study area near Escanaba). Deer in this area migrate longer distances and exhibit yarding behavior during most winters as compared to Escanaba where deer migrate only short distances or are non-migratory (Beyer et al. 2010) and yard less frequently.

**Accomplishments**

**Deer Trapping**

From 4 January 2014–10 March 2014 we captured white-tailed deer in Clover traps (Figure 2) to place radio-collars on pregnant females. We captured 68 deer (54 females, 14 males), with an additional 35 recaptures. Individuals captured included 41 adult females, 4 adult males, 7 yearling females, 4 yearling males, 6 female fawns, and 6 male fawns. The adult female:fawn ratio for winter captures in 2014 was 3.4:1. When compared to the winter 2013 adult female:fawn ratio of 0.9:1, this suggests fewer fawns per adult doe during winter 2014. We attempted to collect body condition scores (BCS) by palpation of fat deposits by two independent observers and attach ear tags (females = blue, males = yellow) to each deer. We also assessed pregnancy of yearling and adult females using ultrasonography.

Females \( n = 52 \) and males \( n = 33 \) had mean (± SD) body condition scores (scale: 1 [moribund]–5 [obese]) of 2.7 ± 0.6 and 3.0 ± 0.3, respectively. One capture related mortality occurred, likely related to physiological stress from the capture event.
We immobilized 46 females and fitted 41 with radio-collars (model 2610B, Advanced Telemetry Systems Inc., Isanti, MN). We fitted 40 pregnant females with a vaginal implant transmitter (VIT; model 3930, Advanced Telemetry Systems Inc., Isanti, MN). We monitored temperature, respiration, and heart rate as soon as practical after immobilization and at about 10 minute intervals thereafter until we administered a reversal drug. We estimated and recorded deer morphometrics and maximum and mid-rump fat depths (Table 1) when practical. We detected pregnancy with ultrasound in 100% of adults ($n = 40$) and 67% of yearlings ($n = 6$). Preliminary data indicates a declining trend in maximum rump fat of immobilized does as winter progressed (Figure 3).

In addition to the 41 individuals radio-collared this winter, we continued to monitor 27 does captured during January–March 2013.

**Deer Mortality**

Eleven radio-collared deer mortalities occurred, consisting of 8 adult females and 3 fawns (2 male, 1 female). We attributed 3 adult female mortalities to apparent starvation/exposure, 2 to wolf predations, 2 to coyote predations, and 1 to apparent birthing complications while aborting fetuses. We attributed 2 cases of fawn mortalities to apparent starvation/exposure, and 1 to coyote predation. We retrieved the carcasses of 2 fawns and 2 adult females and will submit them to the Michigan DNR Diagnostics Laboratory for detailed necropsy.

**Deer Telemetry**

We monitored radio-collared deer weekly for movement and survival using aerial telemetry and telemetry from a truck-mounted antenna. We are currently monitoring 59 individuals on a weekly interval.

**Black Bear Harvest**

Three male black bears with very high frequency (VHF) radio-collars were harvested outside the study area during the Michigan black bear hunting season (10 September–26 October). The fourth bear, a VHF collared female with significant tooth wear, was harvested within the study area. We sent a premolar from each black bear to the Michigan Department of Natural Resources Disease Laboratory for age estimation.

**Black Bear Den Checks**

During 16 December 2013–12 March 2014 we immobilized 14 adult black bears (6 male, 8 female) and 4 yearlings (3 male, 1 female). We weighed, recorded morphometric measurements, and drew blood from each immobilized bear. We replaced VHF radio-collars or Global Positioning System (GPS) collars with new GPS collars on 11 previously collared adult black bears. Additionally, we removed collars from 3 adult black bear that had left the study area earlier in the year to den. We programmed the GPS collars to obtain a location every 35 h until 1 May and then every 15 min until we remove the collar in the den. We handled 12 cubs (10 male, 2 female) from 5 adult females; mean litter size was 2.4 ($SD = 0.55$; Table 2).

**Bobcat Capture**

We set cage traps ($n = 12$) to capture bobcats at previously baited bobcat hair snare sites during 6–15 March. We captured 2 female and 1 male bobcat. Once immobilized, we weighed, sexed, and collected morphometric measurements from bobcats. We collared one male (14.7 kg) and one female (8.8 kg) bobcat with a GPS collar that we programed to record 35 h locations until 1 May and then...
every 15 min until 31 August. We were unable to collar one female bobcat due to her light weight (4.5 kg).

**Coyote Cable Neck Restraints**
We baited 9 locations with vehicle-killed deer carcasses to attract coyotes for capture. We set 10 relaxing-lock cable neck restraints at 3 sites starting on 10 February. Likely due to deep snow conditions and frozen bait from cold temperatures, coyotes failed to visit snares sites with carcasses. We removed all coyote cable neck restraints by 7 March due to continuing unfavorable snow conditions.

**Bobcat Hair Snares**
We began baiting 64 bobcat hair snare sites (Figure 4) on 15 December 2013. After a two-week pre-bait period, we set 4–5 hair snares at each site beginning 2 January 2014. We also deployed a trail camera at each site, directed at the bait, to obtain images of all animals visiting the site.
We visited each bait site every 7 days to collect hair samples, reset snares, perform trail camera maintenance, and add bait as necessary. The eight-week survey was completed and we pulled snares during 1 March–6 March 2014.
We collected 179 hair samples (of both target and non-target species) and will send them to the MDNR Wildlife Disease Laboratory in Lansing for DNA extraction. We also obtained >620,000 camera images. Data entry and analysis is ongoing.

**Public Outreach**
During black bear den checks and white-tailed deer trapping we hosted individuals from Michigan Department of Natural Resources (MDNR), Northern Michigan University, Michigan Technological University, and Iron County Sherriff’s Department.
During 19–27 February we hosted Rick Westphal of Westphal Productions who obtained images and video footage of project staff performing various field duties and will provide this media to Safari Club International Foundation to inform the public about the project.
We updated our project website (fwrc.msstate.edu/carnivore/predatorprey/) and Facebook page (www.Facebook.com/MIpredprey) to provide the public with project results.

**Presentations:**
Technician Hiring
We posted an advertisement and have begun reviewing applicants to assist with summer fieldwork. We received 72 applications and intend to hire 12 technicians to begin fieldwork 1 May 2014.

Publications

Work to be completed (16 March–15 June 2014)

Snowshoe Hare Pellet Survey
Following winter snowmelt and before spring green-up, we will conduct snowshoe hare (*Lepus americanus*) pellet counts along transects within each vegetative cover type to assess hare density within our study area.

Ruffed Grouse Drumming Survey
We will conduct ruffed grouse (*Bonasa umbellus*) drumming surveys beginning in mid-April to estimate occupancy of grouse at survey sites. We will use grouse occupancy to estimate male densities with respect to habitat within our study area.

Carnivore Trapping and Radio-collaring
We will begin trapping black bear, bobcat, coyote, and wolves during late April or early May. We will use #3 Victor soft-catch (Oneida Victor Inc., Cleveland, Ohio) foothold traps for bobcats and coyotes; MB 750 (Minnesota Trapline Products Inc., Pennock, Minnesota) foothold traps to capture wolves; and barrel traps and foot-snares to capture black bears. We will fit captured carnivores with a GPS collar, affix ear tags, record morphometric measurements, determine sex and body condition, and evaluate for injury. We will collect blood, hair, and extract a vestigial premolar from black bear and an incisor from coyotes to estimate age.

Black Bear Hair Snares
During April–May, we will conduct repairs on black bear hair snares (*n* = 64; Figure 4), which were established during 2012. From late May–July we will collect black bear hair samples from snares to estimate abundance throughout the study area.

Predation Site Investigation
We will begin investigations of carnivore predation site locations (clusters) in early May with the use of trained dogs to assess the role of each carnivore in predation on white-tailed deer.

Carnivore Scat Collection
We will begin collecting scat of black bear, bobcat, coyote, and wolves opportunistically throughout the study area 1 May for diet analysis. We will record date, GPS location, if tracks are present, scat diameter, and species for each collected scat.
Technician Hiring

We will conduct interviews of applicants and make final hiring decisions. We will hire 12 technicians to begin work 1 May 2014.

Public Outreach

We will continue to update our project Facebook page (http://www.facebook.com/MIpredprey) and web site (http://fwrc.msstate.edu/carnivore/predatorprey/) with project results.

Equipment Organization, Inventory, and Storage

We will inventory, organize, repair, and store all deer trapping and immobilization equipment and bobcat hair snare equipment. We will also repair and store all project snowmobiles.

Radiotelemetry

We will continue to monitor all radio-collared deer ≥1 time weekly. Beginning mid-May through 90 days post-parturition, we will locate radio-collared deer up to 4 times daily to monitor VIT tag expulsion (as available) and obtain locations. We will investigate mortalities as soon as practical after detecting a mortality signal to determine cause of death.

Fawn Capture and Radio-collaring

We will capture fawns opportunistically and using VIT signals during late May and early June. We will locate radio-collared fawns up to 4 times daily through 90 days post-parturition. We will investigate mortalities as soon as practical after detecting a mortality signal to determine cause of death. In addition, we will use our observations of immobile fawns to estimate how long the fawning period lasts. To estimate the twinning rate for the population, we will record observations of multiple young/adult female and will monitor and occasionally flush collared fawns to observe whether a sibling is present.

Vegetation Surveys

Beginning mid-May, we will collect vegetation data at random locations within the vegetation classes present in our study area. At each point, we will estimate horizontal cover following Ordiz et al. (2009). We will also estimate available forage by collecting current year’s growth of preferred deer food species (McCaffery et al. 1974, Stormer and Bauer 1980), drying the samples, and comparing the resulting dry weights across vegetation classes.

Traffic Estimates

Beginning mid-May, we will place remote cameras at random points along roadways to estimate human use of roads in our study area during the fawning season.

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Participating Upper Peninsula landowners
Jared Duquette, Graduate Research Assistant (Phase 1), Mississippi State University
Nathan Svoboda, Graduate Research Assistant (Phase 1), Mississippi State University

Phase 2 – Project Technicians:
Cody Norton        Caleb Eckloff        Ben Matykiewicz
Chloe Wright        Polly Chen           Anne Patterson
Todd Kautz          Mac Nichols          Phillip Lyons
Olivia Montgomery   Annie Washakowski    David Rogers
Matthew Peterson    Ty Frank             Logan Thompson
Tanya Wolf          Jessie Roughgarden    Kelly Deweese
Elizabeth Robbe     Daniel Tomasetti     Steffen Peterson
Missy Stallard      Evan Shields         Alyssa Roddy
Brian Kidder        Peter Mumford       Kris Harmon
Greta Schmidt

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Neil Harri (Air 1), MDNR
Dr. Dan O’Brien, MDNR
Melinda Cosgrove, MDNR
Dr. Tom Cooley, MDNR
Dr. Steve Schmitt, MDNR
Dr. Dwayne Etter, MDNR
Dr. Pat Lederle, MDNR
Brian Roell, MDNR
Monica Joseph, MDNR
Bob Doepker, MDNR
Kurt Hogue, MDNR
Jason Peterson, MDNR
Marvin Gerlach, MDNR
Jason Neimi, MDNR
Vernon Richardson, MDNR
Literature Cited


Table 1. Mean (X) and standard deviation (SD) of 46 captured adult (n = 40) and yearling (n = 6) female white-tailed deer morphometrics and body condition estimates, Upper Peninsula of Michigan, USA, January–March 2014.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Adults</th>
<th>Yearlings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>65.0 6.4</td>
<td>49.0 5.4</td>
</tr>
<tr>
<td>Hind foot (cm)</td>
<td>48.5 1.9</td>
<td>47.6 2.3</td>
</tr>
<tr>
<td>BCS(^1)</td>
<td>2.8 0.6</td>
<td>2.7 0.3</td>
</tr>
<tr>
<td>MIDF(^2) (cm)</td>
<td>0.4 0.4</td>
<td>0.4 0.3</td>
</tr>
<tr>
<td>MAXF(^3) (cm)</td>
<td>0.6 0.5</td>
<td>0.7 0.4</td>
</tr>
</tbody>
</table>

\(^1\) Body Condition Score (BCS) for does derived from palpation following Cook et al. (2010).
\(^2\) Middle rump fat (MIDF) estimate measured at mid-point between ilium and ischial tuberosity on right hip (Cook et al. 2007).
\(^3\) Maximum rump fat (MAXF) estimate measured above ischial tuberosity of right hip (Cook et al. 2007).
Table 2. Den check data for 22 black bears, Upper Peninsula of Michigan, USA, 16 December 2013–12 March 2014.

<table>
<thead>
<tr>
<th>ID</th>
<th>Den check date</th>
<th>Age</th>
<th>Sex</th>
<th>Body weight (kg)</th>
<th>Right ear tag</th>
<th>Left ear tag</th>
</tr>
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<tbody>
<tr>
<td>BB145</td>
<td>16-Dec-13</td>
<td>Adult</td>
<td>M</td>
<td>103.4</td>
<td>286</td>
<td>285</td>
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<td>BB148</td>
<td>17-Dec-13</td>
<td>Adult</td>
<td>M</td>
<td>111.1</td>
<td>303</td>
<td>307</td>
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<tr>
<td>BB112</td>
<td>18-Dec-13</td>
<td>Adult</td>
<td>F</td>
<td>70.3</td>
<td>220</td>
<td>219</td>
</tr>
<tr>
<td>BB123</td>
<td>18-Dec-13</td>
<td>Yearling from BB112</td>
<td>M</td>
<td>28.1</td>
<td>316</td>
<td>315</td>
</tr>
<tr>
<td>BB124</td>
<td>18-Dec-13</td>
<td>Yearling from BB112</td>
<td>M</td>
<td>25.9</td>
<td>313</td>
<td>314</td>
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<td>BB125</td>
<td>18-Dec-13</td>
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<td>M</td>
<td>25.4</td>
<td>318</td>
<td>317</td>
</tr>
<tr>
<td>BB117</td>
<td>19-Dec-13</td>
<td>Adult</td>
<td>F</td>
<td>121.6</td>
<td>173</td>
<td>161</td>
</tr>
<tr>
<td>BB143</td>
<td>4-Feb-14</td>
<td>Adult</td>
<td>M</td>
<td>79.4</td>
<td>266</td>
<td>280</td>
</tr>
<tr>
<td>BB126</td>
<td>23-Feb-14</td>
<td>Adult</td>
<td>F</td>
<td>NA</td>
<td>287</td>
<td>288</td>
</tr>
<tr>
<td>BB127</td>
<td>23-Feb-14</td>
<td>Yearling</td>
<td>F</td>
<td>18.6</td>
<td>218</td>
<td>242</td>
</tr>
<tr>
<td>BB103</td>
<td>24-Feb-14</td>
<td>Adult</td>
<td>F</td>
<td>70.3</td>
<td>213</td>
<td>214</td>
</tr>
<tr>
<td>BB149</td>
<td>24-Feb-14</td>
<td>Cub from BB103</td>
<td>M</td>
<td>1.5</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>BB150</td>
<td>24-Feb-14</td>
<td>Cub from BB103</td>
<td>M</td>
<td>1.3</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>BB151</td>
<td>24-Feb-14</td>
<td>Cub from BB103</td>
<td>M</td>
<td>1.3</td>
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<td>NA</td>
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<td>BB116</td>
<td>25-Feb-14</td>
<td>Adult</td>
<td>F</td>
<td>70.3</td>
<td>239</td>
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<td>BB152</td>
<td>25-Feb-14</td>
<td>Cub of BB116</td>
<td>F</td>
<td>1.4</td>
<td>NA</td>
<td>NA</td>
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<td>BB153</td>
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<td>Cub of BB116</td>
<td>M</td>
<td>1.6</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>BB144</td>
<td>26-Feb-14</td>
<td>Adult</td>
<td>F</td>
<td>66.2</td>
<td>268</td>
<td>272</td>
</tr>
<tr>
<td>BB154</td>
<td>26-Feb-14</td>
<td>Cub of BB144</td>
<td>M</td>
<td>1.8</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>BB155</td>
<td>26-Feb-14</td>
<td>Cub of BB144</td>
<td>M</td>
<td>1.9</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>BB142</td>
<td>3-Mar-14</td>
<td>Adult</td>
<td>M</td>
<td>81.6</td>
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<td>279</td>
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<tr>
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<td>Adult</td>
<td>F</td>
<td>59.9</td>
<td>229</td>
<td>228</td>
</tr>
<tr>
<td>BB156</td>
<td>3-Mar-14</td>
<td>Cub of BB120</td>
<td>M</td>
<td>1.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>BB157</td>
<td>3-Mar-14</td>
<td>Cub of BB120</td>
<td>M</td>
<td>1.2</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>BB158</td>
<td>3-Mar-14</td>
<td>Cub of BB120</td>
<td>M</td>
<td>1.3</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>BB141</td>
<td>4-Mar-14</td>
<td>Adult</td>
<td>F</td>
<td>68.0</td>
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<tr>
<td>BB159</td>
<td>4-Mar-14</td>
<td>Cub of BB141</td>
<td>M</td>
<td>2.3</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>BB160</td>
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<td>NA</td>
<td>NA</td>
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<tr>
<td>BB146</td>
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<td>Adult</td>
<td>M</td>
<td>74.8</td>
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<td>302</td>
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<td>M</td>
<td>65.8</td>
<td>295</td>
<td>296</td>
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</table>
Figure 1. Location of phase 1 and 2 study areas and Michigan Department of Natural Resources Deer Management Units, Upper Peninsula of Michigan, USA, 2014.
Figure 2. Locations of Clover traps for deer capture, Upper Peninsula of Michigan, USA, 4 January–15 March 2014.
Figure 3. Maximum rump-fat measurements of captured immobilized does, Upper Peninsula of Michigan, USA, 4 January–15 March 2014. Regression line represents the trend in mean rump fat among captured individuals, red squares represent individuals that have died through 15 March 2014.
Figure 4. Location of black bear hair snare sites ($n = 64$) and bobcat hair snare sites ($n = 64$) within a 2.5 km$^2$ grid, Upper Peninsula of Michigan, USA.