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 From 16 September–15 December 2017, we recorded 2 radiocollared adult female deer mortalities (1 wolf predation, 1 unknown cause) and no radiocollared fawn mortalities. We obtained 3,417 deer GPS locations at 13-hour intervals from 34 adult female deer, and monitored fawn survival twice per week using VHF telemetry. We completed a 75-day non-baited deer camera survey and indexed 17,042 images of deer (9,713 adult female, 5,221 fawn, 1,719 adult male, and 389 unidentified age/sex deer). We located 8 black bear dens. We obtained response rates of 13.9 and 1.4% from coyotes and wolves, respectively, to broadcasted coyote group-yip howls. To index beaver abundance, we conducted aerial surveys and detected 50 inactive lodges, 57 active lodges with a cache, and 13 caches with no sign of a lodge. We repaired 52 bobcat hair snare sites, repaired or replaced and sterilized 208 bobcat hair snares, collected bait and began our pre-bait period for a bobcat abundance survey beginning in January 2018. We gave a presentation to one public group. We updated the project website and project Facebook page with information and results obtained this quarter.
Summary

- We recorded 2 radiocollared adult female deer mortalities (1 wolf predation, 1 unknown cause) and no radiocollared fawn mortalities.
- We obtained 3,417 deer GPS locations at 13-hour intervals from 34 adult female deer, and monitored fawn survival twice per week using VHF telemetry.
- We completed a 75 day non-baited deer camera survey and indexed 17,042 images of deer (9,713 adult female, 5,221 fawn, 1,719 adult male, and 389 unidentified age/sex deer).
- We located 8 black bear (*Ursus americanus*) den sites.
- We conducted a beaver cache survey to estimate beaver abundance. We flew 578 km of river and lakeshore and detected 57 active beaver lodges with caches.
- We obtained response rates of 13.9 and 1.4% from coyotes and wolves, respectively, to broadcasted coyote group-yip howls.
- We repaired 52 bobcat hair snare sites, repaired or replaced and sterilized 208 bobcat hair snares, collected bait and began the pre-bait for a bobcat abundance survey beginning in January 2018.
- We gave a presentation at the MDNR Law Enforcement Division District 1 Meeting.
- We updated our Facebook page ([www.Facebook.com/MIpredprey](http://www.Facebook.com/MIpredprey)) and project website 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.

Our overall goal 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 Upper 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 have now completed field work within a low snow depth study site and are currently collecting data within a second study site with moderate snow depth. The following objectives are specific to the Upper Michigan study areas but are also 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 third phase of this study spans about 1,550 km² (598 mi²) within Deer Management Unit 031 in Baraga, Houghton and Ontonagon Counties (Figure 1). The general study area boundaries follow US Highway 41/141 on the east, State Highway M-38 on the north, US Highway 45/State Highway M-26 on the west, and State Highway M-28 on the south. Dominant land cover classes are deciduous (35%), evergreen (23%), and mixed forests (21%). Road density is low across the study area at 0.62 km/km² but higher densities do occur around few small towns on the periphery. The core study area, where we conducted most capture efforts and population surveys, is centered on National Forest Rd 16 and almost exclusively within Ottawa National Forest. 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 high-snowfall range, receiving over 250 cm of snowfall annually (about 70 cm more snowfall annually than the Phase 2 study area near Crystal Falls, Figures 1 and 2).

Accomplishments

Deer Mortality

We recorded 2 adult female mortalities, 1 attributed to wolf caused mortality and one attributed to unknown circumstances. We recorded no fawn mortalities. One radio-collared adult female and 1 radio-collared fawn were censored after slipping their collars. Apparent fawn survival from birth to 15 December was 66%. Six ear-tagged adult male deer were reported as legal hunter harvest. All harvested deer had been tagged as fawns and were of known age, consisting of 5 1.5 year-old deer and 1 3.5 year-old deer.

Deer Telemetry

We obtained 3,417 GPS locations at 13-hour intervals from 34 adult female deer. We monitored 20 radio-collared fawns twice per week using aerial and ground based VHF telemetry to monitor survival. We continue to monitor 34 adult females and 19 fawns.

Deer Camera Survey

To investigate an alternative method to estimate deer population to a baited camera survey, we deployed 52 cameras at non-baited sites along secondary roads and trails within the Phase 3 Study Area for a 75-day period from 14 July–27 September, 2017. To avoid interference from the baited deer camera survey within the same area during 22 August–3 September, non-baited sites were spaced a minimum of 700 meters from the nearest baited camera site (Figure 3). We obtained 35,662 images and indexed 17,042 images of deer (9,713 adult female, 5,221 fawn, 1,719 adult male, and 389 unidentified age/sex deer).

Daily observation rates during the baited deer camera survey conducted from 22 August–3 September 2017 were greater than the non-baited survey by a factor of 3.7, 4.0, and 3.6 for adult females, adult males, and fawns, respectively. Ratios of fawns per doe and bucks per doe derived from daily detection rates were within 2% for the baited and non-baited surveys. Comparison of deer density estimates derived from the non-baited and baited deer camera surveys is ongoing while we select statistical methods for abundance estimation from camera data.
Carnivore Monitoring and GPS Radiocollar Recovery

Eleven black bears were harvested and their collars recovered, during the Michigan and Wisconsin black bear hunting seasons. Currently we are monitoring 13 radiocollared black bears and will replace their collars from late December to early March.

Black Bear Den Location
We located 8 bear dens (4 male, 4 female) during December. The remaining 5 bears will be located using aerial telemetry. Two bears have not been relocated since the 27 June and 31. Black bear den checks are scheduled to begin 16 December 2017.

Beaver Cache Survey
To index of beaver abundance, we flew 578 km of river and lakeshore 06–08 November to identify active beaver caches. We conducted flights at an altitude of 550–650 m. We detected 50 inactive lodges, 57 active lodges with a cache, and 13 caches with no sign of a lodge (equates to one active cache for every 8.2 km flown; Figure 4).

Coyote Abundance Estimation
We completed 8 howl surveys at 40 sites (Figure 5) between 13 July and 24 September. Overall, we obtained a coyote response rate of 13.9% to recorded coyote group-yip howls and recorded four wolf responses (1.4% response rate). Surveys were on a 10 day rotation with each survey completed in 4 days, weather permitting. We elicited vocalizations using a FoxPro game caller (FoxPro Inc., Lewistown, PA) using a group-yip howl to elicit coyote vocal response. At each survey site we recorded moon phase, cloud cover, wind speed, species responding, response time and direction, number of individuals responding, type of response (e.g., bark-howl, lone howl), and recordings of responses. At the end of the survey we will estimate coyote abundance in the Phase 3 study area using an occupancy modeling approach (Petroelje et al. 2014).

Bobcat Hair Snares
We repaired 52 bobcat hair snare sites (Figure 6). We also repaired or replaced and sterilized 208 bobcat hair snares, collected bait (i.e., road-killed deer carcasses, deer from local game processors, and beaver carcasses from private trappers) and pre-baited for a bobcat abundance survey beginning January 2018.

Public Outreach
We gave a presentation for the MDNR District 1 Conservation Officers Meeting. We updated our Facebook page (www.Facebook.com/MIpredprey) to provide the public with current project activities.


Technician Selection and Hiring
This quarter we hired 5 technicians to assist with field work from 1 January through 31 March 2018 in addition to retaining 2 fall 2017 technicians through the end of March:
Work to be completed (16 December 2017–15 March 2018)

**Deer Capture**

We will begin capturing deer using Clover traps on 4 January 2018. We will immobilize adult female deer to estimate pregnancy, condition, and age structure of the doe population. We will deploy up to 55 GPS radiocollars and vaginal implant transmitters on pregnant adult female deer to monitor movement, survival, and reproduction. We will also deploy up to 25 GPS radiocollars on juvenile (>1 year old) deer and adult male deer captured incidentally, as part of a collaboration with a DNR-MSU deer movement study in the Western Upper Peninsula.

**Black Bear Den Checks**

We will conduct den 4–5 male den checks in late December and the remaining 8–9 collared bears in late February to assess reproductive output and replace VHF radiocollars with GPS radiocollars.

**Carnivore Capture**

We will capture coyotes beginning in February 2018 using relaxing-lock cable neck restraints at sites baited with vehicle-killed deer carcasses. We will also begin trapping bobcats with cage traps in late-February 2017.

**Bobcat Hair Snares**

We will bait and deploy hair snares at 52 sites beginning 5 January 2018 and visit sites to collect hair samples once weekly for 8 weeks. We will send hair samples to the MDNR laboratory for DNA extraction and subsequent individual identification.

**Winter Track Survey**

We will begin winter track surveys for wolves in February 2018 or as snow conditions allow, and will continue until we identify number of packs and individuals/pack within the study area. We will conduct track surveys via truck, snowmobile, or ATV 24–48 hours after snowfall to allow for animal movement. Once identified, we will follow wolf tracks until we confirm number of individuals traveling together. We will use numbers of independent tracks in each group to estimate minimum abundance.

**Coyote Abundance Estimation**

Using responses obtained from this year’s howl survey, we will estimate coyote abundance using an occupancy modeling approach (Petroelje et al. 2014).

**Equipment Organization, Inventory, and Storage**

We inventoried, organized, repaired, and stored all summer field equipment until use next year. We inventoried all capture gear and ordered any supplies needed for the upcoming winter trapping season. We repaired or replaced netting and trigger mechanisms on Clover traps in preparation for the winter deer trapping season. We also repaired and stored all project ATVs to limit exposure to the winter conditions.
Public Outreach

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

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Literature Cited


Figure 1. Location of phases 1, 2 and 3 study areas and Michigan Department of Natural Resources Deer Management Units, Upper Peninsula of Michigan, USA, 2008–2017.
Figure 2. Location of phase 3 study area and counties, Upper Peninsula of Michigan, USA, 2017.
Figure 3. Locations of 52 baited and 52 non-baited remote camera sites to estimate deer abundance, Upper Peninsula of Michigan, USA, 2017
Figure 4. Locations of beaver caches and lodges detected aerially during 06–08 November, Upper Peninsula of Michigan, USA, 2017.
Figure 5. Locations of 40 howl survey sites to estimate coyote abundance, Upper Peninsula of Michigan, USA, 2017.
Figure 6. Locations of 52 bobcat hair snare sites to estimate bobcat abundance, Upper Peninsula of Michigan, USA, 2017.
Figure 7. Locations of 52 black bear hair snare sites to estimate black bear abundance, Upper Peninsula of Michigan, USA, 2017.