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– During this quarter, 44 (34 female, 10 male) white–tailed deer (*Odocoileus virginianus*) were captured in Clover traps including 21 adults, 2 yearlings, and 21 fawns. Twenty–one pregnant does were radiocollared and 23 VIT tagged, including 2 does originally captured in 2009. Two fawns radiocollared in 2009 were also recaptured. Four doe and 2 fawn mortalities occurred this quarter. There were 362 doe and 191 fawn radiolocations collected during the quarter. One male wolf (*Canis lupus*) was captured and released with a VHF radiocollar. Eight (3 male, 5 female) adult black bears (*Ursus americanus*) and 2 yearlings (1 male, 1 female) were immobilized in their dens. To estimate carnivore abundance, 161 snares were deployed from which 230 hair samples were obtained. Seventeen carnivore track surveys detected sets of 36 wolf, 2 bobcat (*Lynx rufus*), 44 coyote (*Canis latrans*), 2 marten (*Martes americana*), and 2 fisher (*Martes pennanti*) tracks. This quarter, 110 scat samples were prepared and 91 analyzed for diet. Twenty–four vegetation surveys were conducted and 233 alternative prey and carnivore observations were recorded. Deer were recorded in 84% of 9,693 images from 54 cameras deployed during the deer abundance camera survey in 2009. Personnel gave 3 research talks this quarter and began hiring summer technicians.

Summary

- During this quarter 44 (34 female, 10 male) individual white–tailed deer (*Odocoileus virginianus*) were captured, including 21 adults, 2 yearlings, and 21 fawns.
- Twenty–one pregnant does were radiocollared and 23 VIT tagged, including 2 does originally captured in 2009.
- Two radiocollared female fawns were recaptured; pregnancy was not detected in either.
- Four doe mortalities attributed to wolf (*Canis lupus*), coyote (*Canis latrans*), or unknown predator; 78% of does radiocollared in 2009 are alive.
- Two fawn mortalities attributed to coyote and illegal harvest occurred, 29% of fawns radiocollared in 2009 are being monitored.
- We obtained 362 doe and 191 fawn radiolocations collected during the quarter.
- One male wolf was found captured in an illegal neck snare and project personnel immobilized, weighed, recorded various morphometric measurements, and released the wolf with a VHF radiocollar.
- Fifty–four infrared cameras recorded 9,693 images during the September 2009 deer abundance survey, deer were recorded in 84% of images.
- Eight (3 male, 5 female) adult black bears (*Ursus americanus*) and 2 yearlings (1 male, 1 female) were immobilized in their dens, 5 collars were replaced with new GPS collars.
- We deployed 161 hair snares and obtained 230 hair samples for estimating carnivore abundance.
- Seventeen carnivore track surveys detected sets of 36 wolf, 2 bobcat, 44 coyote, 2 marten (*Martes americana*), and 2 fisher (*Martes pennanti*) tracks.
- This quarter 110 scats were prepared and 91 analyzed for diet, including 62 bear, 1 bobcat (*Lynx rufus*), 23 coyote, and 5 wolf scats.
- Twenty–four vegetation (18 random, 6 predation sites) surveys were conducted.
- Project personnel gave several presentations and collaborated on several mass media project articles and interviews designated for the public and wildlife management sector.
- Activities next quarter will include doe capture, neonatal fawn and carnivore capture, carnivore cluster investigations, and radio–telemetry of deer and carnivores.

- Public relations and communication strategy efforts will continue next quarter, with several presentations already scheduled.

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 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 been conducted demonstrating 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) 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 southern 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, coyote, bobcat, and wolf predation.

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

6. Estimate if minimum composite bear, coyote, bobcat, and wolf use of an area influences fawn predation rates.

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

Study Area:

This overall study area is about 870 km^2 (~340 mi^2) within Deer Management Unit (DMU) 055 in Menominee County. The core study area includes a mix of forested and agricultural lands and is where capture efforts occur. The overall study area consists of a minimum convex polygon that includes the composite locations of telemetered animals. DMU 055 was selected because of the relatively low snowfall and generally low winter severity. Deer in this area are largely non-migratory, making direct comparisons to southern Michigan (i.e., Pusateri Burroughs et al. 2006) easier.

Accomplishments:

Winter Deer Capture

Sixty–one Clover trap sites were set 18 Jan–5 Mar 2010 throughout the core study area and on agricultural lands immediately west of the core study area. We captured 44 individual white–deer (34 female, 10 male) consisting of 21 adults, 2 yearlings, and 21 fawns. Twenty–one pregnant does were radiocollared and 23 were implanted with vaginal implant transmitters (VIT tags), including 2 does (D055 and D037) originally captured in 2009. Two radiocollared female fawns (F008 and F030) were recaptured; pregnancy was not detected in either fawn. All adult and yearling does (n = 21) were pregnant, but no fawns (n = 3) were pregnant. Two fetuses were detected in 11 does. Although multiple fetuses may have been present in remaining does, ultrasound fetal detection was often limited by fetal development and deer handling precautions (e.g., hastened release due to low temperature) taken by personnel. One trap–related mortality occurred (5 occurred in 2009), attributed to a fracture of the first cervical vertebrae before researchers arrived at the trap. Improved capture and handling precautions (e.g., tightening Clover trap netting) implemented this quarter appeared to reduce risk of capture–related mortality. Compared to 2009 during which 77 unique deer were captured, 2010 captures were hindered by limited timber harvesting and low depth and early loss of snow cover. Deer did not appear to concentrate in trapping areas used in 2009 likely due to warmer weather and increased available food in adjacent agricultural areas.

Deer Mortality

Does– Four mortalities occurred this quarter which were attributed to coyote (*n* = 2), wolf (*n* =1), and unknown predator (not wolf; *n* = 1). There have been 8 predations of does captured in 2009 and 2010 which were attributed to: 4 coyote, 2 wolf , 1 black bear, and 1 unknown predator. Eleven mortalities of does captured in 2009 and 2010 have occurred, which in addition to predation included 2 drowning events and 1 vehicle collision. Seventy-eight percent of does radiocollared in 2009 (*n* = 36) are still alive. No radiocollared does were harvested during the 2009 hunting season.

Fawns– Two mortalities occurred this quarter, one each attributed to coyotes and illegal harvest. Thirty fawn mortalities have occurred since May 2009, including 22 predations, 4 suspected abandonments, 2 vehicle collisions, 1 illegal harvest, and 1 unknown. Of the 22 predations, 9 were attributed to coyotes, 6 to bobcats, 3 to unknown predators, 2 to black bears, 1 to an unknown canid, and 1 to a bald eagle (*Haliaeetus leucocephalus)*. Additionally, radiocollars of 5 fawns have either failed or detached from the animal. No fawns were harvested during the 2009 hunting season.

Deer Radiotelemetry

Does– From 2009–2010 captures, 44 radiocollared females were being monitored as of 31 Mar 2010. We collected 362 radiolocations this quarter. Individual does (2009 and 2010) had 3–97 radiolocations depending on capture and censor dates.

Fawns– There were 14 fawns being monitored as of 31 Mar 2010. We collected 191 radiolocations this quarter. Individual fawns captured May–June 2009 had 2–50 radiolocations depending on capture and censor dates. Two fawns could not be located during 6 aerial and ground searches since late February likely due to collar failure.

Deer Camera Abundance Survey

Fifty–five remote infrared cameras were deployed for 10-day periods from 5–26 Sep 2009 to estimate deer abundance. Thirty–four cameras were deployed from 5–15 Sep 2009 and 21 from 16–26 Sep 2009. One camera was stolen during deployment. We recorded 9,693 images with the cameras set to record an image every 5 min. The following species and number of images included white-tailed deer (*n* = 8,159; Figure 1), black bear (*n* = 28), squirrel (*Sciurus spp*.; *n* = 198), turkey (*Meleagris gallopavo; n* = 22), ruffed grouse (*Bonasa umbellus; n* = 1), rabbit/hare (*Sylvilagus floridanus*, *Lepus americanus*; *n* = 3), porcupine (*Erethizon dorsatum*; *n* = 1), coyote (*n* = 1), other (*n* = 686), and no observation (*n* = 594). Other observations recorded were raven (*Corvus corax*), crow (*Corvus brachyrhynchos*), Mourning dove (*Zenaida macroura*), blue jay (*Cyanocitta cristata*), raccoon (*Procyon lotor*), sandhill crane (*Grus canadensis*), red–tailed hawk (*Buteo jamaicensis*), Eastern chipmunk (*Tamias striatus*), mouse (*Peromyscus spp*.), blue heron (*Ardea herodias*), pheasant (*Phasianus colchicus*), stripped skunk (*Mephitus mephitis*), human, and unknown. Deer images had the following number of deer observed (percent of total) in each image, 1 deer (78%), 2 deer (18%), 3 deer (3%), 4 deer (<1%), 5 deer (<1%), and 6 deer (<1%). Female deer were recorded in 5,019 images and males in 2,070 images. Fawns were recorded in 739 images with 627 images having 1 fawn and 112 images having 2 fawns. Ear–tagged and radiocollared deer were recorded in 101 and 105 images, respectively with 104 images of 1

radiocollared deer and 1 image of 2 radiocollared deer. Spike–antlered deer were recorded in 544 images and branch–antlered bucks in 1,596 images, of which 88 uniquely identifiable branch-antlered bucks were observed. There were 42 images with ≥2 bucks in a single image and 40 (74%) cameras recorded ≥1 unique buck. Radiocollared black bears were recorded in 7 images.

Black Bear Den Checks

Eight adult black bears (3 male, 5 female) and 2 yearlings (1 male, 1 female) were immobilized in their dens this quarter. Five adult bears had their GPS collars removed and replaced with new GPS collars. Two black bears (1 male, 1 female) previously captured by MDNRE personnel were immobilized in their dens and fitted with GPS collars. Previously collared female black bear (BB08) and her 2 yearlings slipped their collars during Dec and were re–immobilized in their den and re–collared. Global Positioning System collars were programmed to obtain a location every 35 h until 1 May and then every 15 min. A male bear shot and wounded on 15 Sep 2009 had his GPS collar removed and replaced with a VHF collar. We handled 10 cubs (9 male, 1 female) during den work. Mean litter size was 2.5 cubs (SD = 0.58; Table 1). Black bears were weighed, had morphometric measurements recorded, and implanted with a Passive Integrated Transponder tag (PIT). All bears were placed back into their respective dens for recovery.

Hair Snares

Hair snares for bobcats and coyotes were deployed for 8 weeks from 12 Jan–13 Mar 2010. Snares were deployed on a 2.5 km^2 grid cell system, with one bait site per cell (Figure 2). Grid cells truncated by >50% due to the Lake Michigan shoreline were combined with adjacent cells. We deployed 2–6 snares at each site (161 total snares) based on the number of trails that developed during the 3–week pre-baiting period. Hair samples were collected (Figure 3) and snares reset as necessary every 7 days; 230 hair samples (of target and non-target species) were collected and sent to the MDNRE Wildlife Disease Laboratory in Lansing, MI for genetic analysis.

Bobcat Cage Trapping and GPS Radiocollaring

Ten live-traps (Tomahawk, California Cage traps) were deployed from 1 February–9 March 2010, for a total of 185 trap nights. No bobcats were captured; 2 raccoons were captured and released.

Carnivore Track Surveys

We conducted 17 track surveys on 12 days from 11 Jan–3 Mar 2010, traversing 319.5 km. Additional track observations were made opportunistically while performing other field duties. We detected 36 occasions of wolf tracks with at least 1 individual (28 included >1 individual), 44 sets of coyote tracks with ≥1 individual, 2 sets each of bobcat, marten, and fisher tracks. Poor snow conditions during much of the winter prevented more surveys from being completed, therefore near the end of winter (late Feb through Mar) many track surveys focused on detecting wolves. For wolves and coyotes, the number of individuals traveling together was used to estimate minimum pack sizes and a minimum abundance estimate for the area (Figure 4).

Wolf Abundance Estimations

Track surveys for wolves were used to estimate the number and locations of packs in the study area, as well as minimum number of individuals within each pack. Based on summer GPS data, it was known that at least 2 packs occurred in the study area (7 Mile Marsh Pack and Hayward Lake Pack; Figure 5).

We identified a minimum of 7 individuals in the 7 Mile Marsh Pack. Raised leg urinations were observed suggesting territorial marking and although no estrous blood was detected project personnel heard pups in the 7 Mile Marsh Pack's primary area during May 2009. Surveys this winter identified a minimum of 4 individuals in the Hayward Lake Pack. Track surveys in this area have also revealed several raised–leg urinations and squatted urinations with estrous blood, suggesting territorial marking and breeding.

Additionally, one male wolf was found captured outside of the study area in an illegal neck snare and reported to MDNRE Law Enforcement personnel (see above) and was subsequently fitted with a VHF collar. This individual belongs to the Carney Pack, residing primarily west of the study area boundary. This pack may, however, make occasional forays into the study area; locations of this individual are being monitored (Figure 5).

Bobcat Harvest Data

Unpublished MDNRE data for 2008–2009 and 2009–2010 harvest seasons were compiled and used to assess bobcat distribution and sex ratio in the study area. Distribution was assessed by plotting bobcat harvest locations by section in a GIS (Figure 6). Harvested bobcats from the study area (n = 20) included 6 females, 13 males, and 1 unknown.

Scat Analysis

Carnivore scats were collected opportunistically throughout the study area; labeled by date, species, and UTM coordinates; and then frozen. This quarter 110 scats were cleaned and dried and 91 (62 bear, 1 bobcat, 23 coyote, 5 wolf) were analyzed. To date, 362 scat samples consisting of 103 bear scats, 12 bobcat scats, 143 coyote scats, 59 wolf scats, and 45 unknown scats have been collected. The most common prey items identified in bear scats were unknown plant material, ants, and unidentified seeds (Table 2). Unknown plant material was the most common item in the bobcat scat and the most common items in coyote scats were adult white-tailed deer hair, unknown plant material, and unknown bone fragments. Wolf scats primarily contained wolf hair, unknown hair and bone fragments, and white–tailed deer fawn hair.

Vegetation Surveys

This quarter, 24 surveys quantifying vegetation structure, composition, and density were conducted at 6 predation and 18 random sites.

Alternate Prey, Carnivore, and Deer Data

This quarter, 233 alternate prey, deer, and carnivore observations were recorded (Table 3). Carnivore data included sightings and observations of tracks.

Public Outreach

To improve our outreach efforts, a communication strategy is being developed with the assistance of Dr. James Cantrill, Department Head, Communication and Performance Studies, Northern Michigan University. Dr. Cantrill and his student held 3 focus group sessions this quarter with several stakeholder groups to acquire feedback on how we can more effectively communicate project results to a broader public. Dr. Cantrill and his student are currently summarizing results of these meetings and will provide recommendations to project staff. This information will be used to guide our outreach efforts and encourage further public cooperation with the project.

The following presentations were given by project staff this quarter:

1) Duquette, J., N. Svoboda, J. Belant, D. Beyer, and D. Beyer. 1 Feb 2010. *White-tailed deer fawn survival in the southwestern U.P.* Escanaba Lions Club, Escanaba, MI. 25 attendees.
2) Duquette, J., N. Svoboda, J. Belant, D. Beyer, and C. Albright. 6 Feb 2010. *White-tailed deer fawn survival in the southwestern U.P.* U.P. Trappers Association, Powers, MI. 110 attendees.
3) Duquette, J. N. Svoboda, J. Belant, D. Beyer, and C. Albright. 12 Feb 2010. *Upper Peninsula predator-prey study research update.* North Menominee County Sportsmans Club (NORMENCO), Wilson, MI. 15 attendees.

Project Crew Selection and Hires

A job announcement for 10 seasonal Research Assistants was posted on the Texas A&M job board in early–Mar and closed 24 Mar. Sixty–seven applications were received and are currently being evaluated and scored. Ten seasonal Research Assistants and 1 Research Technician will be hired for the summer field season.

Work to be completed (April–June):

Winter Deer Capture

Air–powered cannon nets will be used for deer capture during April to increase our sample size of pregnant does. The number of Clover trap and cannon net occasions will be summarized after capture efforts are completed.

Neonatal Fawn Capture

Fawn captures will begin during late–May based on observation and capture data from 2009. During this time fawns will be captured opportunistically, by conducting systematic field searches, and from VIT–tagged does. Specifically, upon detecting a change in VIT tag pulse signal, crews

will systematically search the VIT tag location site and direction of the doe in effort to capture and radiocollar neonatal fawns.

Carnivore Trapping and Radiocollaring

Wolf, bobcat, and coyote capture efforts and radiocollaring will occur during Apr–May. Black bear trapping will begin in late May or early Jun and continue through July. We will use Tomahawk and California box traps, #3 Victor soft-catch foothold traps, and cable restraints for bobcats. Cable restraints and #3 Victor soft-catch traps will also be used to capture coyotes, while MB 750 footholds will be used to capture wolves. Black bear trapping will be accomplished using barrel traps and Aldrich foot snares. All captured animals will be fitted with uniquely numbered ear tags, weighed, sexed, and evaluated for injury. Various morphometric measurements will be taken along with blood, hair, fecal, and saliva samples. Body condition index (BCI) scores will be estimated and a tooth will be removed to estimate age. Carnivores will be fitted with a GPS collar with a built in blow-off mechanism.

Radiotelemetry

Does and fawns will continued to be located at least weekly and VIT–tagged does every 8 h during the estimated parturition period to monitor VIT tag expulsion. Aerial flights will be conducted to retrieve predator GPS collar data and obtain locations from VHF–collared carnivores.

Deer Camera Abundance Survey

Deer abundance estimate for 2009 will be estimated from images.

Cluster Investigation

Investigations of carnivore cluster locations will begin early–May and will provide information on potential predations events.

Vegetation Surveys

Vegetation and habitat data will be collected at cluster locations, fawn birth site locations, predation sites, carnivore cluster locations and randomly selected predator locations beginning early–May.

Project Staff

Ten seasonal Research Assistants and one seasonal Research Technician will be hired to assist with summer field work.

Carnivore Scat Collection

Project staff will continue to collect scats of focal carnivore species opportunistically throughout the study area. Staff will record date, GPS location, and species for each scat collected. Samples will be evaluated to estimate diet of each carnivore species throughout the year.

Alternative Prey and Deer Observations

Project personnel will continue to record daily start and end times in the field, as well as locations and time for each deer and alternative prey species observed. These data will provide an index of relative abundance of alternative prey and deer across the study area.

Public Outreach

We will continue to work with Dr. James Cantrill, Department Head, Communications and Performance Studies, Northern Michigan University to implement our communication strategy to improve outreach efforts.

Protocols and Manuals

All protocols except 2 population survey protocols have been completed or are in final revision. The remaining protocols will be completed this quarter.

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Table 1. Carnivore capture and den check data for 21 carnivores, Delta and Menominee counties, Upper Peninsula of Michigan, 1 January–31 March 2010.

Species	ID	Capture date	Age[1]	Sex	Body weight (kg)	Right ear tag	Left ear tag
Wolf	W04	6-Feb-10	Adult	M	47.6	559	560
Black bear	BB12	22-Feb-10	12	F	113.4	72	73
Black bear	BB20	22-Feb-10	Cub from BB12	M	N/A	N/A	N/A
Black bear	BB21	22-Feb-10	Cub from BB12	F	N/A	N/A	N/A
Black bear	BB15	22-Feb-10	3	M	127.0	82	81
Black bear	BB14	23-Feb-10	3	F	83.9	79	80
Black bear	BB22	23-Feb-10	Cub from BB14	M	1.8	N/A	N/A
Black bear	BB23	23-Feb-10	Cub from BB14	M	1.8	N/A	N/A
Black bear	BB24	23-Feb-10	Cub from BB14	M	1.6	N/A	N/A
Black bear	BB16	24-Feb-10	5	F	90.7	84	83
Black bear	BB25	24-Feb-10	Cub from BB16	M	2.3	N/A	N/A
Black bear	BB26	24-Feb-10	Cub from BB16	M	2.3	N/A	N/A
Black bear	BB27	24-Feb-10	Cub from BB16	M	2.3	N/A	N/A
Black bear	BB28	24-Feb-10	Adult	M	113.4	1110	28
Black bear	BB09	25-Feb-10	Adult	M	68.0	99	67
Black bear	BB29	25-Feb-10	Adult	F	133.8	5	45
Black bear	BB30	25-Feb-10	Cub from BB29	M	2.3	N/A	N/A
Black bear	BB31	25-Feb-10	Cub from BB29	M	2.3	N/A	N/A
Black bear	BB08	8-Mar-09	8	F	NA	N/A	11
Black bear	BB17	8-Mar-09	Yearling	F	29.5	35	34
Black bear	BB18	8-Mar-09	Yearling	M	40.8	24	25

[1]Ages were estimated using tooth analyses by the Michigan Department of Natural Resources and Environment

Table 2. Percent frequency of occurrence of prey species identified in black bear (*n* = 62), bobcat (*n* = 1), coyote (*n* = 23), and wolf (*n* = 5) scat collected, Delta and Menominee counties, Upper Peninsula of Michigan, 5 June–13 August 2009.

	Black bear		Bobcat		Coyote		Wolf	
Prey item	**No. Scats**	**%**	**No. Scats**	**%**	**No. Scats**	**%**	**No. Scats**	**%**
White-tailed deer, adult (*Odocoileus virginianus)*	4	6.5	0	0.0	13	56.5	1	20.0
White-tailed deer, fawn	2	3.2	0	0.0	4	17.4	2	40.0
Rabbit/hare (*Sylvilagus floridanus; Lepus americanus*)	0	0.0	0	0.0	2	8.7	0	0.0
Porcupine (*Erethizon dorsatum*)	1	1.6	0	0.0	0	0.0	0	0.0
Raccoon (*Procyon lotor*)	0	0.0	0	0.0	1	4.3	0	0.0
Unknown hair	3	4.8	0	0.0	0	0.0	0	0.0
Unknown bones	4	6.5	0	0.0	19	82.6	4	80.0
Unknown plant material	53	85.5	1	100.0	14	60.9	3	60.0
Corn (*Zea mays*)	7	11.3	0	0.0	0	0.0	0	0.0
Sunflower seeds (*Helianthus annuus*)	2	3.2	0	0.0	0	0.0	0	0.0
Unknown seeds	13	21.0	0	0.0	0	0.0	0	0.0
Unknown insects	5	8.1	0	0.0	1	4.3	0	0.0
Beetle (*Coleoptera*)	6	9.7	0	0.0	2	8.7	0	0.0
Bee (*Apidae*)	1	1.6	0	0.0	0	0.0	0	0.0
Ants	39	62.9	1	100.0	0	0.0	0	0.0
Snails	1	1.6	0	0.0	0	0.0	0	0.0
Ticks	0	0.0	0	0.0	2	8.7	0	0.0
Unknown feathers	1	1.6	0	0.0	0	0.0	0	0.0
Hair of focal species	4	6.5	0	0.0	3	13.0	2	40.0

Table 3. White–tailed deer, alternative prey, and carnivore observations in Delta and Menominee counties, Upper Peninsula of Michigan, 1 January–31 March 2010.

Alternative Prey	Observed	Carnivores[1]	Observed
White-tailed deer	97	Coyote	23
Ruffed grouse	32	Wolf	13
Turkey	18	Skunk	11
Pheasant	11	Fisher	7
Squirrel	7	Bobcat	4
Rabbit/hare	5	Gray fox	1
Porcupine	1	Red fox	1
Small mammal	1	Black bear	1

[1]Carnivore observations include visual observations as well as observed tracks

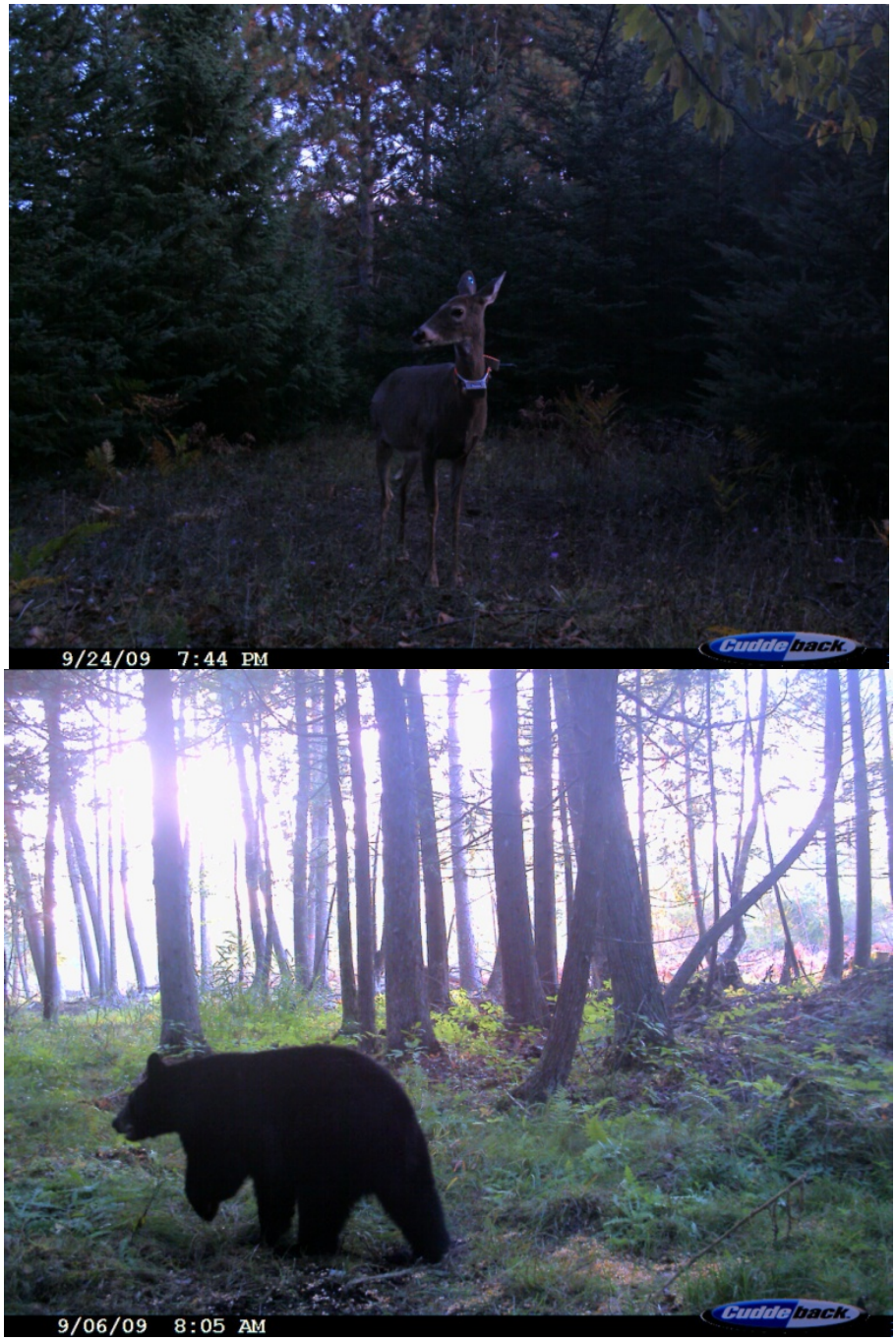

Figure 1. Radiocollared doe (top) and black bear (bottom) captured by remote infrared cameras during deer abundance survey within the study area in Delta and Menominee counties, Upper Peninsula of Michigan, September 2009.

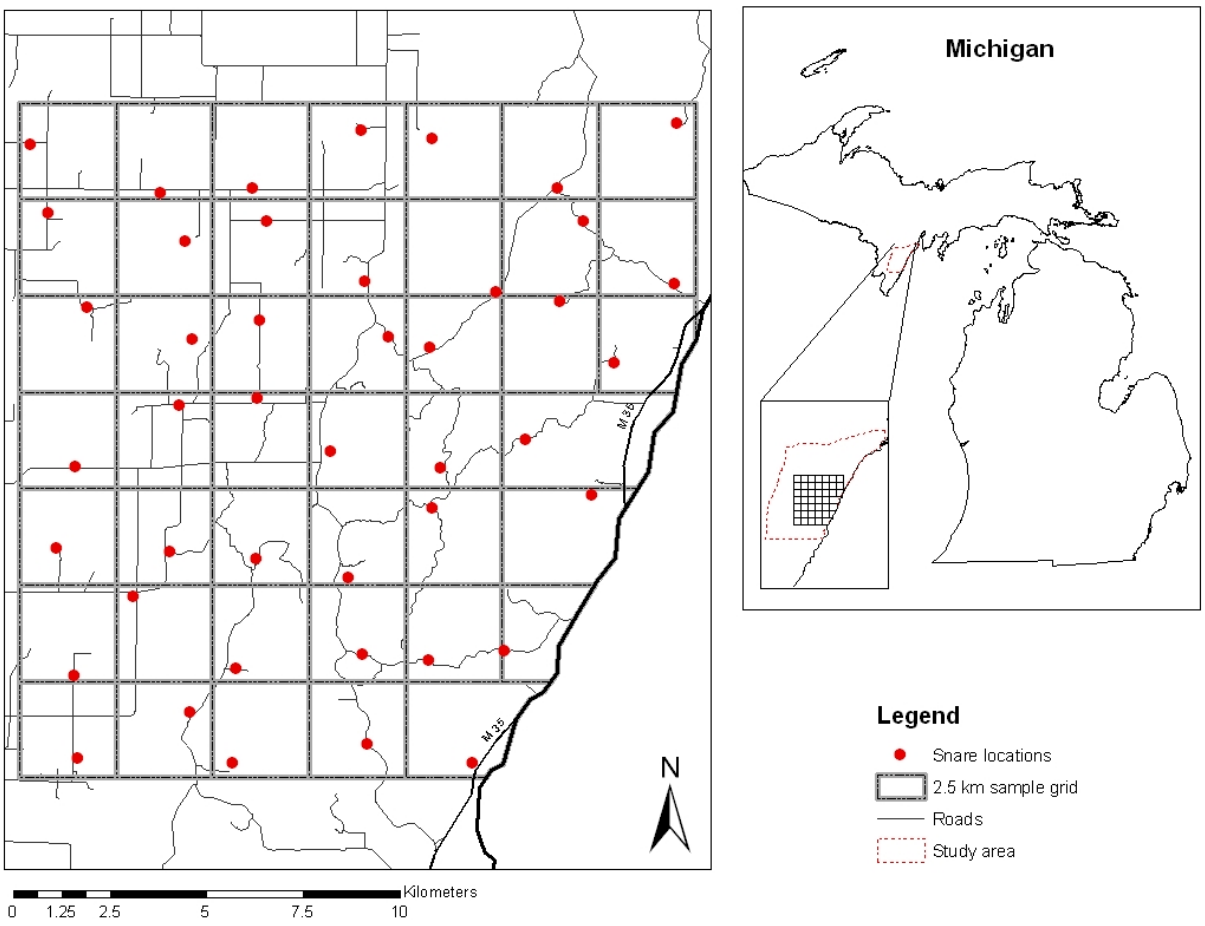

Figure 2. Bobcat and coyote hair snare sites (n = 44) within a 2.5 km^2 grid in Menominee County, Upper Peninsula of Michigan, January–March 2010.

Figure 3. Baited snare site (top) and hair sample captured (bottom) using a modified body snare, Upper Peninsula of Michigan, January–March 2010.

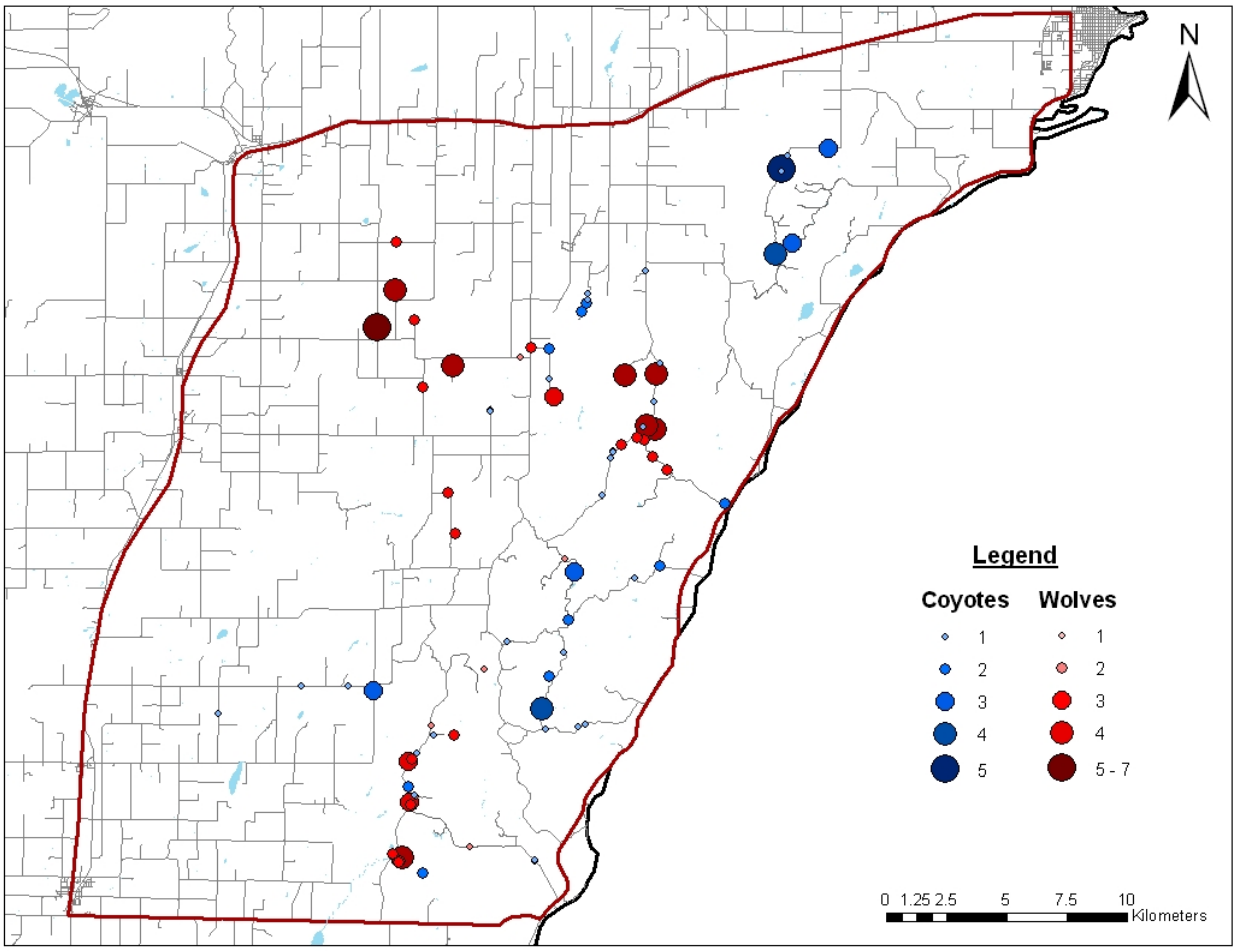

Figure 4. Winter track survey observations for wolves (red) and coyotes (blue) within the study area, Upper Peninsula of Michigan, January–March, 2010. Observations are displayed based on number of animals traveling together.

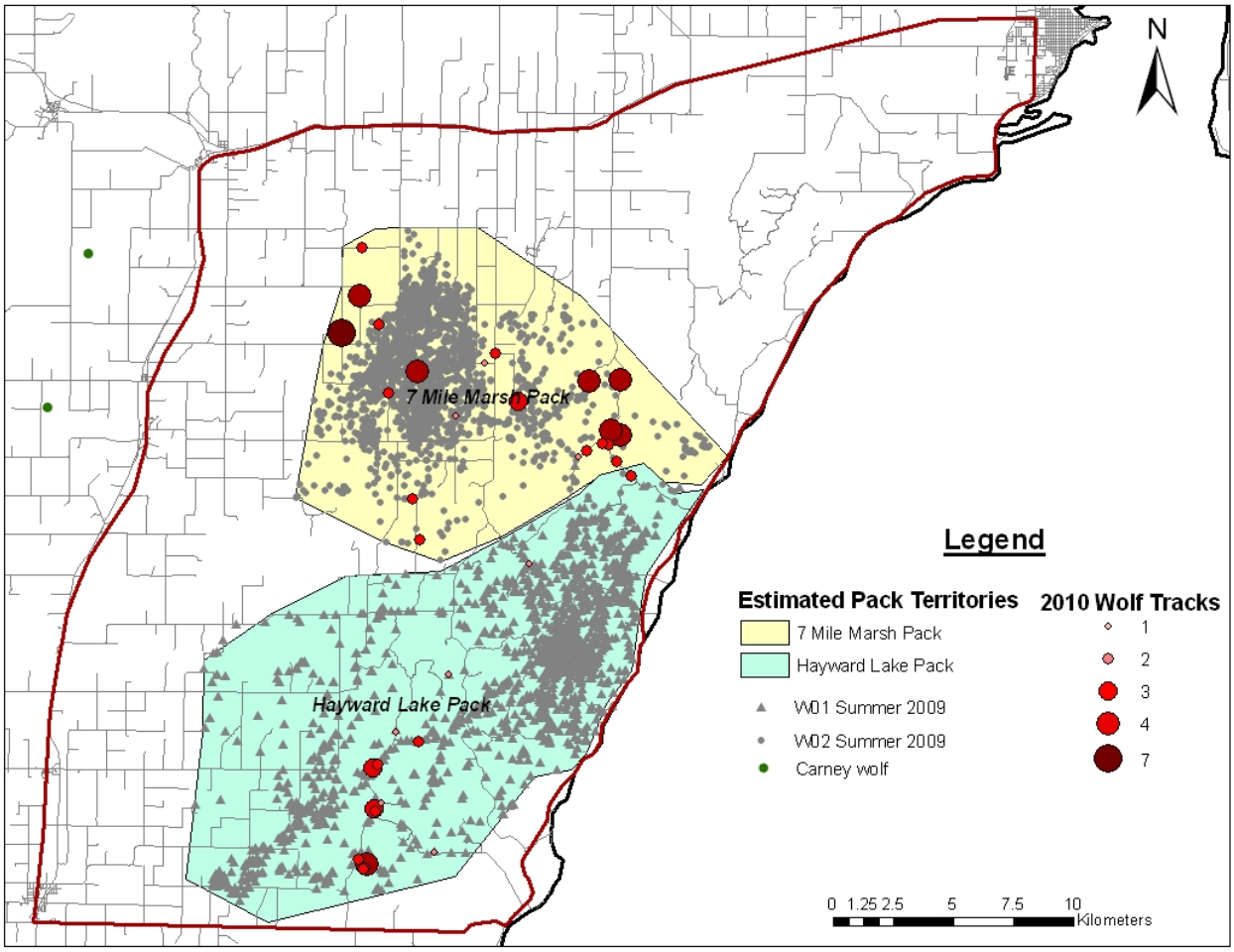

Figure 5. Approximate 2010 wolf pack territories based on summer 2009 wolf GPS data and 2010 winter track survey observations. Also shown are telemetry relocations of a radio-collared wolf in the Carney Pack.

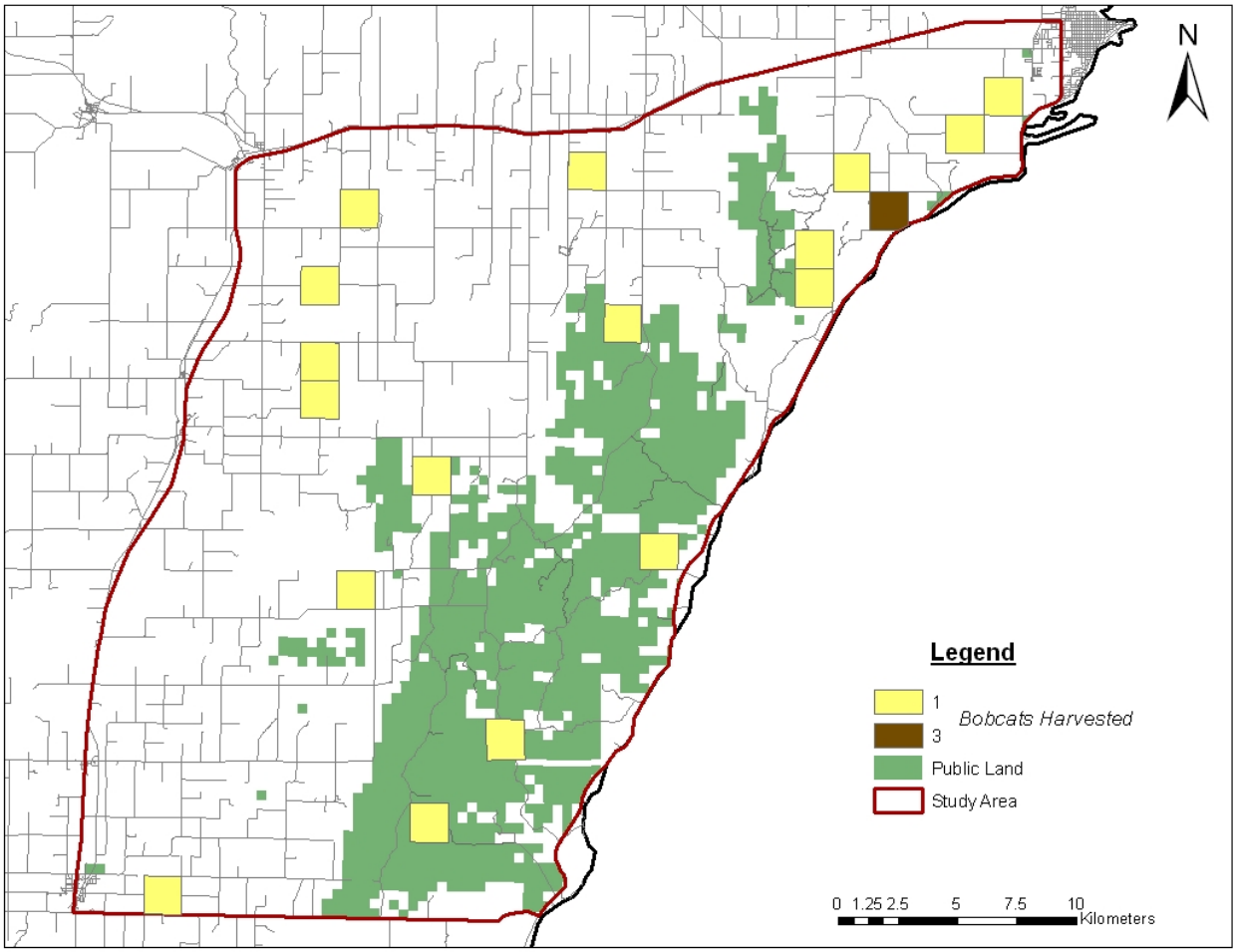

Figure 6. Bobcat harvest data (n = 20) by section (2008 and 2009 MDNRE unpublished data), within the study area in Delta and Menominee counties, Upper Peninsula of Michigan.