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Response of Illinois Deer to Winter Weather

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ABSTRACT

Winters can be a significant factor affecting white-tailed deer (*Odocoileus virginianus*) physical condition, daily behavior, survival, and fecundity. Using harvest data and deer marked in east central and northern Illinois, we examined the effects of snow cover and temperatures on fawn:doe ratios in the deer harvest, fawn recruitment from marked females, female migration behavior, deer survival, and the daily behavior of both sexes when exposed to winter conditions. There was no significant correlation between total winter snow cover or temperature deviations from normal and fawn:doe ratios in the 11-yr deer harvest data used for this analysis. Recruitment to weaning age of fawns born to marked adult females was positively correlated with the previous 2-yr and 3-yr snow accumulations, apparently due to increased survival of older females during snowy winters. In winter, deer avoided bottomland forests and selected younger forests providing more understory cover. Females remained in forest cover and avoided open crop fields when snow was present. For 7 migrating females, snow cover in early December affected return frequencies to the natal range. Snow depths in excess of 10 cm appeared to trigger a return to the winter range while lesser snow accumulations did not. Temperature deviations from normal did not influence female movement back to the winter range.

Keywords: white-tailed deer, Illinois, winter, weather

INTRODUCTION

Winter severity can be life threatening for white-tailed deer that inhabit the northern states and southern Canada. Forced into winter yards, deer often become debilitated because forage has been covered by deep snow or has been severely over browsed (Severinghaus 1947, Verme and Ozoga 1971, Ozoga and Gysel 1972). The very young, the old, and those deer crippled by wounds or disease are particularly vulnerable (Mech and Karnes 1977, Nelson and Mech 1981).

In Illinois, winter severity is usually not life threatening because deer have had access to waste grains and green forages in most winters, and they are seldom confined to specific habitats for long periods by inclement weather. However, Illinois deer must adapt to colder than normal temperatures and periodic snow events that may occur each winter. Similar to deer in more northern climates, deer prepare for winter by gaining weight in the summer and fall before winter begins (Moen and Severinghaus 1981, Warren et al. 1981) and by molting into a thicker, warmer pelage (Ditchkoff 2011). Once winter begins deer typically reduce metabolic demands and food intake (Silver et al. 1969, Moen 1976, Mautz 1978) and increase the size of their home range compared to summer months (Nixon et al. 1991, Stewart et al. 2011). Social grouping of both sexes is common in winter in Illinois, with both sexes banding together to improve feeding opportunities and to avoid predators (Hirth 1977, Ballard 2011).

The effects of winter weather on Illinois deer has received scant attention. Hansen et al. (1986) found snowfall the previous winter had a small but positive effect on the following deer harvest in central and northern Illinois. They speculated snowfall reduced deer movements and thus reduced the likelihood of mortality from highway accidents and poaching.

Winter migrations were observed among deer in northern Illinois during the early years of reintroductions when deer were observed moving into the Rock River valley from surrounding farms in early winter and moving away in the spring (Pietsch 1954). In central and northern Illinois in more recent years, 14–21% of marked females migrated back and forth an average distance of 7.3 km ± 2.1 SD between the natal range and a range occupied in summer (Nixon et al. 2008).

Here we determined deer physical and behavioral response to winter weather. We examined fawn recruitment, daily activity patterns as affected by precipitation, snow cover, and temperature, female migration behavior as affected by snow cover and temp, and winter survival for marked deer located in central and northern Illinois.

STUDY AREAS

Deer were captured during 1980–1985 in Piatt County and 1990–1993 in DeKalb County. The 2,953-ha Piatt area featured 64% row crops, 22% upland forest, and 14% bottomland forest. The pubic portion of the Piatt area was a 600-ha refuge free from all hunting, while the private portions were hunted by both archers and firearm hunters each year. Winter deer densities, based on aerial counts by helicopter conducted once each winter over snow cover, ranged from 13 deer/km^2 in 1981 to 19 deer/km^2 in 1985 in the forests of the study area (Nixon et al. 1991). Only 2.7% of Piatt County was forested in 1989 (Iverson et al. 1989).

The DeKalb area (1,648 ha) is located near the headwaters of the Fox River. The area was covered by 59% row crops, 14% second growth deciduous upland forest, 7% reconstructed tall grass prairie, 6% mixed species pine plantations, and 5% savanna. The remaining 9% consisted of a small suburban area, a golf course, and a 128-ha lake. Forty percent of the public portion of the DeKalb area was hunted by archers only. The remaining private farms were hunted by both firearm and archery hunters. DeKalb County was 1.6% forested in 1989 (Iverson et al. 1989). Deer density estimates were calculated from spotlight counts (4–8/yr) made using fixed routes covering the area. We used Peterson-Lincoln estimates based on the tagged:untagged ratio of yearling and older deer seen per route, with the addition of known fawn production from marked females, to obtain a minimum pre-harvest population estimate (McCullough and Hirth 1982). These densities ranged between 11 deer/km^2 in 1990 and 18/km^2 in 1992.

The DeKalb study area was more open and disturbed (by trails, camping areas, reconstructed prairies, lake shore, and suburban areas) compared to the Piatt area. Deer reactions to human disturbances and road traffic were more restrained at the DeKalb study area compared to deer on the Piatt area making them easier to observe.

Average winter temperatures in Piatt County ranged from +5.4° C (average daily low 0.6° C and high 10.2° C) in November to a low of –4.1° C (average daily low -8.4° C and high 0.2° C) in January. Snowfall averages ranged from 4.1 cm in November to 19.3 cm in January. Winters were somewhat more severe in DeKalb County, with average temperatures of +3.7° C (average daily low -0.9° C and high 8.3° C) in November and –6.8° C (average daily low -11.2° C and high -2.6° C) in January. Snowfall averages ranged from 3.0 cm in November to 24.6 cm in January. Snowfall of ≥ 2.5 cm on the ground averaged 18.0 days ± 10.8 SD in Piatt County and 48.4 days ± 23.5 SD in DeKalb County (Midwest Regional Climatic Center 2016).

METHODS

We captured deer (Piatt = 286, DeKalb = 115) using rocket nets (Hawkins et al. 1968), manually restrained them, and aged them as fawns, yearlings, or adults using tooth wear and replacement observed at capture (Severinghaus 1949). Formal institutional approval from the University of Illinois of deer capture procedures was not required for the years this study was conducted. Females were marked with plastic collars bearing reflective numbers or symbols for identification (Piatt = 81, DeKalb = 41) or with radio transmitters (Piatt = 58, DeKalb = 27). Males were marked with colored plastic ear streamers (Piatt = 103), numbered ear tags (DeKalb = 42), or radio transmitters (Piatt = 38, DeKalb = 5) designed to expand with the neck expansion that occurs during the breeding season. Seven and four deer died of capture myopathy on the Piatt and DeKalb areas, respectively.

On the Piatt area, we located radio marked deer 3–4 times a week using 2 truck-mounted 8-element yagi antennas aligned in a null configuration. On both areas, deer marked without radios were observed during routine field work, during spotlighting at night over fixed routes, or reported to us by the general public.

Personnel limitations on the DeKalb area meant that radio tracking and observations of deer behavior was only possible at 7–10 day intervals. However, we conducted our field work, such as deer captures, spotlight counts, and general observations, in a similar manner on both areas. The small amount of dense cover on the DeKalb area enabled us to use a single antenna, a close approach, and direct observation to locate radio marked deer.

The accuracy of radio locations was established using transmitters placed at known locations on the Piatt area. Radio fixes were validated using an unpublished program for the APPLE II (L. P. Hansen, Illinois Natural History Survey). During summer, location error using 227 known radio locations varied from a low of 77 m ± 5.9 SE using 4 bearings to a high of 147 m ± 166 SE) for 2 bearings. During winter, location errors based on 93 known transmitter locations fell between these extremes. Nearly 40% of all deer radio locations were based on 4 or more fixes (obtained in < 30 min). All acceptable locations on the Piatt area, both radio located and by direct observation, were assigned to a single ha. Each ha was cover mapped for dominant vegetation (> 50% of the canopy) once

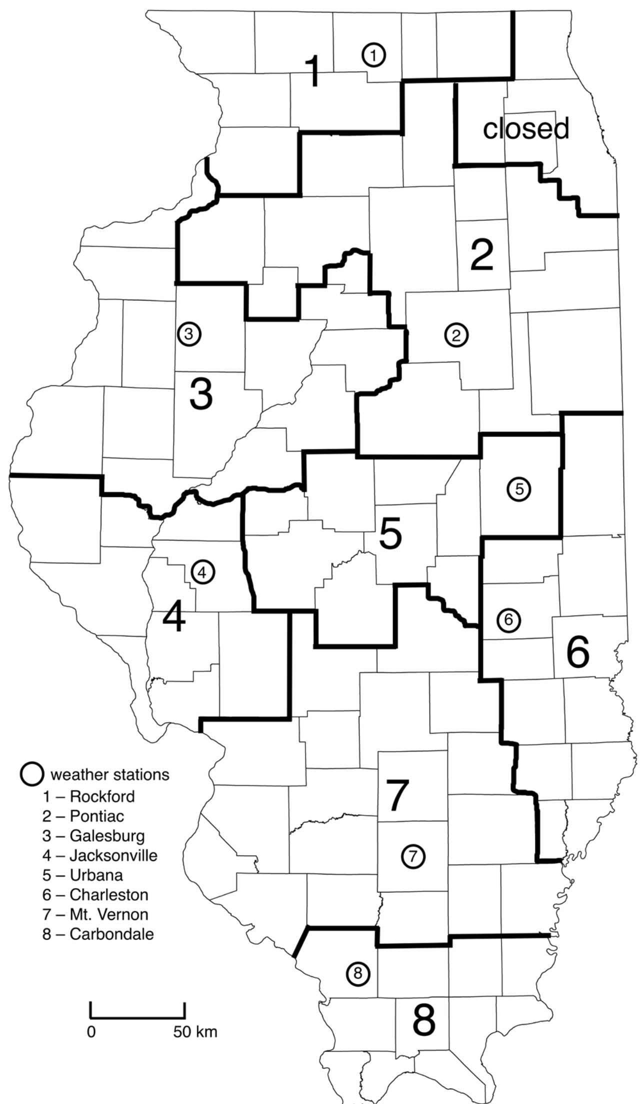

Fig. 1. White-tailed deer harvest management regions used by the Illinois Department of Natural Resources for the years 1977–1985, 1987, and 1990 and the weather station locations within each region used to generate total snowfall and temperature deviations from normal for the December–March period each year.

during the study in late spring; crop fields were mapped twice each year in late spring to record the crop and in late fall to document field treatment after harvest.

Fawn Recruitment

We used fawn:doe ratios from deer harvested for the years 1977–1985, 1987, and 1990 to examine the relationship of winter weather and subsequent fawn recruitment in the fall. We used the harvest years available to us and not the years selected for the winter severity they represent. County harvest data were grouped into 8 regions by the Illinois Department of Natural Resources (IDNR) (Fig. 1), and a single weather station within each region was used to generate total snowfall and temperature deviations from normal for the December–March period each year (NOAA National Climatic Data Center. 2015). We used linear regression to compare the effect of snow accumulations and temperature deviations from normal for each winter (December–March) for 1, 2, and 3 years previous to the fawn:doe ratios in the deer harvest. Using up to 3 winters previous would include maternal condition affected by several winters that could affect fawn health and survival (Mech et al. 1987). We conducted a similar weather analysis using known fawn recruitment from our marked females for the years of study, 1989–1993 for DeKalb area and 1979–1986 for the Piatt area.

Winter Deer Activity Patterns

Drive counts were conducted twice each season (April, July, October, January) during 1982–1985 in 177-ha of permanent cover on the Piatt area only to ascertain seasonal habitat use (Nixon et al. 1991). We did not have the resources to duplicate these counts on the DeKalb area. We used Duncan's multiple range test to examine within season selection of habitats (the major types used were pasture, oak-hickory, bottomland hardwoods, early succession forest (< 30 yrs), intermediate succession (30–60 yrs), mixed conifer-hardwoods (< 40 yrs), and cottonwood plantations. We also measured habitat selections made by radio marked deer on both areas using chi-square analysis. We compared individual deer habitat selection in winter with habitats visited by each deer during the life of the radio during all seasons. This represents the best indication of seasonal habitat use and availability. We did not detect significant differences in deer detection rates among habitats based on the results of placement of transmitters in known locations within each of these habitats.

We measured wind velocities in the 7 principle habitat types on the Piatt area using an anemometer set up at 10 random sites within a 1-ha plot also selected at random from all 1-ha plots in the forest type. Wind velocity was measured for 2 min. in the forest type and then immediately in an adjacent opening. The difference between the wind in the forest and in the open was used as an index to the wind buffering ability of each forest type. Daily precipitation on the Piatt area was measured from the Urbana weather station and compared with movement patterns of radio marked deer using ANOVA (Nixon et al. 1991).

Three to 5 deer were intensively tracked on the Piatt area 3–4 consecutive days per week each season (locations every 15–30 min for 2–4 hours after sunset). Use of various habitats in winter was based on data from 26 radio marked females and 3–10 males per year. We used radio marked deer to examine winter movements of both sexes to feeding areas and the effects of wind chill (calculated for temperatures < 8° C and wind > 8 km/hr) on daily movements (Nixon et al. 1991).

The minimum area method (Mohr 1947) was used to generate seasonal home ranges for deer on the Piatt area with at least 30 acceptable locations per season. Locations were compatible with the Professional Map Analysis Package (P-map, Spatial Information Systems, Inc., Omaha, NE).

We used radio locations of individual deer in a contingency table to examine the effect of snow cover on deer use of landscape (i.e., whether deer were seen or radio-tracked in permanent cover or on a crop field). Observations were made throughout the day and during 2–4 hours post-sunset while radio-tracking.

Female Migration Behavior

Female migration movements between the natal range used in winter and the range selected by migrators in summer are often triggered by weather conditions (Nelson 1998). So far as is known, male deer do not exhibit migratory behavior in Illinois (Nixon et al. 2008). Females are considered either obligate or conditional migrators, depending if they migrate back to a winter range regardless of winter weather conditions (obligate) or either remain sedentary on the summer range or migrate back to the natal range (conditional) (Nelson 1998, Sabine et al. 2002, Brinkman et al. 2005). Using t-tests, we compared winter movement decisions made by 7 migratory females that made 23 migrations when exposed to early December snowfall totals and temperature deviations from normal. We used a recursive partitioning test to determine the dividing line in snow cover between remaining on the summer range or returning to the winter range.

Deer Survival

We used a winter severity index (sum of all days with snow present and all days with average temperatures < 0° C, December–March) to examine the winter survival of marked deer on our study areas. We used the proportion of marked fawns, yearlings, and adults that died in winter regressed on the winter severity index as a measure of the effect of winter weather on deer survival. We also compared winter fawn survival by litter size (1, 2, or 3 fawns) with the winter severity index to see if larger litter sizes affected winter survival. We also tested fawn condition (using chest girths and hind foot measurements from captured fawns as a measure of fawn growth to midwinter) in relation to litter size to evaluate the effect of litter numbers on fawn condition in winter (Roseberry and Klimstra 1975, Verme and Ozoga 1982).

RESULTS

Fawn Recruitment

Fawn:doe ratios varied among regions over the 11-yr period, with means ranging between 1.13 and 1.51 ($F = 3.58$, $df = 7,80$, $P = 0.0021$). There was no association between fawn:doe ratios and winter snow cover ($F = 0.48$, $df = 1,86$, $P = 0.49$) or temperature deviations from normal ($F = 0.53$, $df = 1,86$, $P = 0.47$) the previous winter and for 2-yr ($F = 0.83$, $df = 1,85$, $P = 0.37$) and 3-yr snow accumulations ($F = 0.004$, $df = 1,84$, $P = 0.95$). Recruitment of fawns born to marked fawn and yearling breeders was not significantly affected by temperature deviations from normal ($P = 0.10–0.24$) or sums of snow cover up to 3 winters pre-partum ($P = 0.15–0.27$), although fawn recruitment from fawn breeders were closely related to the sum of the previous 2-yr accumulation of snow cover ($P = 0.052$). Fawn recruitment from our marked adult female breeders was positively correlated with mean temperature ($F = 6.21$, df = 1,146, $P = 0.014$) and snow cover, using both 2-yr snow sums ($F = 67.3$, df = 1,146, $P < 0.0001$) and 3-yr sums ($F = 40.9$, df = 1,146, $P < 0.0001$). As snow accumulated, fawn recruitment to the subsequent harvest season increased.

Deer Activity Patterns

Drive counts conducted on 177 ha twice each January on the Piatt study area showed that deer were grouped together ($\bar{x}$ = 7.4 deer, range 7–34), and were most abundant in early successional forests (< 30 yrs old and in mixed hardwood-conifer types). Deer avoided bottomland forests and older oak-hickory forests (Duncan's multiple range test, $P < 0.0001$), both forest types with little understory present in winter. We also found that the wind difference between the bottomland forest type and the open was significantly lower compared to upland forest types (Duncan's Multiple range test, $P = 0.001$) where understory densities were higher.

These results were mirrored by habitat selections of our radio marked deer. In winter, females (N = 26) on the Piatt area were most often found in mixed cover (hardwood-conifer plantations), early successional forest types, and wheat and alfalfa fields. These females avoided soybean fields and bottomland forests. Yearling males in Piatt county (N = 5) selected early successional forest and avoided conifer plantations. Adult males in Piatt County (N = 5) also selected early successional forest and avoided row crops. Adult males (N = 3) in DeKalb County also avoided crop fields in winter and were more likely to use early successional forest and oak-hickory upland forests (all $P < 0.05$). In DeKalb County, too few females and yearling males were radio located to assess winter habitat use.

Females on the Piatt area bedded closer to areas of human disturbances (houses, roads, trails) in winter than did males (38 females, $\bar{x}$ = 157 m, 15 males, $\bar{x}$ = 227 m; $F = 3.55$, df = 1,51, $P = 0.07$). On both study areas, both sexes moved over larger home ranges in winter (9 male yearlings, $\bar{x}$ = 489 ha ± 26 SE; 9 male adults, $\bar{x}$ = 440 ha ± 19 SE; 44 females, $\bar{x}$ = 177 ha ± 14 SE) compared to summer (7 male yearlings, $\bar{x}$ = 300 ha ± 72 SE; 8 male adults, $\bar{x}$ = 323 ha ± 49 SE; 36 females, $\bar{x}$ = 110 ha ± 13 SE). The distance between presumed bedding sites (in midday with no radio movement detected for consecutive radio locations) and feeding sites (located at dusk or post-sunset) was greater in winter on the Piatt area (12 deer, sexes combined, $\bar{x}$ = 457 m ± 58 SE; N = 47 radio fixes) than in summer (26 deer, $\bar{x}$ = 269 m ± 14 SE; N = 357 radio fixes). Also on the Piatt area, radio marked yearling and adult males moved farther ($\bar{x}$ = 448 m, N = 6) between consecutive locations than females ($\bar{x}$ = 283 m, N = 9) during winter days ($F = 5.08$, df = 1,12, $P < 0.05$). At night, however, both sexes moved about the same distance between radio fixes. The total distance moved (sum of all distances between radio locations/24 hr) did not differ among sexes, ages, or seasons. Females averaged 5.6 km/24 hr (range 3.8 km in May to 8.2 km in April, N = 2–8 deer/season), and males averaged 5.7 km/24 hr (range 4.7 in summer to 6.5 in spring, N = 2–4 deer/season) (Nixon et al. 1991).

Snow cover did not reduce deer activity (N = 11 deer) on the Piatt area, but snow depths were typically < 25 cm. This was also the case on the DeKalb area. However, cold rains in winter on the Piatt area reduced 30-minute movement distance somewhat for both sexes (N = 5 males—rain present in winter, $\bar{x}$ = 128.8 m ± 24.5 SE; rain absent $\bar{x}$ = 165.9 m ± 18.5 SE) (N = 14 females—rain present in winter, $\bar{x}$ = 112.2 m ± 12.1 SE; rain absent $\bar{x}$ = 133.4 m ± 14.9 SE) ($P > 0.05$). Wind chill (temperatures < 8° C and wind > 8 km/hr) was not significantly correlated with deer activity (N = 14, $r = 0.082$). When temperatures dipped below –8° C, deer on both study areas moved to hill-edged bottomlands that reduced wind (Piatt area) or to habitats with dense overhead cover (both areas) such as conifer plantations or deciduous types with a dense understory. There were no bottomlands present on the DeKalb area. Well fed deer are known to bed in the open on winter nights (Moen 1968, Kramer 1971, Kucera 1976), and we observed at least a few deer in open corn fields on both study areas nearly every winter night we were present.

Group size was larger in winter compared to summer on both areas ($\bar{x}$ = 7.4 deer in winter, 3.4 in spring, and 2.2 in July). Groups in winter featured both sexes feeding together and, at least on the Piatt area, bedding together (indicated by drive counts of deer during daylight hours).

Females were more likely to remain within permanent cover when snow was present (58.0% of 517 observations) and more likely to visit crop fields without snow present (55.5% of 497 observations) ($\chi^2 = 18.5$, df = 1, $P < 0.0001$). Males (N = 307 observations) did not show a significant difference in use of crop fields whether or not snow was present (45.4% in crops with snow absent, 39.3% with snow present; $\chi^2 = 1.15$, df = 1, $P = 0.28$). Of 992 observations using both sexes, 62% remained within forest cover when the average daily temperature was < 0° C and 40% of observations were in forest cover when the average temperature was > 0° C ($\chi^2 = 36.6$, df = 1,990, $P = 0.0001$).

Female Migration Behavior

There was a significant amount of snow present in early December when our 7 marked migrating females returned to their natal range (returned $\bar{x}$ = 29.1 cm ± 4.0 SE snow present; remained on the summer range $\bar{x}$ = 17.5 cm ± 4.5 SE; $t = 3.42$, df = 21, $P = 0.003$) (Fig. 2). We determined that 10 cm of snow was the dividing line between returning to the natal range or remaining sedentary. When snow was < 10 cm deer remained sedentary 80% of the time. When snow exceeded this amount females returned 84.6% of the time. Temperatures below normal did not significantly affect female migration patterns on our study areas.

Deer Survival

Winter survival of both sexes and all ages was high for our marked deer and was not affected by the winter severity index ($P > 0.05$). Survival of fawns examined by litter size was not affected by winter severity ($F = 2.23$, df = 1,10, $P = 0.17$). We did not find a significant difference ($P = 0.27–0.56$) in fawn condition (using chest girths and hind foot measurements from captured fawns)

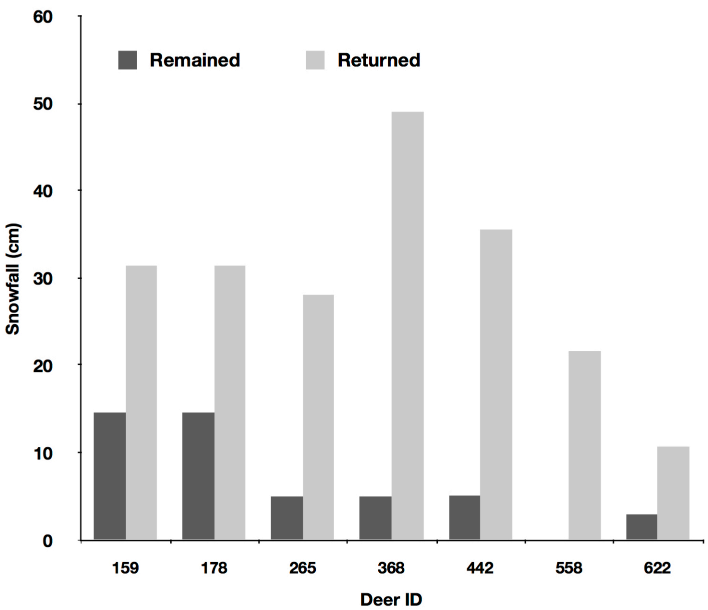

Fig. 2. Movement behavior of 7 migratory female white-tailed deer (23 migrations) when exposed to early December snowfall (cm). Deer either returned to their natal range (N = 13) migrations or remained on the summer range (N = 10) for remainder of the winter in east central and northern Illinois, 1980–1993.

due to litter size.

DISCUSSION

While Mech et al. (1987) has shown a lag effect of up to 7 previous winters on offspring mortality for northern deer and moose (*Alces alces*), mild winter weather buffers Illinois females from any unusual winter stress effects on condition and fecundity. This situation accounts for the high productivity and generally excellent condition of the Illinois deer herd. The relatively benign winters in Illinois do not appear to affect deer survival, but do influence daily behavior and migration movements.

The improvement in fawn recruitment from marked adult females with increased snow cover may explain in part the positive effect of snow cover on subsequent harvests reported by Hansen et al. (1986) in northern and central Illinois. Above average snowfalls enhance adult survival by restricting movements (and thus reducing certain mortality factors such as highway accidents and poaching losses) that allow more older females to survive and to produce more fawns than are produced by younger females (Haugen 1975, Harder 1980, Nixon et al. 1991).

Illinois deer are well insulated from the ravages of winter because the agriculturally dominated landscape of Illinois provides deer with abundant energy and protein filled forage in summer and fall. In past years even in winter, deer have had access to large amounts of waste grains and other forages. This was demonstrated by a small winter sample of rumens (N =19) from central Illinois deer road kills. Sixty percent of the diet by volume was crop residues, 26% fruits and seeds, 8% forbs, and almost no use of woody twig ends (Nixon et al. 1991). This diet, mainly gleaned from crop fields, is shared by deer throughout the Midwest as reported for deer in Missouri (Korschgen 1962), Iowa (Mustard and Wright 1964), and Kansas (Watt et al. 1967). This diet produced estimates of 13.3% crude protein and 74.5% digestible energy (both dry weight) available to wintering deer in Illinois (Nixon et al. 1991), dietary levels exceeding that reported as needed for winter maintenance (Silver et al. 1969, Holter et al. 1977). This diet has produced a deer herd known for trophy sized antlers (Walmsley 1994) and a consistently high level of fawn production and recruitment (Nixon et al. 1991).

Deer Activity Patterns

Marked deer molted into a winter coat during late August–early September that featured long guard hairs and a short underfur. The insulating qualities of this coat was evident during snowstorms when snow frequently remained unmelted on their backs. Marked deer changed their daily habits during winter. Home ranges expanded because of declining food supplies, deer moved to areas offering wind protection and heat retention when temperatures were unusually low, and they grouped together for predator protection and forage opportunities (Nixon et al. 1991, Nixon and Mankin 2007). Except during extreme weather conditions, marked deer avoided selecting a home range in bottomland forests during winter on the Piatt area, based on winter drive counts and radio locations. This agrees with a study of areas used as sites of winter concentration in central and northern Illinois. Nixon and Hansen (1986) located 290 areas in 7 of the 8 IDNR Regions (Fig. 1) where deer habitually congregated in winter. Nixon et al. (1988) used discriminant function analysis to examine 43 landscape variables and determined that deer in these areas seek out upland forest offering at least some refuge protection from hunters and avoided bottomland forests. In much of Illinois, bottomlands routinely flood in winter, a condition that also reduces understory cover and its use for buffering winter winds on these sites. Our marked deer consistently utilized upland forests with understory cover in winter. Early successional forests < 60 years old were particularly favored on both study areas.

Female Migration Behavior

The reaction of 7 migratory females to early winter snow cover was similar to migratory deer observed in New Brunswick, Canada (Sabine et al. 2002) and north central Minnesota (Fieberg et al. 2008). Nelson (1998) felt migration behavior was not rigidly controlled in white-tailed deer, but that deer inherit the capacity to migrate. He also stated that the extent of snow cover was the ultimate factor initiating migration in northeastern Minnesota. Because any movement away from familiar landscapes can be potentially dangerous and because breeding females have a strong attraction to a previous site of parturition (DeYoung and Miller 2011), conditional migrators are often reluctant to vacate the parturition range (Drolet 1976, Fieberg et al. 2008). An accumulation of > 10 cm of snow in early winter was necessary before our conditional migrators vacated their summer range. Fieberg et al. (2008) found conditional migration behavior became more prevalent for individual females with more years of study suggesting conditional migration behavior may be more prevalent than is reported here.

CONCLUSIONS

The relatively benign winter weather of Illinois has not stressed the deer herd in most winters. The relatively short bursts of low temperatures and snow cover that does occur does not pose a serious threat to deer health because deer have usually entered the winter season in prime condition, the result of a superior diet derived mostly from agricultural crops. In winter, Illinois deer are less threatened by predation risk than deer located in the northern ranges that are exposed to wolves. Winter severity in these regions compounds predation risk because deep snow reduces physical condition and impedes escape movements (Nelson and Mech 1986). Illinois deer are not entirely predation free as coyotes and domestic dogs occasionally kill adult deer in Illinois during winter (coyotes were observed once killing a deer on the Piatt area).

Illinois deer also avoid summer stress brought on by heat and drought related to forage decline as experienced by southern deer (Short et al. 1969, Meyer et al. 1984). Midsummer in Illinois corresponds to rapid growth of row crops that provide deer with nutrient rich foraging that benefits both sexes.

Illinois deer retreat to dry bottomlands or dense upland cover during inclement winter weather. Females remain in forest cover during short bouts of snow cover that cover crop fields in Illinois. In the east central and northern counties where forest cover is reduced, upland forests are essential to allow deer to feed and rest whenever bottomlands experience periodic flooding. Upland forests also provide deer with forage when crop fields are cultivated in the fall postharvest, an increasingly common occurrence in many counties in east central and northern Illinois.

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