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Characteristics of White-tailed Deer Trapped and Tagged in Michigan's Upper Peninsula, 1989–2006

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Introduction

In northern latitudes that experience high amounts of snowfall, white-tailed deer (*Odocoileus virginianus*) frequently exhibit seasonal migrations to areas that mitigate the impact of adverse winter weather (Ozoga 1968, Verme 1973, Van Deelan 1998, Sabine et al. 2002, Potvin and Boots 2004). Verme (1973) provided generalized information on deer migration for Michigan's Upper Peninsula (UP), and Van Deelan (1995) provided specific insights into deer migrations and annual range occupied by deer in 3 wintering complexes in the south-central UP. However, the seasonal migration tendencies of deer in vast areas of the UP are largely undocumented. .

Winter range typically represents only a fraction of the annual range occupied by deer in northern latitudes. In Ontario, approximately 10-15% of the annual range is classified as deer winter range (Broadfoot and Voigt 1996), and in the higher snowfall areas of the western UP of Michigan about 15% of the landscape is deer wintering complex (Michigan Department of Natural Resources [MDNR] 2005). Deer populations that are low to medium density on spring to fall range can swell to very high densities when these deer concentrate in wintering complexes following migrations (Doepker and Ozoga 1991). Deer move to wintering areas having a high proportion of conifer tree cover that provides shelter from snow and wind, and to take advantage of food supplies that are often provided by active timber harvest operations.

Despite the advantages of deer seasonal migrations, this behavior results in a problem for both the deer themselves and for wildlife biologists charged with their management. Deer commonly face several months of inadequate nutrition when concentrated in wintering complexes, and high deer densities can result in high browsing pressure on trees and shrubs, the main source of food and future cover for deer during winter. Forest ecologists and managers have expressed concern over the impact of deer "herbivory" on tree regeneration and the diversity of ground flora. Population management to address deer herbivory in winter concentration areas is problematic due to the migratory nature of many UP deer. For example, if deer that over-browse vegetation within wintering complexes are located many miles away on "summer range" during the fall hunting seasons, then increasing the deer harvest within wintering areas will not address herbivory problems. Rather, antlerless deer harvesting would need to be focused on the range those deer inhabit during the hunting seasons before they migrate to wintering complexes.

Land management decisions in deer wintering complexes have potential impacts on the deer population over a much larger land area. For example, timber harvesting that decreases the value of wintering complexes or divestitures of corporate holdings that result in conversion of forest to other uses can negatively impact the capability of the area to over-winter deer, thus potentially influencing deer sightings and hunter satisfaction over a large geographical area. It is important to know the location and size of the geographic area occupied by deer during the non-winter period, as winter concentration areas service different sized areas and different geographical areas.

It is important to recognize the origins of this long-term study. According to John Ozoga, retired MDNR deer research biologist, this effort was largely the result of inquiries by organized sportsmen in the UP who wished to become involved in deer management. Ozoga wrote (personal communication): “Many years ago Dick Aartila (formerly district wildlife biologist in the central U.P.) called me and asked what a bunch of gung-hoe sportsmen could do to help deer management. I suggested they trap and tag deer.” Ozoga’s recommendation was embraced by Aartila in 1989, and the deer tagging project had its beginnings. The project was undertaken as a management activity to involve local sportspersons and to document movements of deer from a wintering complex in which northern white cedar (*Thuja occidentalis)* and hemlock (*Tsuga canadensis*) was being managed unsustainably.

During the mid-1990’s, this project was incorporated into a Pittman-Robertson research grant, and attempts were made to standardize data collection and reporting. Objectives were incorporated into the effort which included identifying the sex and age of captured animals, determining distance and direction of seasonal migrations, calculating the approximate annual range of the deer associated with each wintering complex, and involving deer enthusiasts in the process of capturing, handling and recording biological data from trapped animals.

This report summarizes data collected on deer tagged and observed in the UP from 1989 to 2006. In addition, we discuss implications for deer management and recommendations for potential research to expand on important questions raised as a result of this study.

Methods

Local MDNR wildlife biologists selected trapping sites based on knowledge of where deer concentrate during winter. Most trapping sites were within wintering complexes or “deer yards” that have been recognized as winter concentration areas, some for decades. Trapping occurred on multiple land ownerships, including state forest, national forest, corporate CFA lands, and private property. All trapping and tagging was done during the months of January through March when deer were most concentrated and natural foods were in short supply, making them more prone to enter traps.

Traps were usually deployed in active timber harvest operations because deer numbers were greatest there, helping to maximize captures per effort. Trap sites and traps were pre-baited with whole-kernel corn for approximately one week prior to deployment. Stephenson box traps were constructed by sportsman volunteers using their organizational funds to pay for materials. Typically, 6 to 12 traps were set in each timber harvest area, but sometimes clusters of 2 to 4 traps were placed in scattered locations separated by several miles.

Trapping operations during this period were operated largely by sportsman groups. Sometimes MDNR employees were present to assist and provide oversight, but often the sportsman volunteers worked independently. Traps were normally set during the morning hours and left overnight. A trapping crew, usually consisting of 2 to 6 individuals, checked the traps the following morning. If a deer was captured, a “push-board” was used to force the animal through a side door into a smaller squeeze crate. Deer were extracted from the small crate, the sex and age (adult or fawn) were determined, and a plastic livestock ear tag was attached. The entire process of extracting the animal from the trap, ear tagging, and release took no more than 2 to 5 minutes per animal once the trap crews gained experience.

Efforts were made to use a unique ear tag color for each wintering area, particularly in the later years of this study when MDNR oversight improved. However, there were instances in which several ear tag colors were deployed in a single wintering complex and instances in which one tag color was used at several sites in the U.P. Some redundancy in ear tag colors was unavoidable due to the finite number of color choices available. Each ear tag was labeled with a unique number (2-3 digits) or letter combination (2 letters), and some tags included a request to "Notify MI MDNR." Ear tags were about 4 inches long by 3 inches wide.

Subsequent observations of tagged deer by the public were most often phoned in to local MDNR or Forest Service offices. Some were reported on the MDNR's internet site in recent years. Observations of tagged deer included live free-ranging deer, hunter-harvested animals, and deer struck by vehicles. To maximize the usefulness of reported sightings, standardized forms were developed for use in agency offices when interviewing citizens who observed a tagged deer. Although attempts were made to learn about antler size on tagged males, number of fawns accompanying tagged females, and whether the observed animal was alive or dead, the most useful and complete information obtained from reported sightings was fundamental--ear tag color, ear tag number/letter, date of sighting, and location (township, range, and section).

Spatially explicit databases (one including a unique record for each tagged deer and one including a unique record for each observed deer) were developed in ArcMap using centroids for the township, range, and section in which deer were tagged and later observed. Only deer observations that could be unambiguously related back to their tagging locations using the unique color/number combination reported by the observer were used in our analyses.

We defined 3 periods of the year for analyzing tagged deer sightings based on deer biology and the distribution of reported observations within the calendar year. We defined "Winter" as the 3-month period of January through March. This was the period in which deer were trapped and tagged in this study. "Transition" was defined as the months of December and April--months in which migratory deer are frequently "on the move," either heading to or from winter range. "Summer" was defined as the 7-month period of May through November when deer are normally occupying their non-winter home ranges.

Minimum convex polygons (Mohr 1947) representing the combined winter, transition, and summer observations for each tagging site were delineated in ArcView 3.3 using the animal movement extension (Hooge and Eichenlaub 1997). We chose to exclude 5% of the locations that were most distant from the center of the polygon to eliminate outlying points that may have been due to errors in observation, reporting, or recording of data. Distance from tag sites to deer observation points was also calculated using this extension.

Results

During 1989 to 2006, 2,694 deer were captured and tagged at winter concentration sites within 28 wintering complexes in the UP (Figure 1, Table 1). Some wintering complexes were trapped only one winter whereas others were trapped multiple years. For example, deer were captured at Hiawatha and Choate during 6 and 7 winters, respectively. The number of years each complex was trapped depended on a combination of factors, such as interest and proximity of volunteers to that particular site and the ease of capturing new deer without encountering large numbers of repeat individuals.

The number of deer tagged at each wintering complex averaged 96 and ranged from a low of 6 at Carmody to a high of 249 at Choate (Table 2). Records of trap nights per capture were not kept for most of the tagging operations, nor were records of accidental deaths or recaptures of deer that had already been tagged during the same winter at the site. Thus, the following information on sex and age ratios does not include trap deaths or recaptures—only those deer being tagged for the first time and successfully released.

More fawns than adults were captured at 19 of the 28 sites. The ratio of fawns to adults for all sites combined was 1.2 fawns per adult deer. Male fawns exceeded female fawns at 18 sites, and the overall ratio of males to females among fawns was 53:47. The ratio of fawns per doe averaged 1.5 for all sites and years and ranged from 0.6 to 5.3. The adult sex ratio favored females at an overall ratio of 4.2 females per male and ranged from 1.5 females per male at Hiawatha to 16.0 females per male at Silver Creek.

Of the 2,694 deer tagged during this study, 1,030 (38%) of them were subsequently observed at least once (Table 3). If multiple sightings of the same individual deer are included, there were 1,721 observations reported in which the observer could read the numbers/letter combination on the tags. The percentage of animals observed ranged from a low of 15% at Hiawatha to a high of 72% at Sturgeon River. Observation rates of tagged deer were probably related to the proximity of tagging sites and summer ranges to human population centers, including homes, farms, camps, roads, and MDNR offices. Of those deer observed at least one time, the majority (64%) were seen only once, with 21% and 8% observed 2 or 3 times, respectively (Table 4). Seventy-four deer were observed at least 4 times, and at the high end of the spectrum, one tagged deer was observed 13 times and another 19 times.

Male deer trapped as adults had a higher incidence of being observed at least once (49%) when compared to all other sex/age classes. Thirty-six percent of female deer trapped as adults were subsequently sighted. Males and females trapped as fawns had a resighting incidence of 38% and 37%, respectively. The higher resighting rate of adult males is probably due to the likelihood of them being harvested by hunters and then reported out of curiosity as to where and when they were tagged. Does and fawns are harvested much less intensively in the UP, so most sightings of these deer would be the result of observing free-ranging animals whose ear tags would be more difficult to read. The low resighting rate of male fawns vs. male adults may be due to mortality suffered by fawns during the winter they were tagged. We cannot explain why female fawns and adults were sighted at similar frequencies other than to speculate that we may have captured adult females in poor condition that were susceptible to over-winter mortality.

Almost half (48%) of all deer observations were reported during the months of October (13%) and November (35%) when deer hunters are most active in the UP (Figure 2). The summer observation period (May-November) accounted for 63% of sightings, the transition periods of April and December each accounted for 6%, and the winter period (January-March) tallied 25% of total annual sightings. Most deer that were observed were seen in the first year they were tagged, but some deer were seen up to 12 years following tagging (Figure 3). Females exhibited greater longevity between the time of tagging and subsequent observations, probably because they exceeded males in the trapped samples and suffered lower annual mortality compared to males. Fourteen unique males were observed greater than 4 years after they were tagged, including 7 males at 6 years post-tagging, 2 at 7 years, and 3 at 10 years. Whether these observations of old-age males are legitimate or the result of observation or data recording errors is unknown. Males greater than 5 years of age are rare in the UP deer harvest.

The distance traveled between winter tagging sites and the locations where deer were subsequently observed varied by sex and season. However, differences were not statistically significant between sexes for the summer, transition, and winter observation periods ($P=0.09$ to 0.63; Table 5). As expected, the greatest mean distance between tagging sites and observations was during the summer period. Females were observed an average of 11.6 miles from their original tagging site, and males averaged 10.6 miles. During the winter period, mean distance from tagging sites to observation location averaged 4.9 and 4.2 miles for females and males, respectively. Transition period distances were intermediate between winter and summer.

Distances from winter tagging sites to summer locations was greater for female deer than males at 17 of 27 (63%) wintering areas (Table 6). However, differences in migration distance between the sexes were significant for only 3 wintering complexes (Middle Branch, North Perkins and Whitefish), and female distances exceeded males at all three. Females from the Middle Branch wintering complex had the longest mean distance between tagging sites and summer locations, averaging 23.0 miles. The largest mean distance between tagging sites and summer locations for males was 17.1 miles at Ogontz. Distances from winter to summer locations exceeded 5 miles for nearly all wintering complexes and sex combinations, demonstrating the mobility of northern deer.

Because differences in mean migration distance of females vs. males was not significant for the summer, transition, or winter observation seasons ($P>0.09$; Table 5), female and male observations were pooled to compute a "combined-sex seasonal migration distance" for each wintering complex (Table 7). We then plotted the combined (female and male) summer locations, along with the original tagging sites, on individual maps for each wintering complex (Figures 4-31). Because observations of tagged deer were recorded at a 1 sq. mile resolution, a point on the maps may represent more than 1 deer observation. Summer migration distances from winter tagging sites for both sexes combined ranged from a low of 3.8 miles at De Temple to a high of 17.2 miles at Hulbert.

The total annual range occupied by deer populations associated with each wintering complex was computed by plotting observations from all seasons. Annual range sizes varied widely from a low of 72 sq. miles at Carmody to a high of 2,388 sq. miles at the Mead wintering complex (Table 8). The majority of wintering complexes had annual deer population range sizes in the 300–500 square mile range. Variation in sample sizes for the number of deer tagged and observed, and the number of tagging sites at some wintering complexes, may have resulted in computed annual range sizes that are biased low.

Discussion

Sex and Age Ratios: Knowledge of sex and age ratios can be useful to wildlife managers who are tasked with managing deer herds. However, such information is difficult to obtain and often plagued with biases. Can samples of winter-trapped deer provide useful estimates of sex and age ratios? The answer to this question is largely dependent on whether deer of each sex and age class enter traps in proportion to their occurrence in the winter population.

Fawns normally comprise 22-30% of the October 1 deer population in most UP deer management units based on sex-age-kill reconstruction techniques. Hunter harvest can increase the proportion by about 5% due to heavy exploitation of adult males, moderate to low harvesting of adult females, and a relatively light removal of fawns. However, even factoring in hunter harvest, adult deer should typically make up 65-70% of the population heading into winter and fawns should comprise only 30-35%. In this study, fawns made up 54% of the captures during winter, and fawns exceeded adults in the trapped sample at 68% of the wintering areas. During intensive studies of deer at the UP's Cusino Research Station in the 1970's and 80's, 2 fawns per doe were captured during the first week of winter trap outs when the fawn-doe ratio was known to be 1:1 in the research enclosure (J. Ozoga, personal communication).

The tendency for fawns to be trapped at a higher proportion than their occurrence in the population is probably due to their relatively small size, limited fat reserves, and intense drive to obtain food—in this case, bait. Fawns are at the bottom of the dominance hierarchy when feeding at common food sources, such as timber harvest sites (Ozoga 1972), and baited traps probably provide an enticing meal free from the harassment of adults. The observation by trapping crews that some fawns were captured multiple times per year (sometimes daily), in contrast to adult deer, is further evidence that fawns are more susceptible to traps than adults.

Because fawns are more susceptible to trapping, fawn-to-doe ratios from the trapped sample would seem to have limited utility for management. Indeed, the ratio of 1.5 fawns per adult doe documented in this study greatly exceeds the ratio reported by hunters at UP deer camps each autumn. In the west half of the UP, firearm season hunters reported seeing an average of 0.5 fawns per doe during the period 1996 to 2007 (MDNR West UP Deer Camp Survey, unpublished data). A ratio of 1.5 fawns per doe during winter would suggest essentially no mortality of fawns from birth through the middle of their first winter—a phenomenon that is clearly improbable.

Male fawns exceeded female fawns in the capture by a ratio of 53:47, even though fawns of each sex did not differ in trappability at the Cusino Research Station (J. Ozoga, personal communictation). Verme (1983) provided a critical review of sex ratio variation at birth in *Odocoileus*. He suggested an excess of male fawns would be expected (1) where the majority of the breeding individuals are fawn and yearling does, (2) in herds of low density or scattered distribution, (3) among animals in poor condition prior to conception, and (4) in instances of extreme density. The Wisconsin DNR adjusts the sex ratio calculations in their sex-age-kill population reconstruction to account for a higher proportion of male fawns being born into the population than females. Whether the ratio favoring males in this study is due to a skewed sex ratio at birth, unequal mortality by sex following birth, or more adventuresome behavior by male fawns at trap sites is unknown.

The amount of skew in the adult doe to buck ratio is a perennially hot topic among deer hunters. Both hunters and wildlife biologists agree that adult females outnumber adult males in UP deer populations, but the degree of imbalance is contested. Sex-age-kill reconstruction, which is based on contrasting mortality rates between does and bucks, usually provides a pre-hunt estimate of about 2 females per male. Cooperators in UP deer camp surveys consistently report doe to buck ratios of 3 or 4 females per male on opening day of firearm season which skews to 5+ does per buck as the season progresses. These estimates of 2-5 adult females per male appear reasonable to most wildlife managers and are in a range that should provide high pregnancy rates and a short, intense breeding season. However, a great many deer hunters disagree with these ratios. In fact, hunter reports of sex ratios as imbalanced as 10 or 20 females per male are common.

Adult deer at the Cusino Research Station did not differ in trappability by sex, except perhaps for trap-wary adult males that were > 4 years old (J. Ozoga, personal communication). Of the 25 wintering complexes in this project in which both sexes of deer were captured, 17 (68%) had adult sex ratios of 5 females per male or better (even closer to parity). When all areas and years were combined, the ratio of captured adults was 4.2 females per male, despite the ratio being obtained following 3 months of heavy buck removals during hunting seasons. The sex ratio results from this study are consistent with other methods of measuring this ratio and provide evidence that adult sex ratios are not nearly as imbalanced either before or after the hunting seasons as commonly believed.

Seasonal Migration: Seasonal migration is an important adaptation of deer to winter weather conditions in northern areas that receive substantial snow cover (Verme and Ozoga 1971; Voigt et al. 1997). Fawns learn seasonal migratory behavior from their mothers and subsequently pass the tradition on to their own offspring (Tierson et al. 1985, Nelson and Mech 1999, Nelson et al. 2004). Many deer that reside in the high snowfall areas of the UP move to more southern areas which receive reduced amounts of snow (Doepker and Ozoga 1991; Figures 1 and 4-31). Snowfall data for the UP exhibit a strong gradient from north-to-south with higher snow depths and duration of snow cover due to lake effect snowfall off of Lake Superior.

Deer living in environments with reduced snow depths and less persistent snow cover tend to move shorter distances and for shorter durations (Lesage et al. 2000, Nixon et al. 1991, Sabine et al. 2002). Sabine et al. (2002) characterized these deer as conditional migrators. Deer from the Bark River and De Temple wintering complexes exhibited the shortest distance between tagging sites and summer observations. Winter distances from tag sites actually exceeded summer distances at these locations. The majority of deer from these wintering complexes are probably conditional migrators, i.e., moving to winter cover for short periods of time only during the most stressful winter periods and then returning to their summer range.

Most of the trap sites in this study were located in wintering complexes in the mid-latitudinal areas of the UP (Figure 1). Deer movements are strongly oriented north-south indicating deer move from northern areas to concentrate in wintering complexes which experience less snow and for shorter durations (Figures 4–31). Deer from more northern areas tend to have longer migration distances (Nelson 1995, Van Deelen et al. 1998), concentrate for longer periods of time, and can be classified as obligate migrators (Sabine et al. 2002). Deer concentrate in wintering complexes in the transition zone between deeper snow conditions to the north and reduced snow depths to the south.

Studies have shown the importance of a winter food supply and conifer cover, primarily hemlock and northern white-cedar, to deer during periods of winter concentration (Morrison et al. 2003, Voigt et al.1997, Verme 1973, Van Deelan 1995). During winter, deer concentrate in landscapes that possess approximately 50% suitable conifer cover (Weber et al.1984, Doepker and Ozoga 1991, Potvin and Boots 2004). In areas receiving high amounts of snow, conifer cover may be the most important factor eliciting a settling response by deer during the winter. Conifer cover functions to intercept snow, resulting in reduced ground level snow cover and easier travel conditions for deer (Ozoga 1968, Verme and Ozoga 1971, Morrison et al. 2003).

Migration Distance: The greatest distance between tagging site and observation for deer in this study was 53 miles. Fifteen deer were sighted $\geq$ 40 miles from their tagging site, and all 15 were observed in Marquette County. These deer were tagged in the Echo Lake, Mead, and North Perkins wintering complexes. The average distance from tagging sites to summer observations was 11.6 and 10.6 miles for females and males, respectively. Verme (1973) reported an average movement distance of 8.6 miles for deer in the UP with the longest distance traveled being 32 miles. In Michigan's northern Lower Peninsula, Sitar (1996) reported a mean seasonal migration distance of 9.4 miles and maximum distance of 27.4 miles. Van Deelen (1995), working in the central UP during 1992-94, reported the median distance between harmonic mean centers of winter ranges and summer ranges was 1.0 to 3.4 miles and greatest migration distance was 28.6 to 32.3 miles. Seasonal movements of deer reported in Minnesota ranged from 1 to 19 miles by Rongstad and Tester (1969) and 6.2 to 24.8 miles by Hoskinson and Mech (1976). In a third Minnesota study, the greatest seasonal distance traveled was 9.3 to 24.8 miles and averaged 10.6 miles (Nelson and Mech 1981).

Female deer in this study were observed at greater distances from tagging sites than males during summer (11.6 vs. 10.6 miles). This was somewhat surprising because males are known to disperse from their mother's home range during late summer and autumn after their first year (Nelson and Mech 1984). If these dispersal movements are random, we would expect some tagged males to move farther away from their original tagging sites before settling into a new home range, resulting in larger mean distances from tagging locatons for males versus females. Perhaps dispersing yearling males in our study tended to move toward the winter concentration area before settling on a new home range as discovered by Nelson and Mech (1984) in their Minnesota study.

Nelson and Mech (1981) reported that over 90% of the deer in their Minnesota study were migratory. Van Deelan (1995) reported that about 50% of the deer in his study were year-round residents of the wintering complex. Because our long-term study did not include radio-telemetry, it is impossible to determine the proportion of ear-tagged deer that were residents of the wintering complex versus migrants from other locations. In our analysis, we pooled all sightings of ear-tagged deer regardless of how far they were from the original tagging locations. Thus, maps of migration direction and calculations of movement distances include both resident deer within wintering complexes and those which make migratory movements.

An unexpected finding of this project was the relatively large average distance between winter tagging sites and winter observations. We had expected to see relatively small (0-2 mile) distances based on prevailing thought that migratory deer return to the same sites each year, often the same exact conifer swamp. However, deer observed during winter in this project averaged 4.9 miles from tagging sites for females and 4.2 miles for males. These rather large winter distances may be the result of incomplete migrations due to mild weather. Van Deelen (1995) noted that some of his radio-collared deer remained on summer range as late as January and February during mild winters in the central UP. Another explanation for these large distances from tag sites to winter observations is the observed tendency for deer to seek out active timber operations for food, particularly in years with low snow depths. The long-standing notion that northern deer migrate to a precise deeryard location and then remain there for the duration of the winter is likely oversimplistic. Milder winters with decreased snow depths have allowed deer in many areas to seek out new sources of food in a landscape that might be better described as a wintering complex rather than a deeryard.

Annual Range: There was high variability in the total annual range occupied by deer populations associated with each wintering complex (72 to 2,388 square miles). Some of the variability can be attributed to small sample sizes. Only 6 and 15 animals were tagged at Carmody and St. Martin's Bay, respectively, which yielded annual range estimates of 72 and 79 square miles for each. The Mead wintering complex had by far the largest annual range (2,388 square miles). The minimum convex polygon method for calculating and plotting total annual range of deer associated with wintering complexes may exaggerate annual ranges as an artifact of the methodology. Visual inspection of the data points indicates areas that may be avoided by deer (large wetland complexes, abrupt topographic changes, etc.), but they were included in the annual range plots due to constraints of the method. The majority of wintering complexes had annual deer population home range sizes in the 300–500 square mile range.

Only 18 tagged deer were seen during winter within 2 miles of a winter concentration site other than the one in which they were originally tagged. Nelson (1998) reported that 14 of 16 (88%) yearling males returned to the same wintering complex in subsequent years and only 2 (12%) switched wintering complexes. Eleven of the 18 deer in this study that were seen in a different wintering complex were observed in an area that had several wintering complexes in close proximity to each other. The delineation of wintering complexes is an arbitrary construct of biologists attempting to develop maps with incomplete data. Therefore, these sightings may not represent "switching" to a new wintering area, but rather, a suggestion that current wintering complex maps need revisions based on new information. Even with the constraints of the minimum convex polygon method for displaying annual ranges of deer, minimal overlap of annual ranges suggests each wintering complex harbors a relatively distinct deer population. Deer use a particular wintering complex to mitigate winter weather and then disperse to a geographical area that is unique for each complex..

Management Implications

This study demonstrates that collaborative efforts with sportspersons can yield a wealth of new information on the biology and management of white-tailed deer. Arguably no other Wildlife Division project has done as much for MDNR-sportspersons relations in the UP as has deer tagging. Organizations such as U.P. Whitetails Association not only donated hundreds of volunteer hours to dutifully check traps and mark deer, they also provided funding and personnel to build traps. Members of these organizations fondly talk about their "deer trapping" days for the MDNR even years after the project has been completed. Nonetheless, this study also pointed out that projects of this type cannot simply be turned over completely to volunteers for implementation. If studies of this nature are comtemplated in the future, we strongly recommend that MDNR employees exert a leadership presence during all aspects of the operation, including daily data collection.

It is increasingly apparent that deer herbivory problems in wintering complexes cannot be easily solved by liberalizing fall harvests. Sportspersons will either vehemently object to antlerless harvesting in low density areas to which deer dispersed or will choose to forgo use of antlerless licenses if they judge the deer herd to be too low. Holding early firearm seasons to thin year-round resident deer within concentration areas (prior to being joing by migrants) is a possibility, but this idea would probably be very unpopular among sportspersons. It is important to consider the extent of deer browsing at the landscape scale, and not just the intensity of deer browsing at the stand level, to add perspective to the debate over the impacts of deer browsing. Browsing appears focused on a relatively small proportion (10-15%) of the UP landscape that falls within the medium to high snowfall areas, and a larger proportion of the UP in the low snowfall areas. It may be desireable to modify forest management objectives in these locations to simply protect long-lived species such as cedar and hemlock, rather than attempting to regenerate them when they have attained only moderate age. Alternatively, creating new wintering complexes in high snowfall areas that would eventually possess suitable winter habitat conditions for deer may help to disperse deer over a wider geographic area during the winter concentration period (MDNR 2004).

A basic understanding of where deer go once they leave wintering complexes could be important if the UP deer herd ever contracts bovine tuberculosis, as is the case in northeast Lower Michigan, or chronic wasting disease, as is the case in southern Wisconsin. Knowing the direction of spread of these serious diseases could be important for formulating containment and eradication plans. Although deer migration directions have been studied fairly well in the southern UP, there has been relatively little tagging work done in the high snowfall aeas in the northern and far western UP (Figure 1).
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The study suggests distinct populations of deer are associated with individual wintering complexes. Deer dispersal patterns appear to be the result of 2 factors: deer summer and winter habitat conditions. Habitat conditions are determined by the quantity, quality, and spatial arrangement of forest types, seasonality of timber harvest operations, geographic location, and climatic factors. Geographic and climatic conditions cannot be controlled, but other factors may be manipulated. Research to identify habitat characteristics of summer range and wintering complexes should rate a very high priority due to the potential negative effect on deer over a large geographic area if habitat conditions that benefit deer are eliminated or badly degraded in the wintering complexes.

In conclusion, this paper catalogs and reviews some basic statistics resulting from a long-term project. The dataset undoubtedly contains many more insights into deer characteristics and behavior. For example, it may be possible to discover important aspects of deer movments, both daily and seasonal, by more closely examining the locations of deer that were observed multiple times. Because this project is ongoing as long as tagged deer are alive, it will be important to improve the data collection system. A reporting form that asks all pertinent questions regarding tagged deer observations should be developed and distributed to agency offices and on the MDNR's internet site. Also, a Wildlife Division employee, possibly a research biologist, should be tasked with overseeing the database and periodically providing analyses and reports.

We agree with Van Deelan (1995) and Verme (1973) that marking deer with ear tags during the winter concentration period provides information that resource managers may use to fine tune deer and habitat management decisions.

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Table 1. Summary of deer trapping and tagging locations in Michigan's Upper Peninsula during 1989 to 2006.

Tagging Site	Year	Dates	County	Trapping locations	Ear tag color	Tag numbers	No. deer tagged	DNR coordinator	Primary cooperator or volunteer help
Bark River	1998	Feb. 12-24	Delta	T37N, R24W, S22	Purple	107-141	35	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1999	Feb. 2-12	Delta	T37N, R24W, S28	Purple	142-188	47	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
Big River	1991	Feb. 21-Mar. 1	Delta	T40N, R20W, S32	Orange	1-21	21	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1992	Jan. 20-Mar. 7	Delta	T39N, R20W, S5	Orange	22-65	44	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
				T40N, R20W, S29					
	1993	Jan. 28-Mar. 5	Delta	T40N, R20W, S32	Orange	66-105	40	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
				T40N, R21W, S12					
	1994	Winter	Delta	T40N, R20W, S20	Orange	106-150	45	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
Big Spring	1995	Feb. 6-Mar. 15	Schoolcraft	T42N, R17W, S25	Red	1-33	33	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
	1996	Jan. 13-Feb. 22	Schoolcraft	T42N, R17W, S25	Purple	1-20	20	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
	1997	Feb. 14-23	Schoolcraft	T42N, R17W, S25	Purple	21-45	25	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
Camp Suicide	1996	Feb. 17-Mar. 12	Dickinson	T41N, R29W, S9	Purple	1-49	49	Bill Scullon	E. Dickinson Sportsmans Club
	1997	Jan. 29-Feb. 9	Dickinson	T41N, R28W, S10	Purple	50-106	57	Bill Scullon	E. Dickinson Sportsmans Club
Carmody	1994	Mar. 2-3	Luce	T45N, R10W, S17	Green	51-56	6	Ray Perez	Tahquamenon Area Sportsmans Club
Choate	1994	Feb. 19-Mar. 8	Ontonagon	T47N, R39W, S31	White	1-20	20	Terry Lindholm	Whitetails Unlimited - Ontonagon Cty.
				T47N, R40W, S14					
	1995	Feb. 28-Mar. 13	Ontonagon	T47N, R40W, S14	White	21-28	8	Terry Lindholm	Whitetails Unlimited - Ontonagon Cty.
	1996	Feb. 27-Mar. 11	Ontonagon	T47N, R39W, S31	White	29-66	38	Terry Lindholm	Whitetails Unlimited - Ontonagon Cty.
	1997	Feb. 15-Mar. 1	Ontonagon	T46N, R39W, S4, 5, 6	Yellow	67-95	29	Terry Lindholm	Whitetails Unlimited - Ontonagon Cty.
				T47N, R39W, S31	Orange	96-122	27		
				T47N, R40W, S24, 25					
	1999	Mar. 8-14	Ontonagon	T46N, R39W, S4, 5, 6	Orange	123-139	17	Terry Lindholm	Whitetails Unlimited - Ontonagon Cty.
				T46N, R40W, S36	Yellow	140-159	20		
	2000	Feb. 10-25	Ontonagon	T46N, R39W, S4, 6, 7	Yellow	161-186, 201-202	26	Terry Lindholm	Whitetails Unlimited - Ontonagon Cty.
				T46N, R40W, S1	Red	188-200	13		
	2001	Feb. 23-Mar. 4	Ontonagon	T46N, R39W, S4, 6, 7	Yellow	203-251	49	Terry Lindholm	Whitetails Unlimited - Ontonagon Cty.
				T47N, R40W, S1, 36					
Deadhorse	1995	Feb. 13-23	Delta	T43N, R22W, S18	Light blue	XA-XY, YA-YU	46	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1997	Jan. 31-Feb. 20	Delta	T43N, R22W, S18	Light blue	LA-LY, NA-NX	44	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
Deerfoot Lodge	1999	Mar. 8-17	Iron	T44N, R32W, 11, 15	Light blue	1-83	83	Bill Scullon	None
				T45N, R31W, S30					
	2001	Feb. 14-23	Iron	T44N, R32W, S10, 11, 12	Light blue	84-149	66	Bill Scullon	None
De Temple	1999	Feb. 1-14	Menominee	T37N, R27W, S16, 21	Orange	1-98	97	Bill Scullon	Champion International Corp.
				T37N, R28W, S1, 11					
				T38N, R27W, S16					
	2000	Feb. 9-16	Menominee	T37N, R27W, S21	Orange	99-149	51	Bill Scullon	Champion International Corp.
				T38N, R27W, S27					
				T38N, R28W, S21, 25					

Table 1 (continued). Summary of deer trapping and tagging locations in Michigan's Upper Peninsula during 1989 to 2006.

Tagging Site	Year	Dates	County	Trapping locations	Ear tag color	Tag numbers	No. deer tagged	DNR coordinator	Primary cooperator or volunteer help
Echo Lake	2001	Jan. 19-Feb. 6	Marquette	T49N, R26W, S25	Purple	1-47	47	Mike Koss	U.P. Whitetails Assoc. - Marquette Cty.
	2002	Feb. 6-Mar. 26	Marquette	T49N, R26W, S25	Purple	49-98	51		U.P. Whitetails Assoc. - Marquette Cty.
Frenchs	1993	Mar. 9-19	Luce	T45N, R11W, S34	Orange	26-47	22	Ray Perez	Tahquamenon Area Sportsmans Club
	1994	Feb. 14-26	Luce	T45N, R11W, S21, 34	Orange	126-149	24	Ray Perez	Tahquamenon Area Sportsmans Club
Gulliver	1995	Feb. 6-21	Schoolcraft	T42N, R14W, S3	Yellow	1-22	22	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
		Feb. 22-Mar. 10	Schoolcraft	T41N, R14W, S1	Green	1-21	21	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
	1996	March 11-20	Schoolcraft	T42N, R13W, S6	Yellow	23-45	23	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
		Jan. 13-Feb. 27	Schoolcraft	T41N, R14W, S1	Green	22-50	29	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
	1997	March 9-17	Schoolcraft	T42N, R13W, S6	Green	51-75	25	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
Hiawatha	1997	Jan. 21-Feb. 17	Mackinac	T43N, R9W, S21, 29 T43N, R10W, S1,12,14,24	Blue	1-81	81	Terry Minzey	Hiawatha Club
	1998	Feb.	Mackinac	T43N, R10W, S24 T43N, R9W, S21	Blue	82-89	8	Terry Minzey	Hiawatha Club
	1999	Jan.-Feb.	Mackinac	T43N, R10W, S12, 14, 24 T43N, R9W, S21, 24	Blue	92-111	20	Terry Minzey	Hiawatha Club
	2000	Jan.-Feb.	Mackinac	T43N, R10W, S12, 14, 24 T43N, R9W, S21	Blue	112-125, 151-171	32	Terry Minzey	Hiawatha Club
	2001	Jan.-Feb.	Mackinac	T43N, R10W, S12, 14, 24 T43N, R9W, S21	Blue	126-150, 168-174	32	Terry Minzey	Hiawatha Club
	2002	Jan.-Feb.	Mackinac	T43N, R10W, S12, 14, 24 T43N, R9W, S21	Blue	175-195, 201-211	32	Terry Minzey	Hiawatha Club
Hulbert	1996	Feb. 14-Mar. 10	Chippewa	T45N, R7W, S3 T46N, R7W, S28	Red	1-35	35	Ray Perez	Tahquamenon Area Sportsmans Club
	1997	Feb. 7-21	Chippewa	T45N, R7W, S3	Red	36-53	18	Ray Perez	Tahquamenon Area Sportsmans Club
Keldon	1993	Mar. 14-22	Chippewa	T44N, R1W, S5	Red	1-15	15	Ray Perez	Tri-County Sportsmans Club
	1994	Feb. 8-24	Chippewa	T44N, R1W, S5	Red	16-31	16	Ray Perez	Tri-County Sportsmans Club
	1995	Feb. 16-Mar. 3	Chippewa	T44N, R1W, S5	Red	32-50	19	Ray Perez	Tri-County Sportsmans Club
Kelly	1997	Feb. 26-Mar. 8	Schoolcraft	T42N, R14W, S33	Yellow	46-81	36	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
Kossow	1997	Feb. 24-Mar. 5	Delta	T41N, R23W, S11	Orange	EA-EY, MA-MY	48	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
Mead	1989	Feb. 7 - Mar. 3	Men. / Delta	T40N, R25W, S7, 18 T40N, R26W, S26 T41N, R24W, S4	White	1-53	53	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1990	Jan. 17-29	Menominee	T40N, R27W, S27 T41N, R26W, S22	Yellow	1-68, 95-126	100	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1990	Feb. 3-27	Marquette	T42N, R25W, S33	Yellow	69-94, 127-140	40	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1990	Mar. 2-7	Marquette	T42N, R24W, S29	White	176-191	16	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
Middle Branch	2005	Feb. 15-21	Ontonagon	T49N, R38W, S8	Purple	1-56	56	Brad Johnson	Ottawa National Forest
	2006	Feb. 22-Mar. 1	Ontonagon	T49N, R38W, S5	Purple	57-100	44	Brad Johnson	Ottawa National Forest
North Perkins	1995	Feb. 27-Mar. 8	Delta	T42N, R22W, S17	Light blue	AA-AY, CA-CX	49	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1997	Jan. 31-Feb. 20	Delta	T42N, R22W, S17	Light blue	FA-FY, OA-OV	44	Frank Short	U.P. Whitetails Assoc. - Delta Cty.

Table 1 (continued). Summary of deer trapping and tagging locations in Michigan's Upper Peninsula during 1989 to 2006.

Tagging Site	Year	Dates	County	Trapping locations	Ear tag color	Tag numbers	No. deer tagged	DNR coordinator	Primary cooperator or volunteer help
Ogontz	1991	Mar. 4-10	Delta	T41N, R20W, S34	Yellow	1-34	34	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
River Bend	1998	Jan. 23-Feb. 14	Mackinac	T42N, R3W, S19	Purple	1-20	20	Ray Perez	Tri-County Sportsmans Club
	1999	Jan. 16-Mar. 7	Mackinac	T42N, R3W, 3, 4, 5	Purple	22-77	56	Ray Perez	Tahquamenon Area Sportsmans Club
	2000	Feb. 12-Mar. 4	Mackinac	T41N, R4W, S33 T42N, R4W, S4, 33	Purple	84-94	11	Ray Perez	Tahquamenon Area Sportsmans Club
	2001	Feb. 3-Mar. 4	Mackinac	T42N, R4W, S35	Purple	95-109	15	Ray Perez	Tahquamenon Area Sportsmans Club
Silver Creek	1999	Mar. 5-16	Schoolcraft	T41N, R17W, S12	Purple Red	46-50 51-70	5 20	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
	2000	Jan. 19-Feb. 1	Schoolcraft	T41N, R17W, S1	White	1-28	28	Terry Minzey	U.P. Whitetails Assoc. - Schoolcraft Cty.
Soo Junction	1993	Feb. 12-25	Luce	T45N, R8W, S12 T45N, R9W, S15	Yellow	1-14, 76-82	21	Ray Perez	Tahquamenon Area Sportsmans Club
	1995	Feb. 16-Mar. 13	Luce	T45N, R8W, S12, 18	Yellow	101-117	17	Ray Perez	Tahquamenon Area Sportsmans Club
	1996	Jan. 12-29	Luce	T45N, R8W, S18	Yellow	15-24, 118-125 201-204	22	Ray Perez	Tahquamenon Area Sportsmans Club
St. Martins Bay	1993	Feb. 25-Mar. 7	Mackinac	T43N, R3W, S27	Yellow	1-15	15	Ray Perez	Les Chenaux Islands Sportsmans Club
Sturgeon River	1997	Feb. 10-21	Dickinson	T42N, R27W, S12 T42N, R28W, S12	Green	1-46	46	Bill Scullon	E.Dickinson Sportsmans Club
Whitefish	1991	Feb. 1-18	Delta	T41N, R21W, S17 T42N, R20W, S30 T42N, R21W, S26	Green	1-54	52	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1992	Jan. 27-Mar. 13	Delta	T41N, R21W, S15, 23, 25 T42N, R21W, S15, 23, 25 T43N, R21W, S25	Green	55-146, 46, 48	93	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1993	Feb. 10-Mar. 19	Delta	T41N, R21W, S10 T42N, R20W, S6, 19	Green	147-187, 76	42	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1994	Winter	Delta	T41N, R20W, S7 T41N, R21W, S2,15,25,26,36 T42N, R20W, S7, 30 T42N, R21W, S2,15,25,26,36 T43N, R20W, S7, 30	Green	179-224	46	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
Wilsey Bay	1991	Feb. 21-28	Delta	T39N, R21W, S24	Blue	1-14	14	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1992	Jan. 20-Feb. 11	Delta	T38N, R21W, S17 T39N, R21W, S1, 17, 19	Blue	16-35	20	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1993	Jan. 28-Mar. 4	Delta	T39N, R21W, S15, 26, 27	Blue	36-60	25	Frank Short	U.P. Whitetails Assoc. - Delta Cty.
	1994	Winter	Delta	T39N, R21W, S26,29,31,33,34	Blue	61-82, 96	22	Frank Short	U.P. Whitetails Assoc. - Delta Cty.

Table 2. Sex and age structure of white-tailed deer captured and ear-tagged during winters 1989 to 2006 in Michigan's Upper Peninsula.

Tagging location	Fawn				Adult				Unknown sex/age	Total
	Female	Male	Total	F:M ratio	Female	Male	Total	F:M ratio		
Bark River	25	27	52	48:52	24	6	30	4.0 to 1	0	82
Big River	28	39	67	42:58	68	13	81	5.2 to 1	0	148
Big Spring	19	23	42	45:55	31	5	36	6.2 to 1	0	78
Camp Suicide	26	30	56	46:54	44	5	49	8.8 to 1	0	105
Carmody	5	0	5	100:0	1	0	1	n/a	0	6
Choate	64	68	132	48:52	88	29	117	3.0 to 1	0	249
Deadhorse	21	30	51	41:59	25	14	39	1.8 to 1	0	90
Deerfoot Lodge	29	48	77	38:62	58	15	73	3.9 to 1	0	150
DeTemple	43	53	96	45:55	45	7	52	6.4 to 1	0	148
Echo Lake	29	28	57	51:49	31	10	41	3.1 to 1	0	98
French's	9	20	29	31:69	14	3	17	4.7 to 1	0	46
Gulliver	22	31	53	42:58	50	15	65	3.3 to 1	1	119
Hiawatha	25	25	50	50:50	35	24	59	1.5 to 1	65	174
Hulbert	16	12	28	57:43	19	2	21	9.5 to 1	4	53
Keldon	26	12	38	68:32	10	2	12	5.0 to 1	0	50
Kelly	7	7	14	50:50	22	0	22	n/a	0	36
Kossow	11	11	22	50:50	20	6	26	3.3 to 1	0	48
Mead	57	72	129	44:56	70	17	87	4.1 to 1	1	217
Middle Branch	14	21	35	40:60	60	4	64	15.0 to 1	0	99
North Perkins	30	28	58	52:48	27	7	34	3.9 to 1	1	93
Ogontz	8	12	20	40:60	10	4	14	2.5 to 1	0	34
River Bend	18	21	39	46:54	48	14	62	3.4 to 1	0	101
Silver Creek	16	17	33	48:52	16	1	17	16.0 to 1	3	53
Soo Junction	28	20	48	58:42	9	3	12	3.0 to 1	0	60
St. Martin's Bay	3	7	10	30:70	5	0	5	n/a	0	15
Sturgeon River	11	6	17	65:35	18	4	22	4.5 to 1	0	39
Whitefish	53	76	129	41:59	76	17	93	4.5 to 1	1	223
Wilsey Bay	19	16	35	54:46	42	3	45	14.0 to 1	0	80
Totals	662	760	1,422	47:53	966	230	1,196	4.2 to 1	76	2,694

Table 3. Percentage of white-tailed deer captured during winters 1989-2006 that were subsequently reobserved in Michigan's Upper Peninsula.

Tagging location	No. of deer tagged	No. of deer subsequently observed*	Percent
Bark River	82	43	52%
Big River	148	63	43%
Big Spring	78	28	36%
Camp Suicide	105	55	52%
Carmody	6	3	50%
Choate	249	50	20%
Deadhorse	90	46	51%
Deerfoot Lodge	150	50	33%
DeTemple	148	56	38%
Echo Lake	98	18	18%
French's	46	25	54%
Gulliver	119	67	56%
Hiawatha	174	26	15%
Hulbert	53	23	43%
Keldon	50	20	40%
Kelly	36	13	36%
Kossow	48	20	42%
Mead	217	121	56%
Middle Branch	99	17	17%
North Perkins	93	41	44%
Ogontz	34	18	53%
River Bend	101	25	25%
Silver Creek	53	16	30%
Soo Junction	60	29	48%
St. Martin's Bay	15	8	53%
Sturgeon River	39	28	72%
Whitefish	223	82	37%
Wilsey Bay	80	39	49%
Totals	2,694	1,030	38%

*Number of individual deer subsequently observed and reported. Number does not include multiple reobservations of the same animal.

Table 4. Frequency of observation for white-tailed deer captured and tagged in Michigan's Upper Peninsula during 1989-2006.

No. of instances deer was observed	No. of unique deer	Percent
0	1,675	62%
1	652	24%
2	210	8%
3	83	3%
4	34	1%
5	17	1%
6	13	0%
7	3	0%
8	2	0%
9+	5	0%
Totals	2,694	100%

Table 5. Distance between winter tagging sites and subsequent observations of white-tailed deer females and males during 3 seasons (summer, transition, and winter) in Michigan's Upper Peninsula during 1989-2006.

Season deer was observed *	Distance from winter tag site (miles)						P-value
	Females			Males			
	n	Mean	SD	n	Mean	SD	
Summer	593	11.6	9.7	467	10.6	9.0	0.09
Transition	151	8.3	8.7	56	8.9	6.0	0.63
Winter	348	4.9	7.6	65	4.2	5.4	0.48

* Summer = May-Nov; Transition = Dec. and April; Winter = Jan.-March.

Note: Multiple observations of the same deer are included.

Table 6. Sex-specific migration distance (miles) from winter tagging sites to points of subsequent summer (May-November) observations for female and male white-tailed deer tagged in Michigan's Upper Peninsula during 1989-2006.

	Females			Males			
Tagging site	n	Mean	SD	n	Mean	SD	P-value
Bark River	39	8.1	6.9	23	6.4	3.9	0.30
Big River	54	10.0	8.6	19	11.2	8.6	0.61
Big Spring	7	14.6	11.7	9	11.4	6.6	0.51
Camp Suicide	31	5.4	4.7	18	5.5	3.8	0.91
Carmody	3	11.7	3.2	0	n/a	n/a	n/a
Choate	13	8.8	11.4	23	5.5	4.1	0.22
Deadhorse	14	10.1	7.5	26	12.8	7.9	0.30
Deerfoot Lodge	32	10.0	5.8	21	11.8	9.0	0.37
DeTemple	32	3.9	3.0	28	3.7	3.3	0.81
Echo Lake	5	18.4	16.4	13	10.5	5.9	0.14
Frenchs	18	15.1	7.6	6	11.7	8.5	0.37
Gulliver	28	9.4	6.2	16	10.9	6.6	0.44
Hiawatha	8	13.4	5.3	19	9.4	10.1	0.30
Hulbert	11	18.1	7.0	7	15.7	8.8	0.53
Keldon	13	7.4	5.0	5	3.6	1.9	0.12
Kelly	7	10.6	5.8	4	10.5	8.5	0.99
Kossow	9	14.9	3.8	9	6.1	4.9	* 0.0007
Mead	107	15.7	10.9	89	16.6	11.8	0.62
Middle Branch	2	23.0	2.8	5	5.4	8.0	* 0.03
N. Perkins	19	18.8	17.9	15	9.6	6.1	0.07
Ogontz	5	11.4	12.6	13	17.1	9.7	0.32
River Bend	15	12.1	7.8	11	13.9	5.0	0.50
Silver Creek	5	7.0	4.1	6	10.7	7.6	0.36
Soo Junction	14	9.8	7.8	9	8.9	5.9	0.77
St. Martins Bay	2	9.0	0.0	3	11.7	2.5	0.25
Sturgeon River	30	11.6	10.4	9	7.2	3.6	0.22
Whitefish	37	15.5	7.9	48	9.0	8.2	* 0.004
Wilsey Bay	33	10.2	12.1	13	6.2	10.0	0.30

Note: Multiple observations of the same deer are included.
***** Statistically significant at P<0.05.

Table 7. Distance (miles) from winter tagging sites to subsequent observation for white-tailed deer tagged in Michigan's Upper Peninsula during 1989-2006.

	Season of observation*								
	Summer			Transition			Winter		
Tagging site	n	Mean	SD	n	Mean	SD	n	Mean	SD
Bark River	62	7.5	6.0	4	5.5	3.1	5	10.6	6.2
Big River	73	10.3	8.6	10	10.1	7.0	36	5.6	5.0
Big Spring	16	12.8	9.0	7	4.9	5.7	22	0.0	0.0
Camp Suicide	49	5.4	4.4	12	4.3	3.4	22	5.0	3.2
Carmody	3	11.7	3.2	2	1.0	0.0	1	6.0	n/a
Choate	36	6.7	7.6	1	8.0	n/a	23	2.2	2.1
Deadhorse	40	11.9	7.8	5	7.4	3.4	17	6.1	2.8
Deerfoot Lodge	53	10.7	7.2	15	5.7	6.4	9	3.3	3.1
DeTemple	60	3.8	3.2	4	4.3	2.8	14	3.9	3.0
Echo Lake	18	12.7	10.1	3	5.7	4.0	3	3.3	2.1
Frenchs	24	14.2	7.8	12	8.3	7.1	7	6.4	3.8
Gulliver	44	10.0	6.3	16	4.4	3.2	56	3.2	12.0
Hiawatha	27	10.6	9.0	6	12.0	4.1	7	1.9	1.5
Hulbert	18	17.2	7.6	10	2.2	5.6	6	1.5	2.5
Keldon	18	6.3	4.6	9	3.4	2.1	8	4.4	3.6
Kelly	11	10.5	6.5	1	4.0	n/a	4	2.8	2.6
Kossow	18	10.5	6.2	5	7.6	5.4	6	4.0	2.9
Mead	197	16.2	11.3	27	15.0	9.4	17	14.5	6.8
Middle Branch	7	10.4	10.9	8	7.1	9.3	27	0.4	1.4
N. Perkins	34	14.8	14.6	8	17.3	13.2	10	9.4	13.7
Ogontz	18	15.5	10.5	1	12.0	n/a	12	6.0	4.6
River Bend	26	12.8	6.7	1	12.0	n/a	2	1.0	0.0
Silver Creek	11	9.0	6.2	3	7.0	7.9	5	7.2	6.3
Soo Junction	23	9.4	7.0	2	7.0	9.9	7	2.0	1.9
St. Martins Bay	5	10.6	2.3	1	6.0	n/a	5	2.8	2.5
Sturgeon River	39	10.6	9.4	11	6.6	6.6	15	8.2	9.4
Whitefish	85	11.8	8.6	15	13.2	9.0	51	7.1	7.5
Wilsey Bay	46	9.1	11.6	8	11.9	9.7	16	4.8	7.1

* Summer = May-Nov; Transition = Dec. and April; Winter = Jan.-March.

Note: Multiple observations of the same deer are included.

Table 8. Total annual range (sq. miles) occupied by white-tailed deer that were tagged during winters 1989-2006 and subsequently observed in Michigan’s Upper Peninsula. Observations include all seasons of the year. Multiple observations of individual deer were not excluded from the calculations.

Tagging site	No. of observations	Square miles
Bark River	71	294
Big River	119	439
Big Spring	45	174
Camp Suicide	83	210
Carmody	6	72
Choate	60	196
Deadhorse	62	434
Deerfoot Lodge	77	531
De Temple	78	132
Echo Lake	24	268
Frenchs	43	419
Gulliver	116	541
Hiawatha	40	510
Hulbert	34	603
Keldon	35	189
Kelly	16	320
Kossow	29	334
Mead	241	2,388
Middle Branch	42	451
North Perkins	52	680
Ogontz	31	530
River Bend	29	621
Silver Creek	19	314
Soo Junction	32	512
St. Martin's Bay	11	79
Sturgeon River	65	544
Whitefish	151	859
Wilsey Bay	70	751

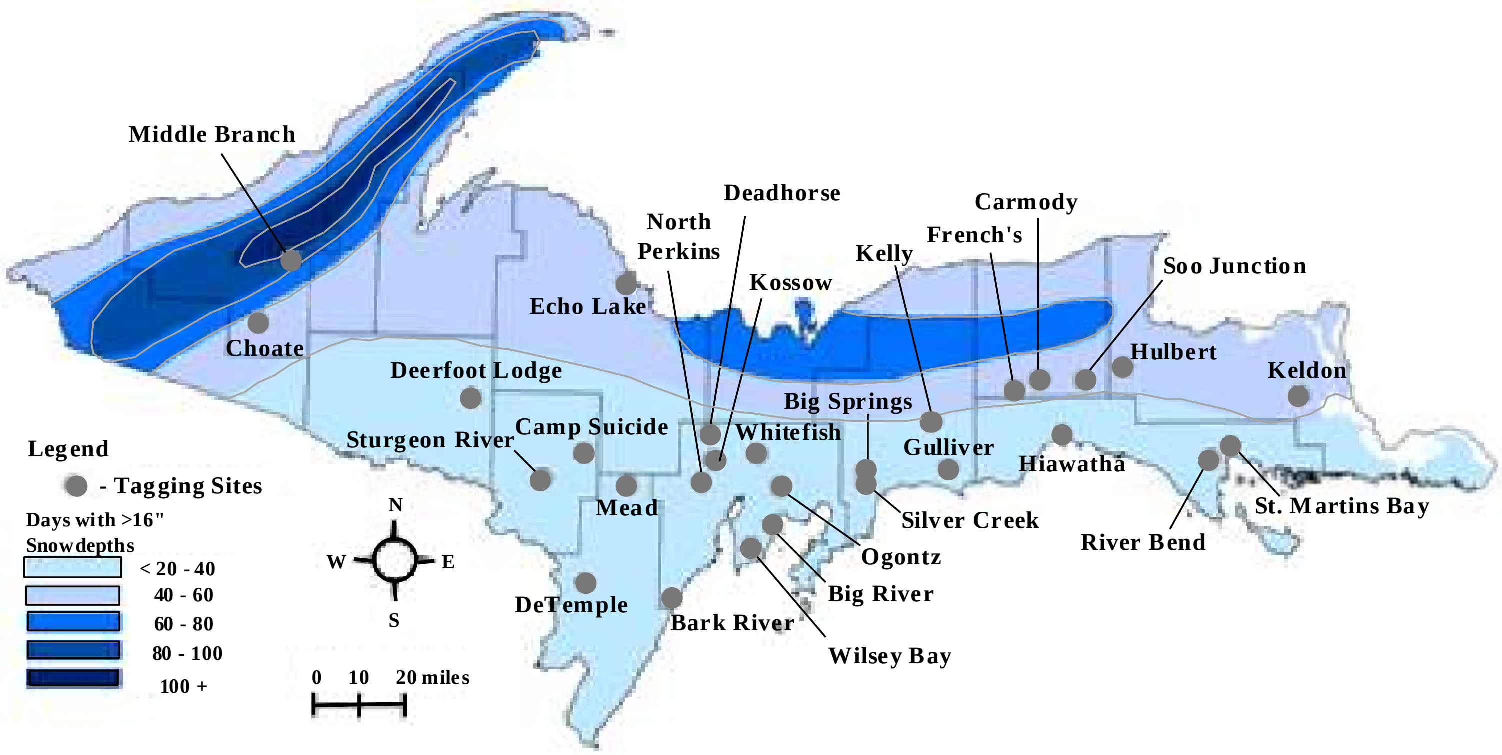

Figure 1. White-tailed deer trapping and tagging locations in relation to snowfall gradients in Michigan's Upper Peninsula durng 1989 to 2006. Deer were trapped in winter concentration areas as identified by local MDNR wildife biologists.

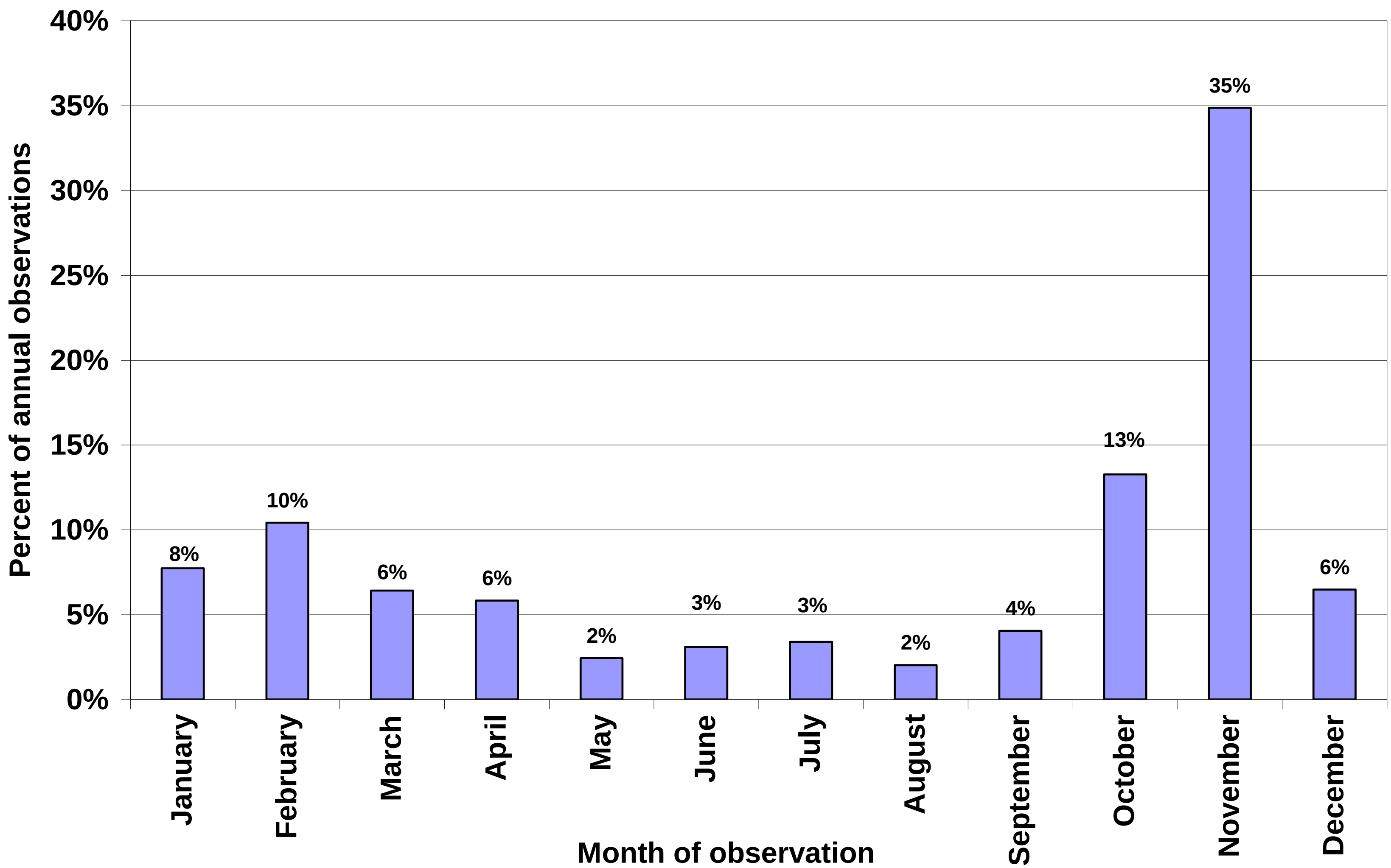

Figure 2. Month of observation of 1,681 white-tailed deer that were ear-tagged during winter in Michigan's Upper Peninsula during 1989-2006.

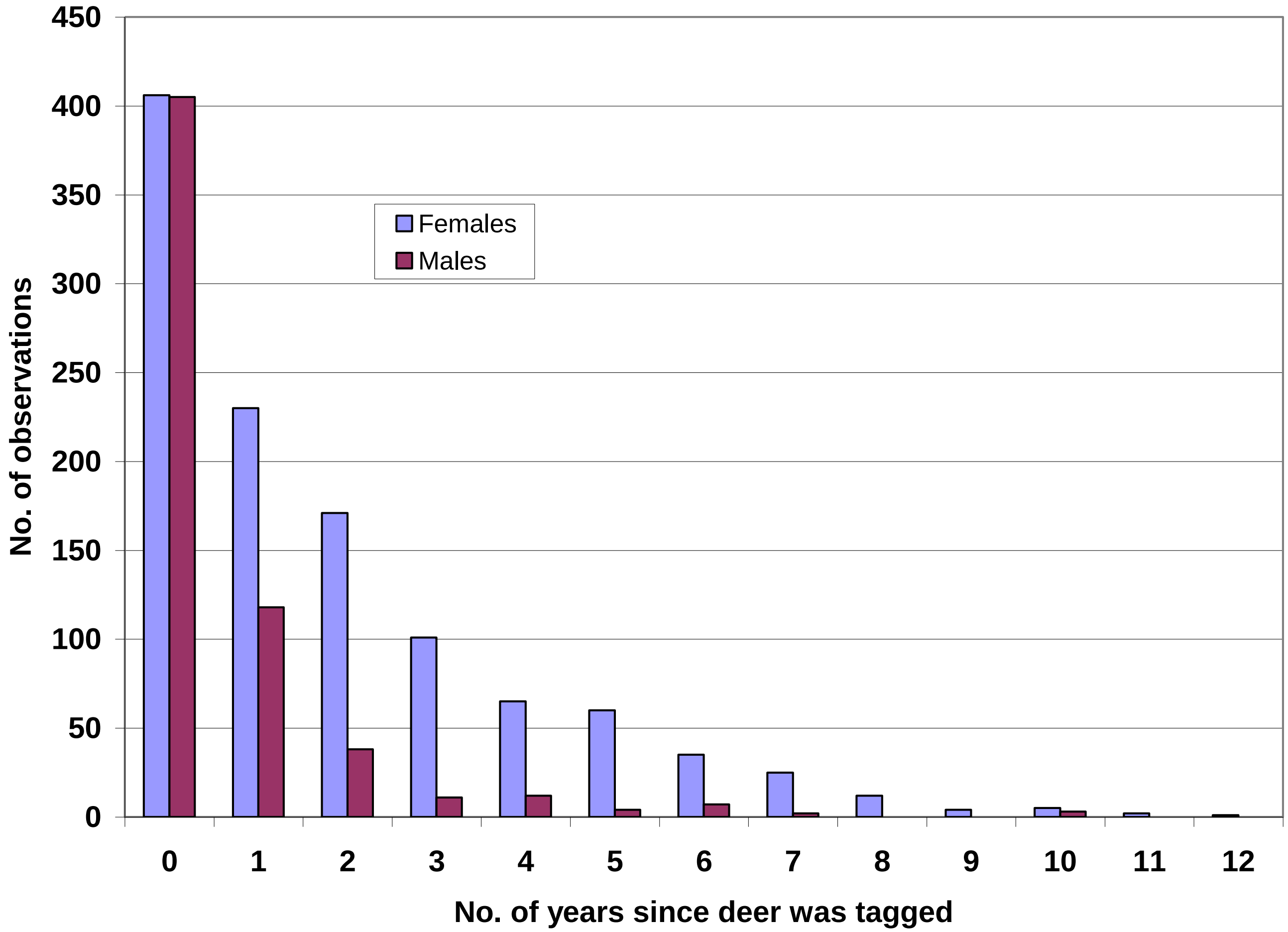

Figure 3. Number of years between tagging and observation for white-tailed deer tagged in Michigan's Upper Peninsula during 1989 to 2006.

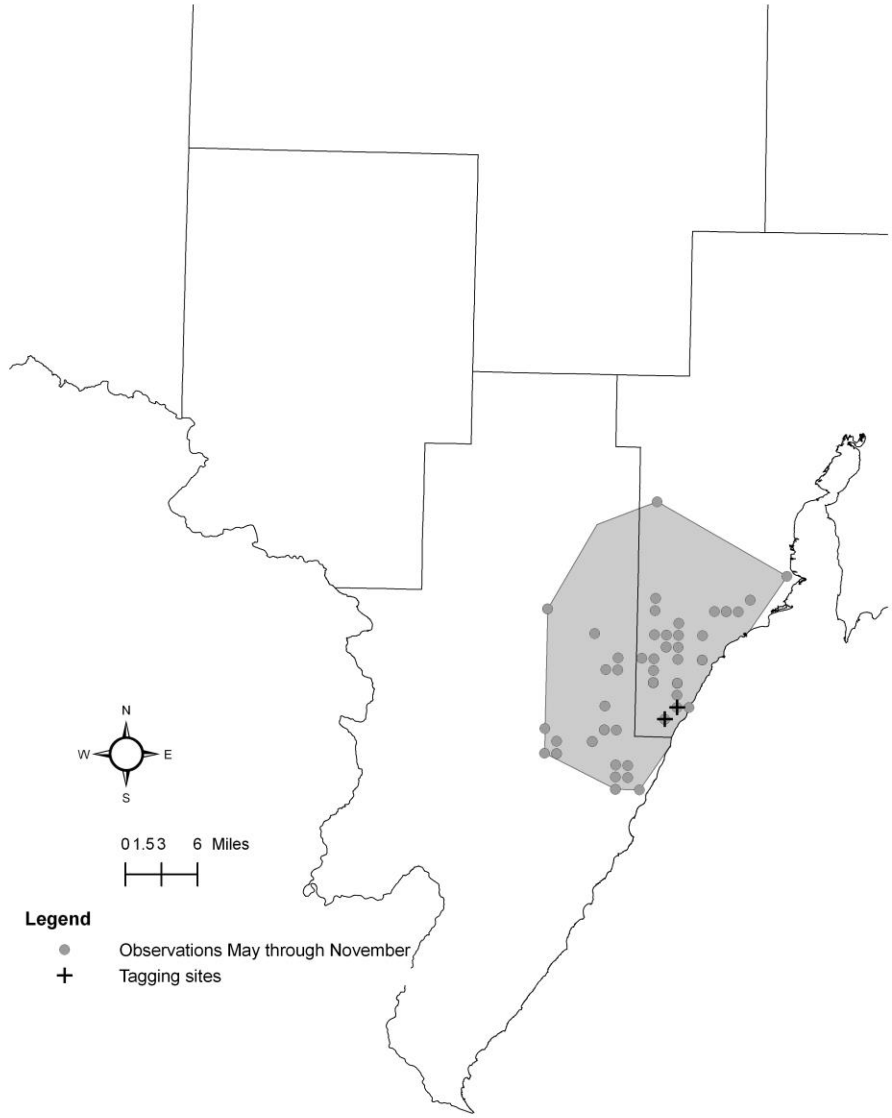

Figure 4. Observations of white-tailed deer ear-tagged in the Bark River winter concentration area of Michigan's Upper Peninsula during 1998 and 1999. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

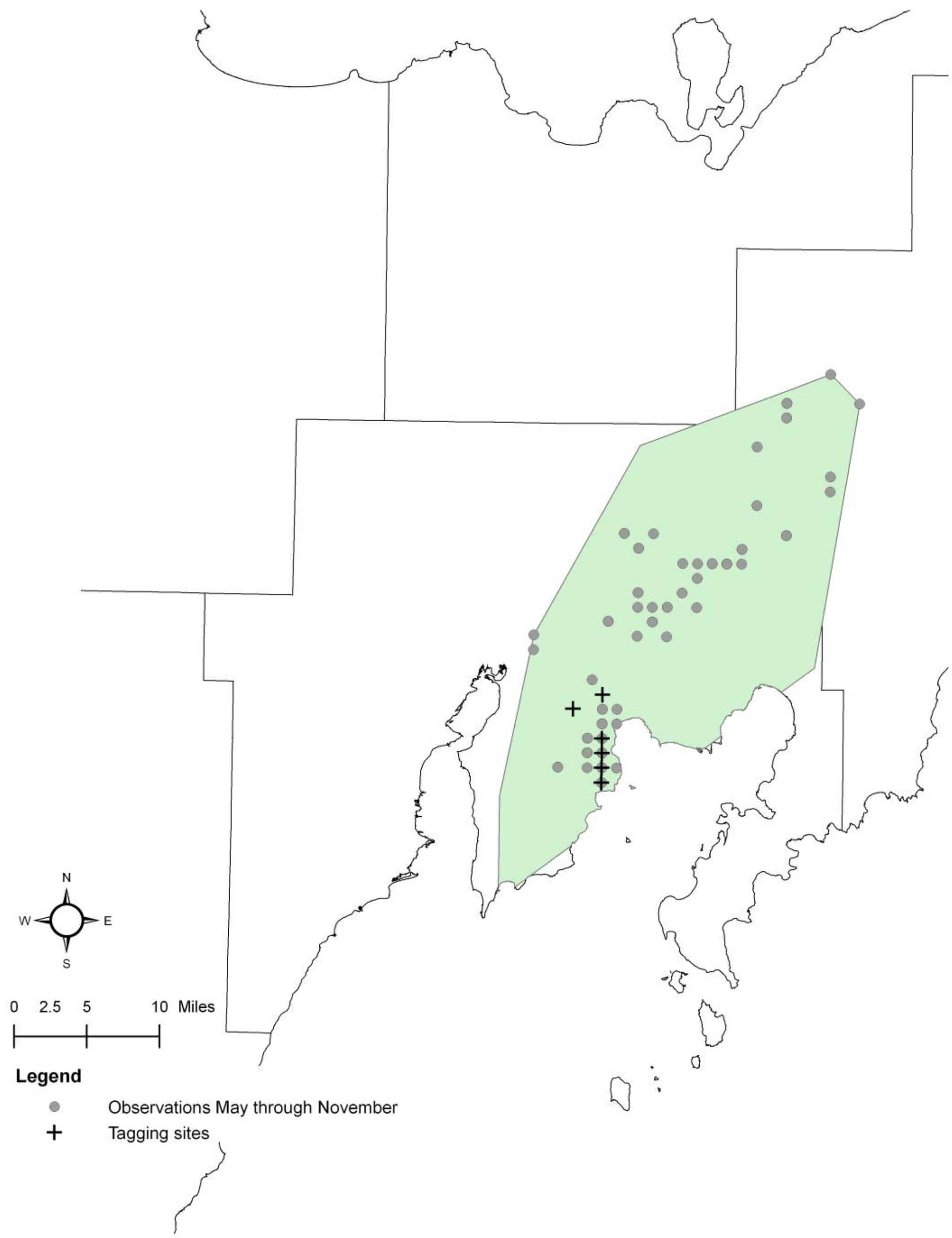

Figure 5. Observations of white-tailed deer ear-tagged in the Big River winter concentration area of Michigan's Upper Peninsula during 1991 to 1994. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

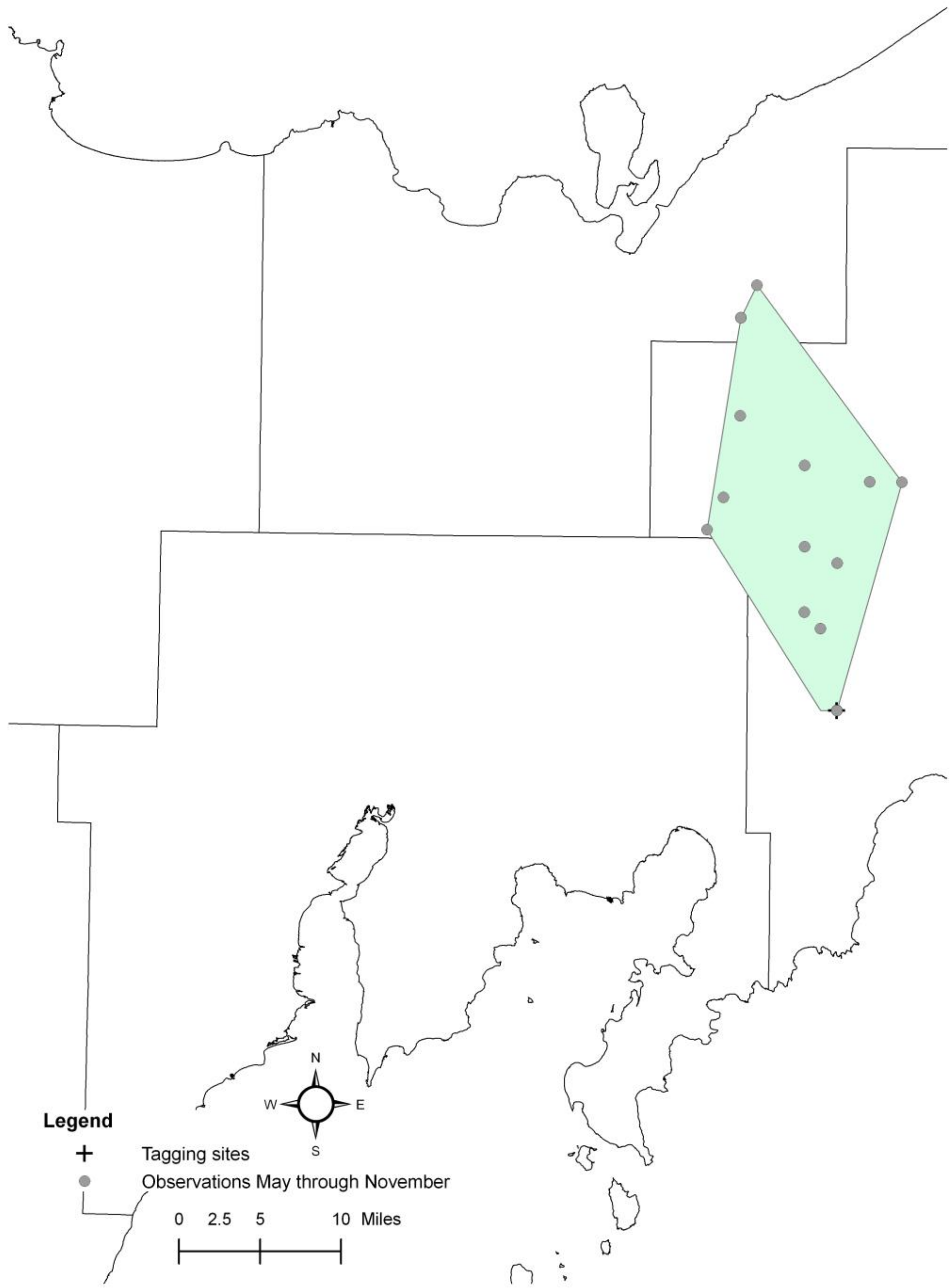

Figure 6. Observations of white-tailed deer ear-tagged in the Big Spring winter concentration area of Michigan's Upper Peninsula during 1995 to 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

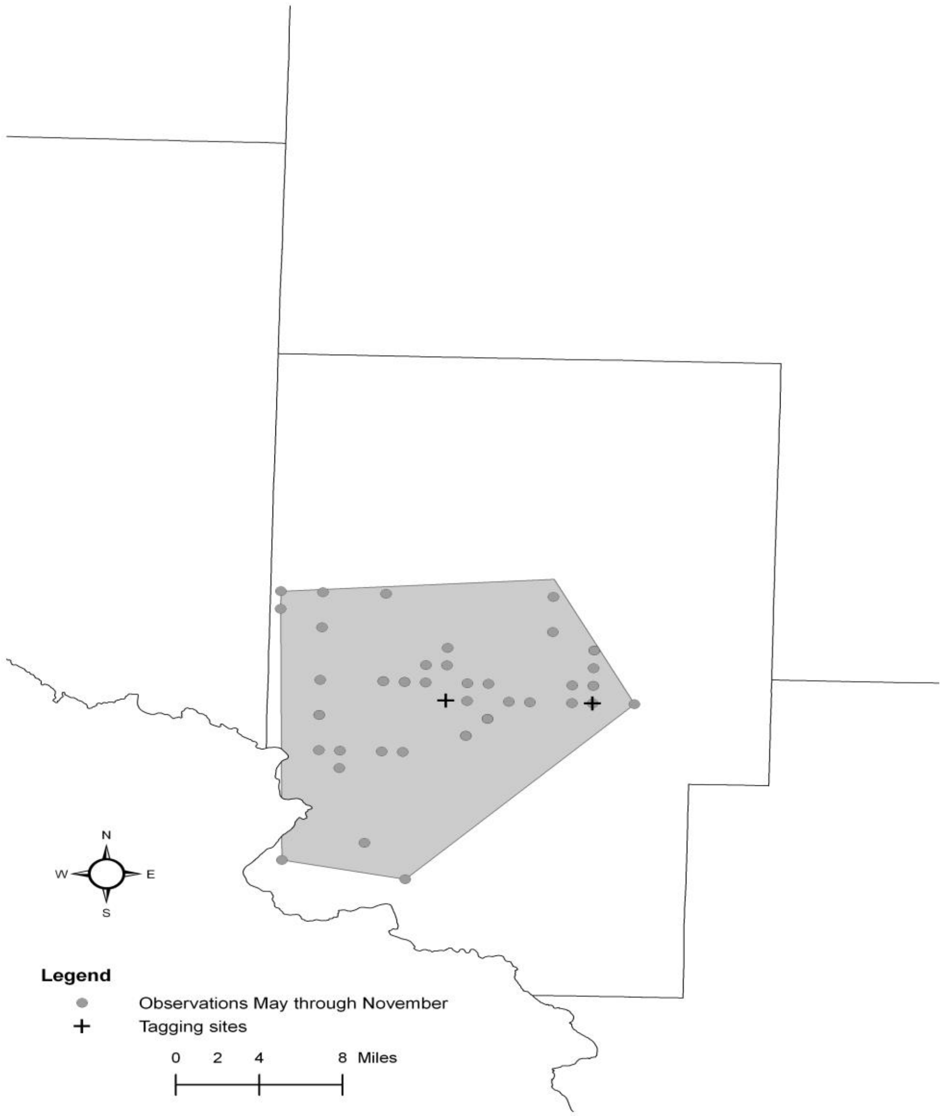

Figure 7. Observations of white-tailed deer ear-tagged in the Camp Suicide winter concentration area of Michigan's Upper Peninsula during 1996 and 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

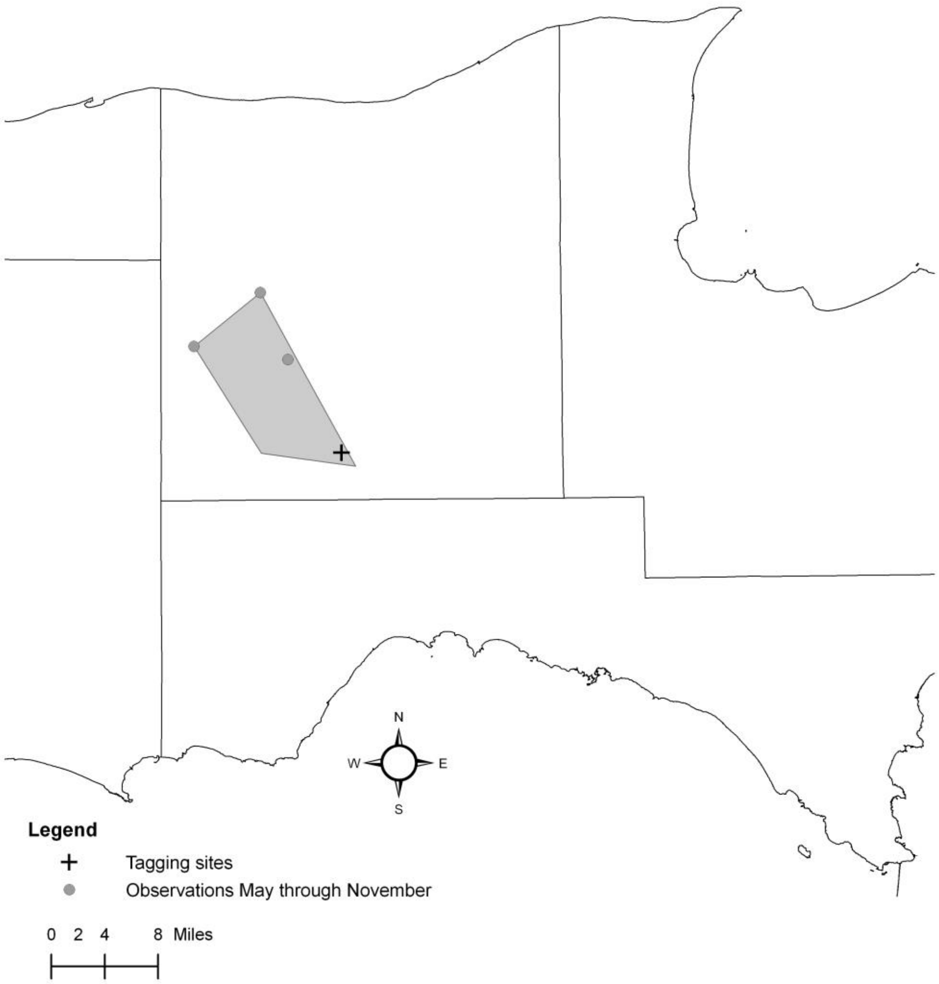

Figure 8. Observations of white-tailed deer ear-tagged in the Carmody winter concentration area of Michigan's Upper Peninsula during 1994. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

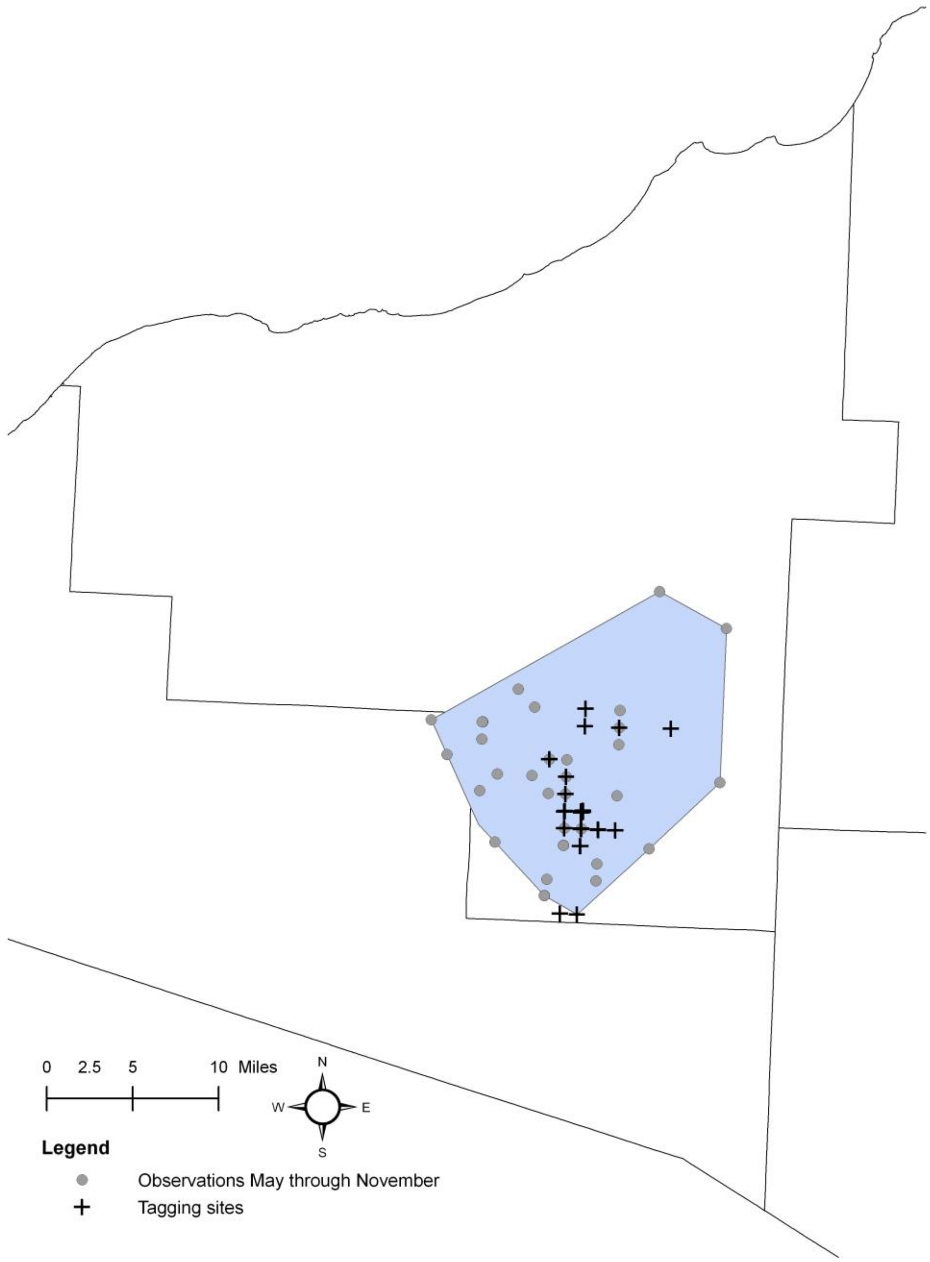

Figure 9. Observations of white-tailed deer ear-tagged in the Choate winter concentration area of Michigan's Upper Peninsula during 1994 to 1997 and 1999 to 2001. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

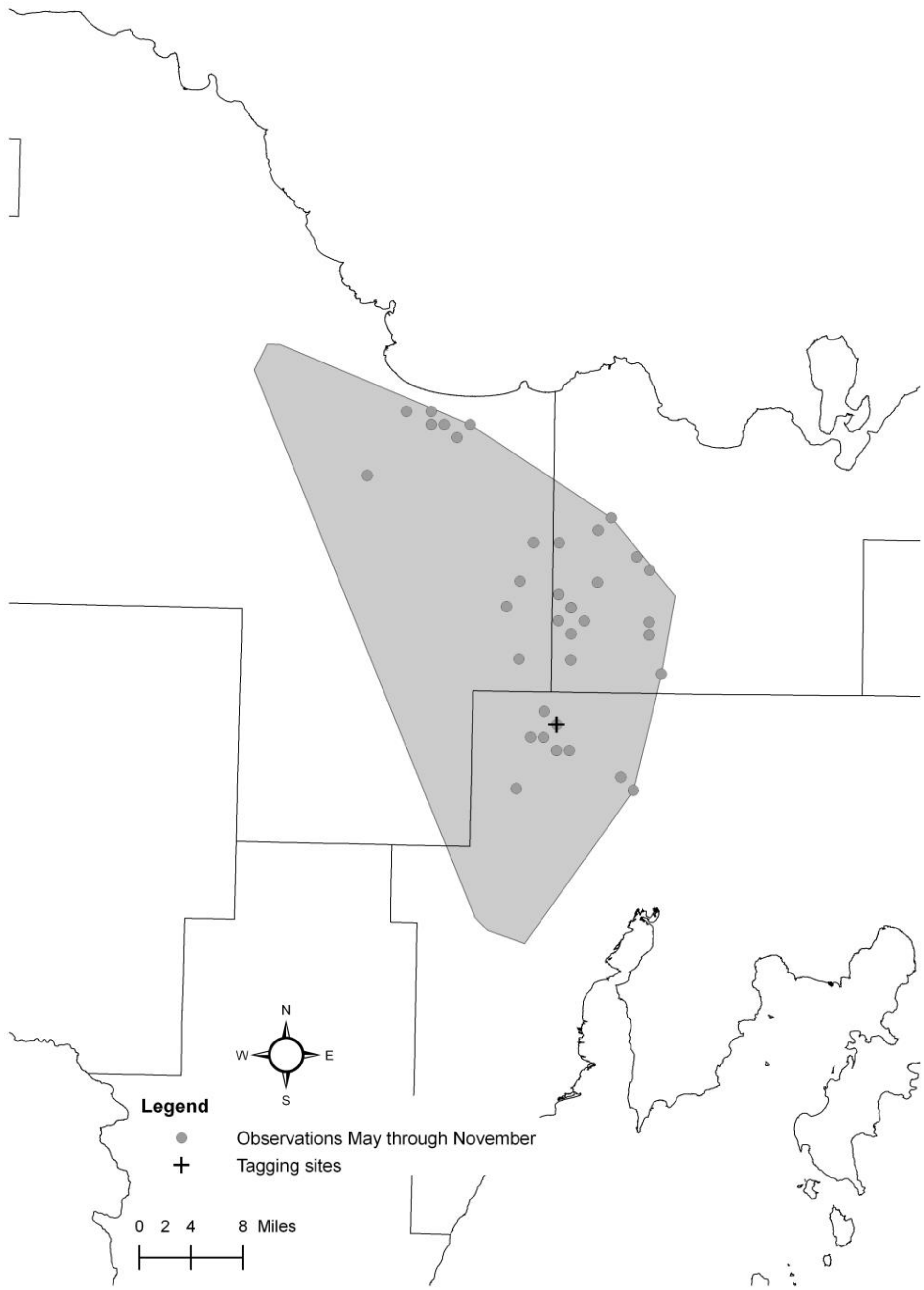

Figure 10. Observations of white-tailed deer ear-tagged in the Deadhorse winter concentration area of Michigan's Upper Peninsula during 1995 and 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

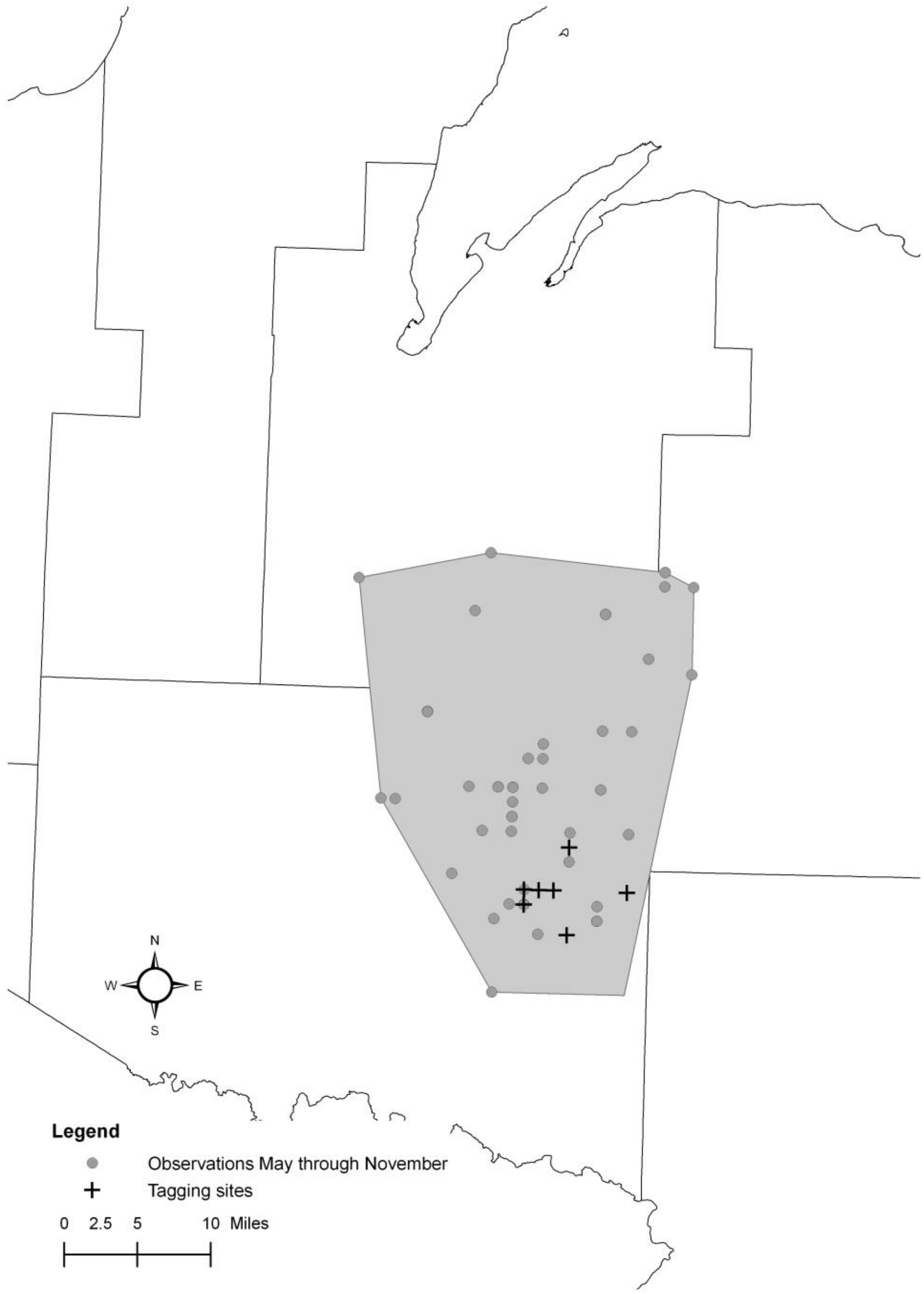

Figure 11. Observations of white-tailed deer ear-tagged in the Deerfoot Lodge winter concentration area of Michigan's Upper Peninsula during 1999 and 2001. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

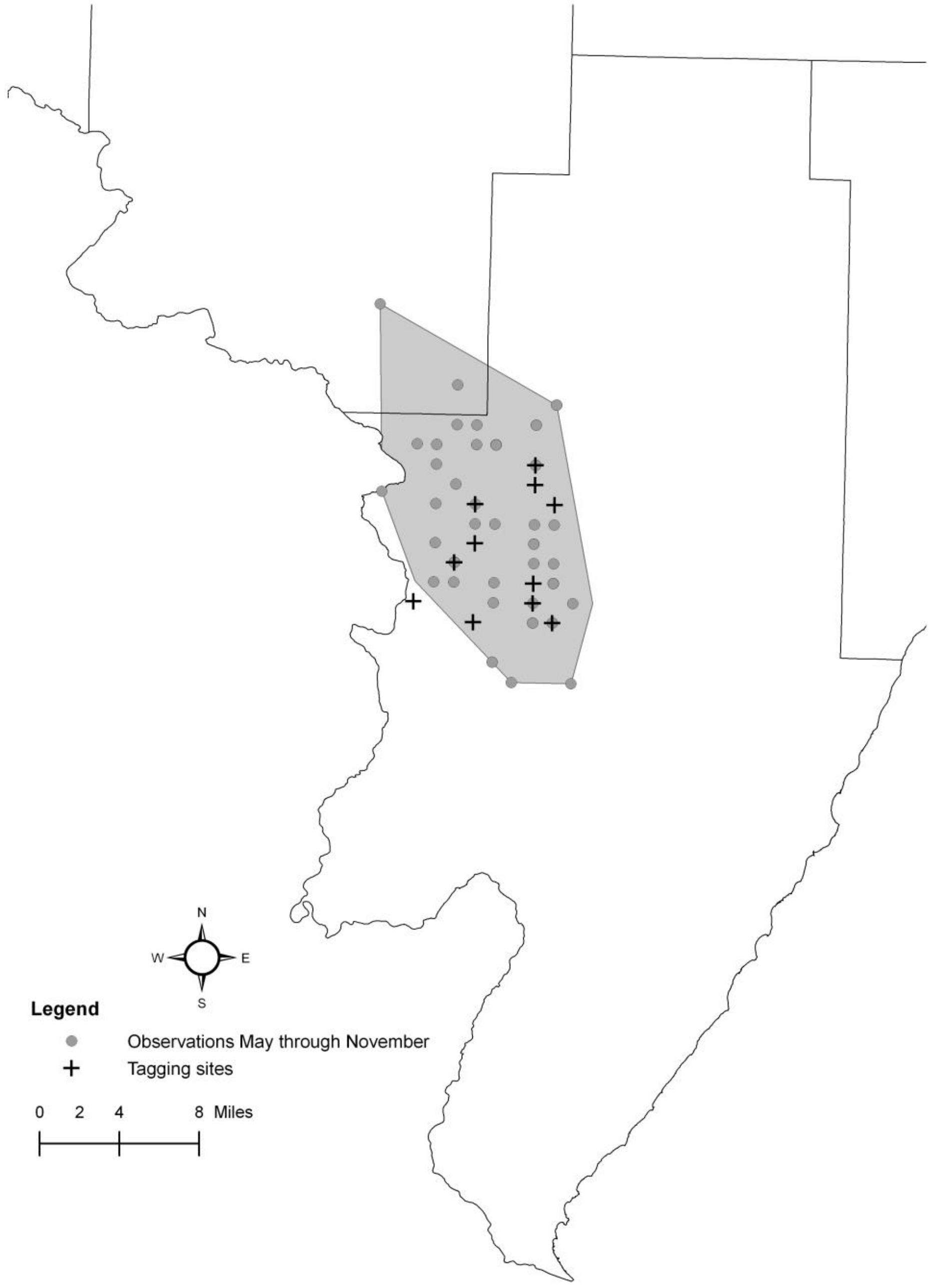

Figure 12. Observations of white-tailed deer ear-tagged in the De Temple winter concentration area of Michigan's Upper Peninsula during 1999 and 2000. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

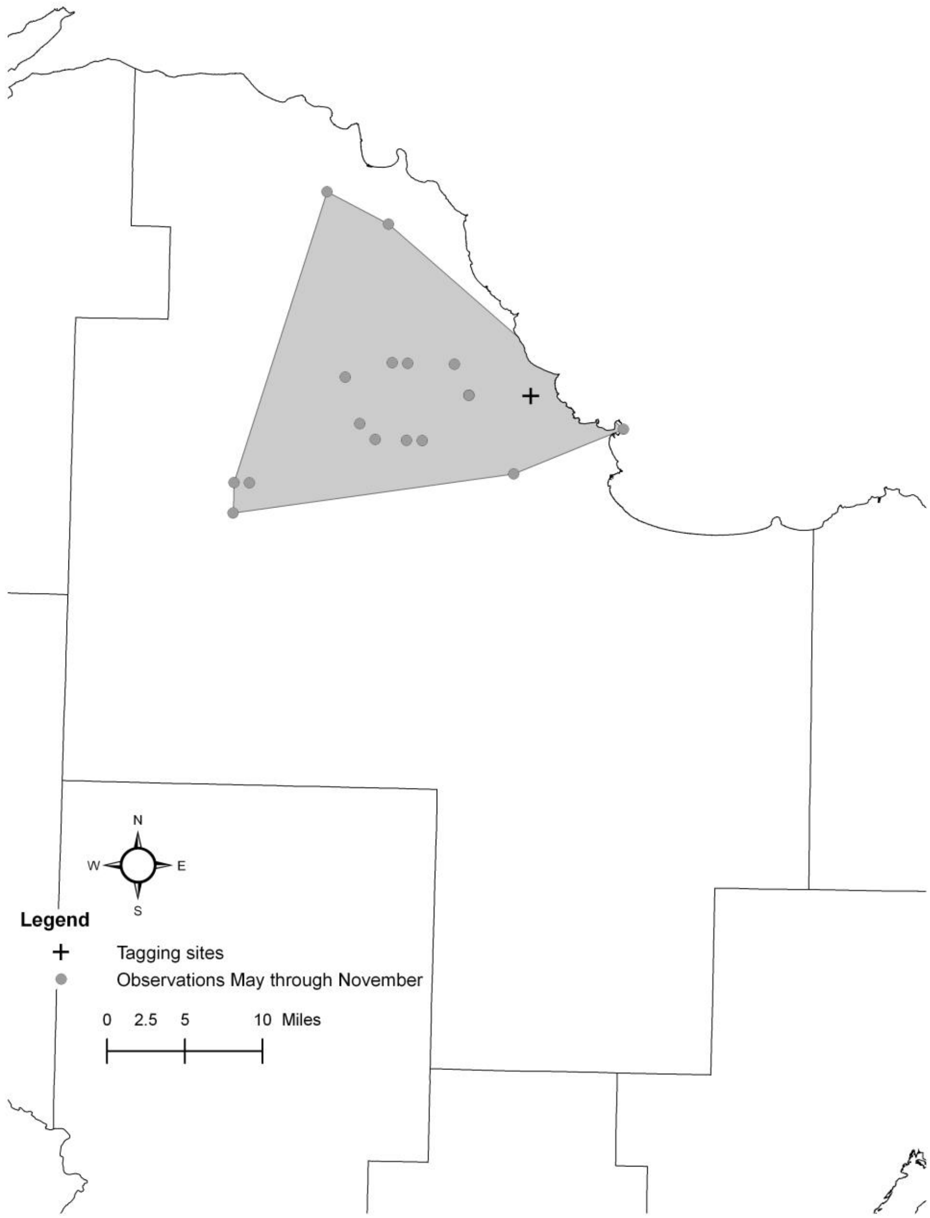

Figure 13. Observations of white-tailed deer ear-tagged in the Echo Lake winter concentration area of Michigan's Upper Peninsula during 2001 and 2002. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

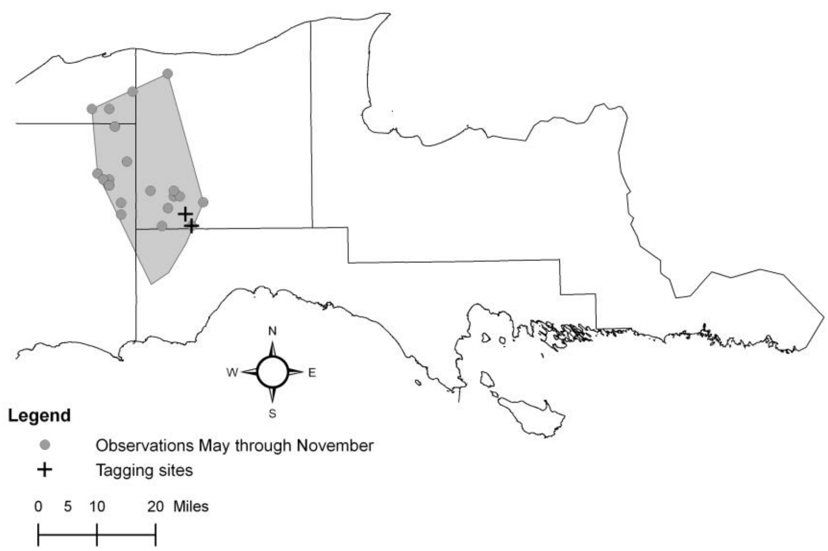

Figure 14. Observations of white-tailed deer ear-tagged in the Frenchs winter concentration area of Michigan's Upper Peninsula during 1993 and 1994. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

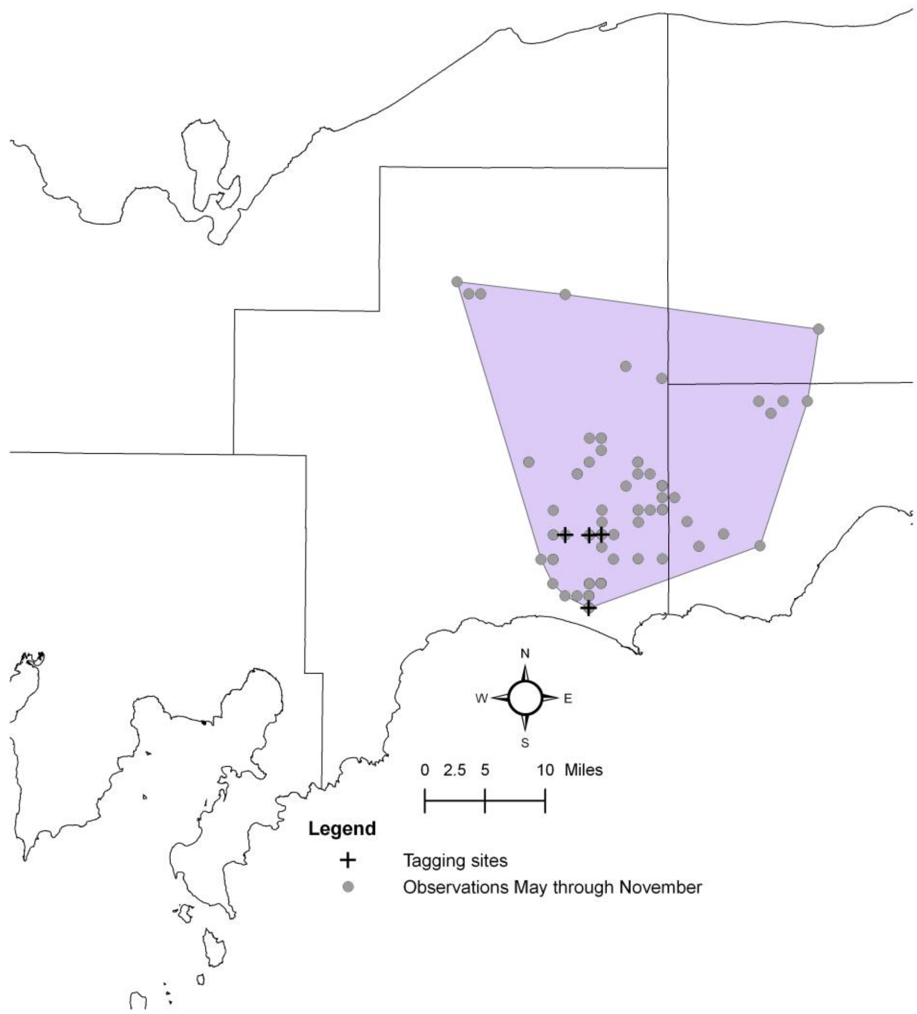

Figure 15. Observations of white-tailed deer ear-tagged in the Gulliver winter concentration area of Michigan's Upper Peninsula during 1995 to 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

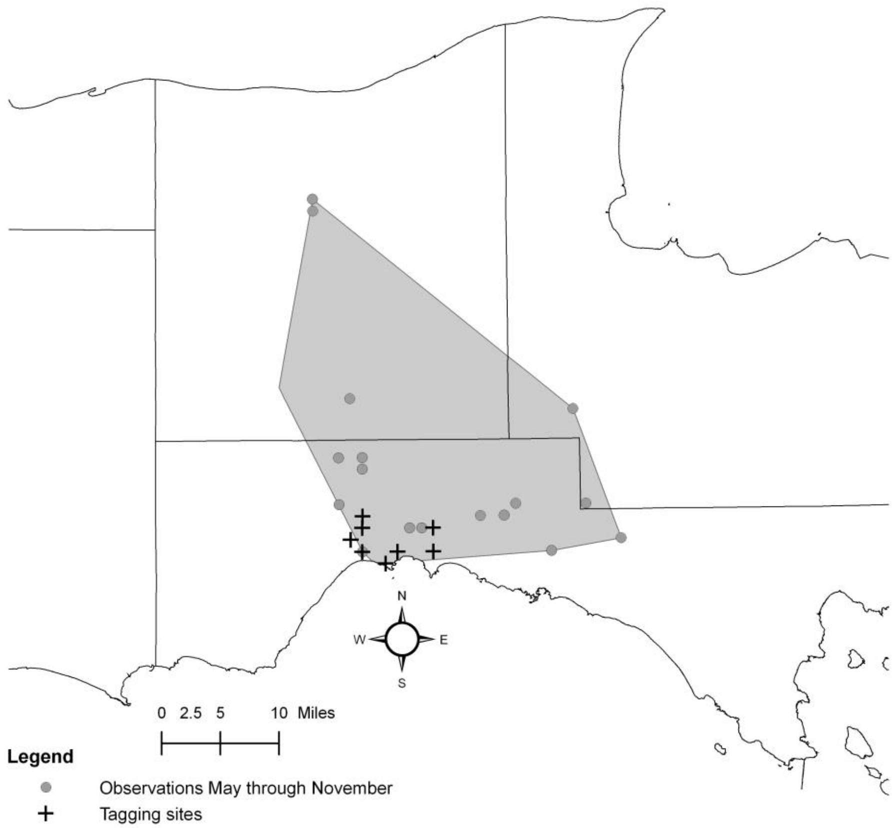

Figure 16. Observations of white-tailed deer ear-tagged in the Hiawatha winter concentration area of Michigan's Upper Peninsula during 1997 to 2002. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

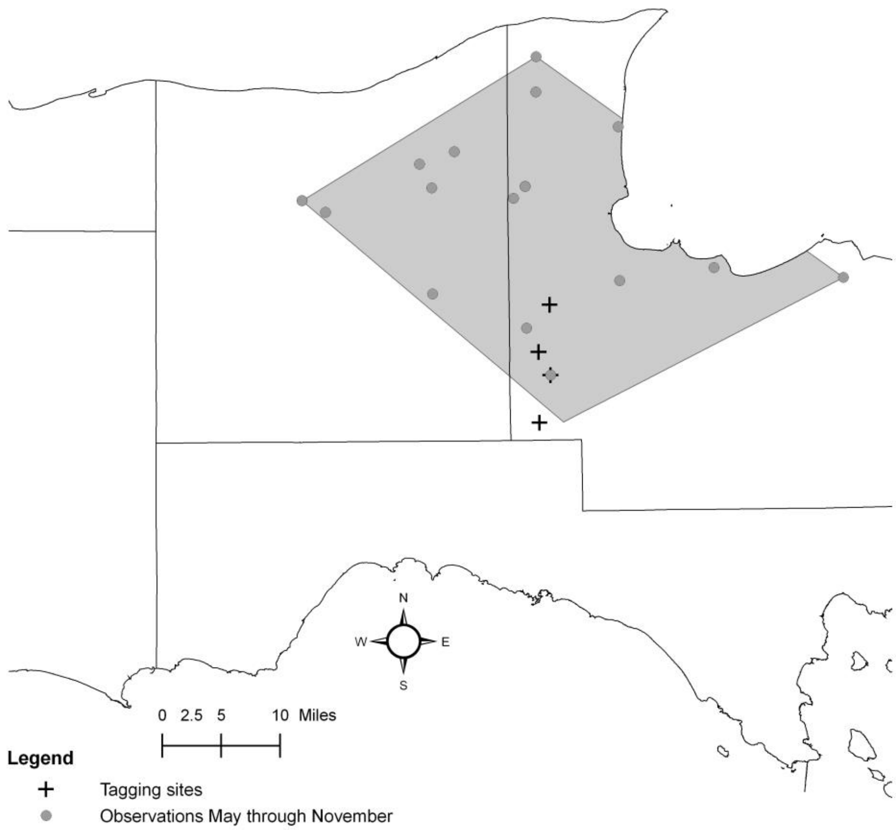

Figure 17. Observations of white-tailed deer ear-tagged in the Hulbert winter concentration area of Michigan's Upper Peninsula during 1996 and 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

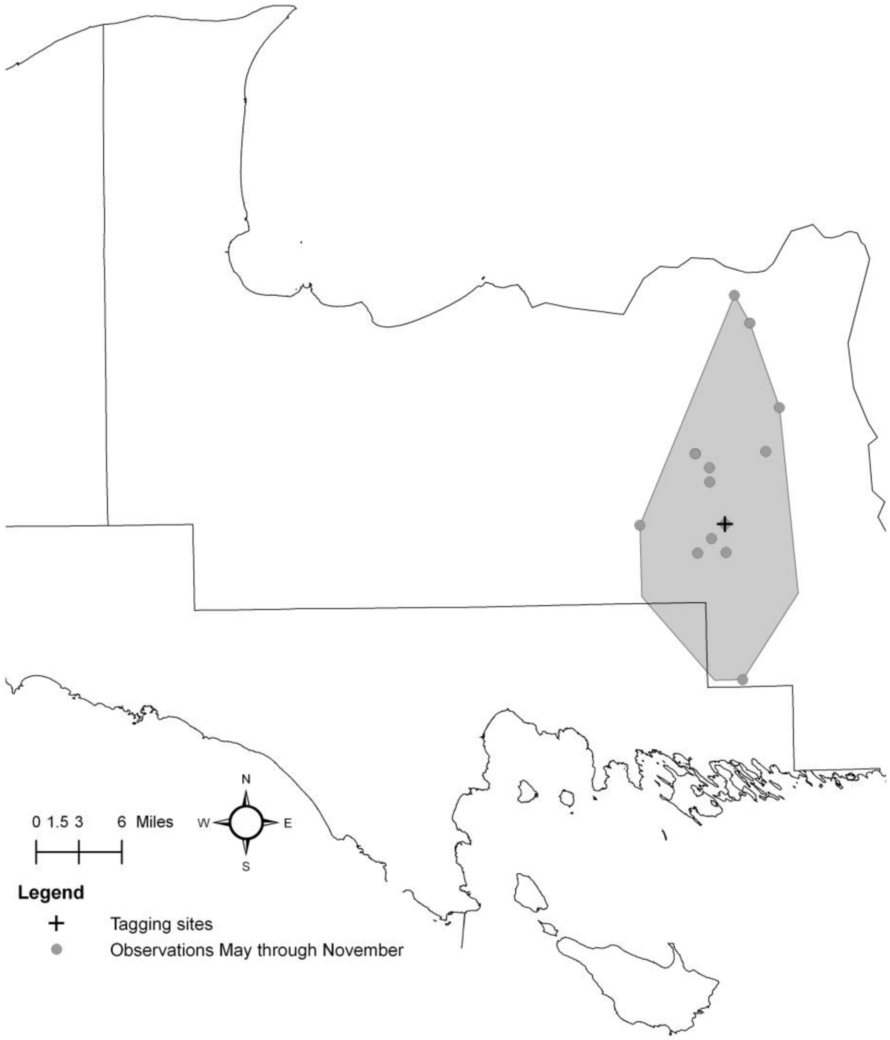

Figure 18. Observations of white-tailed deer ear-tagged in the Keldon winter concentration area of Michigan's Upper Peninsula during 1993 to 1995. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

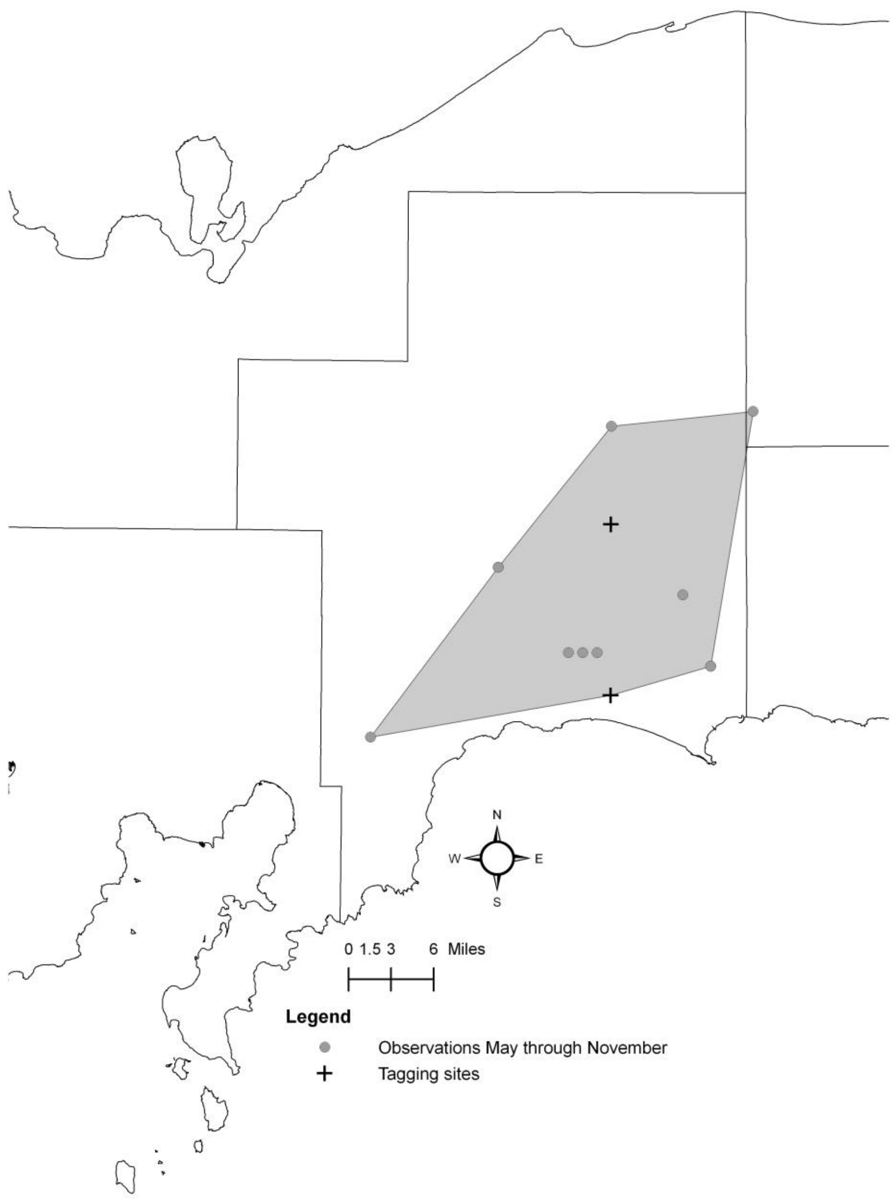

Figure 19. Observations of white-tailed deer ear-tagged in the Kelly winter concentration area of Michigan's Upper Peninsula during 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

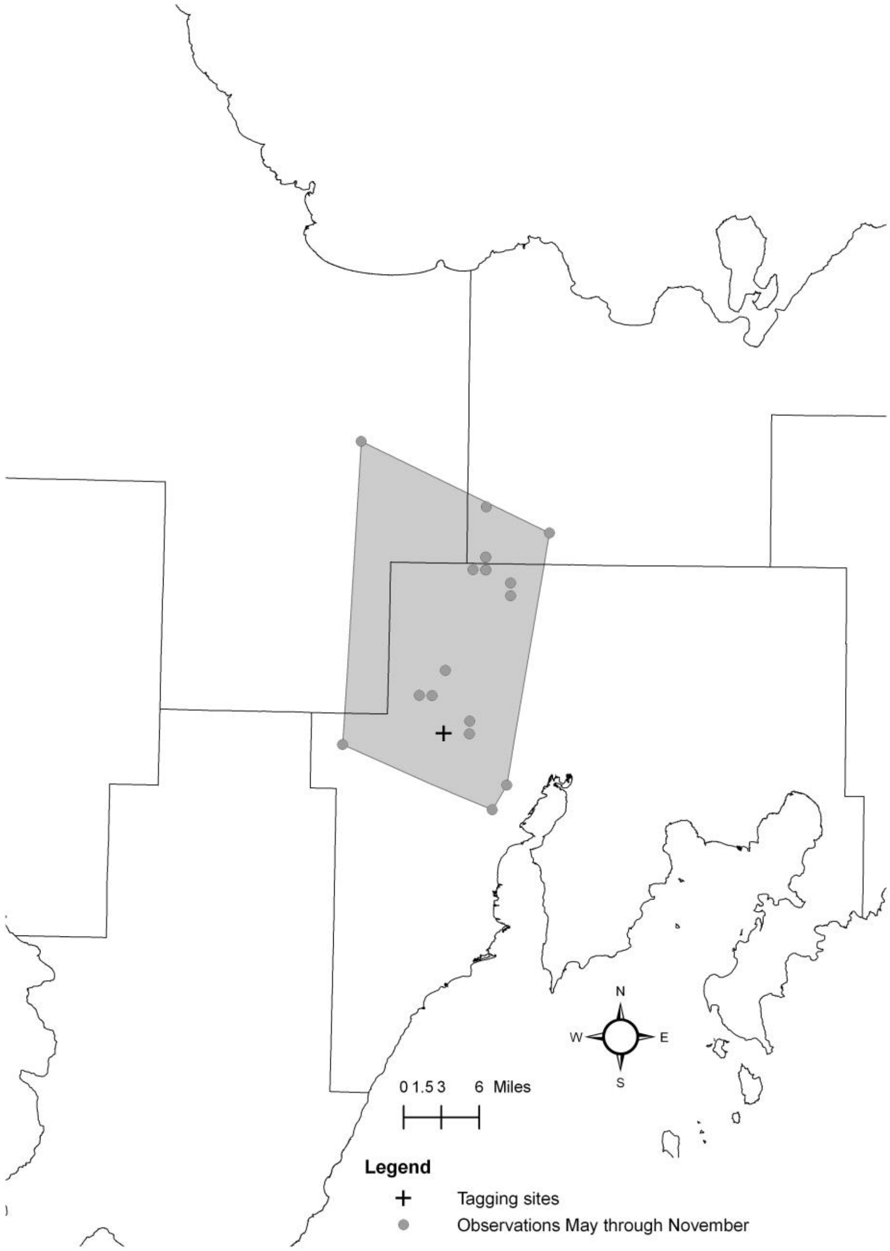

Figure 20. Observations of white-tailed deer ear-tagged in the Kossow winter concentration area of Michigan's Upper Peninsula during 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

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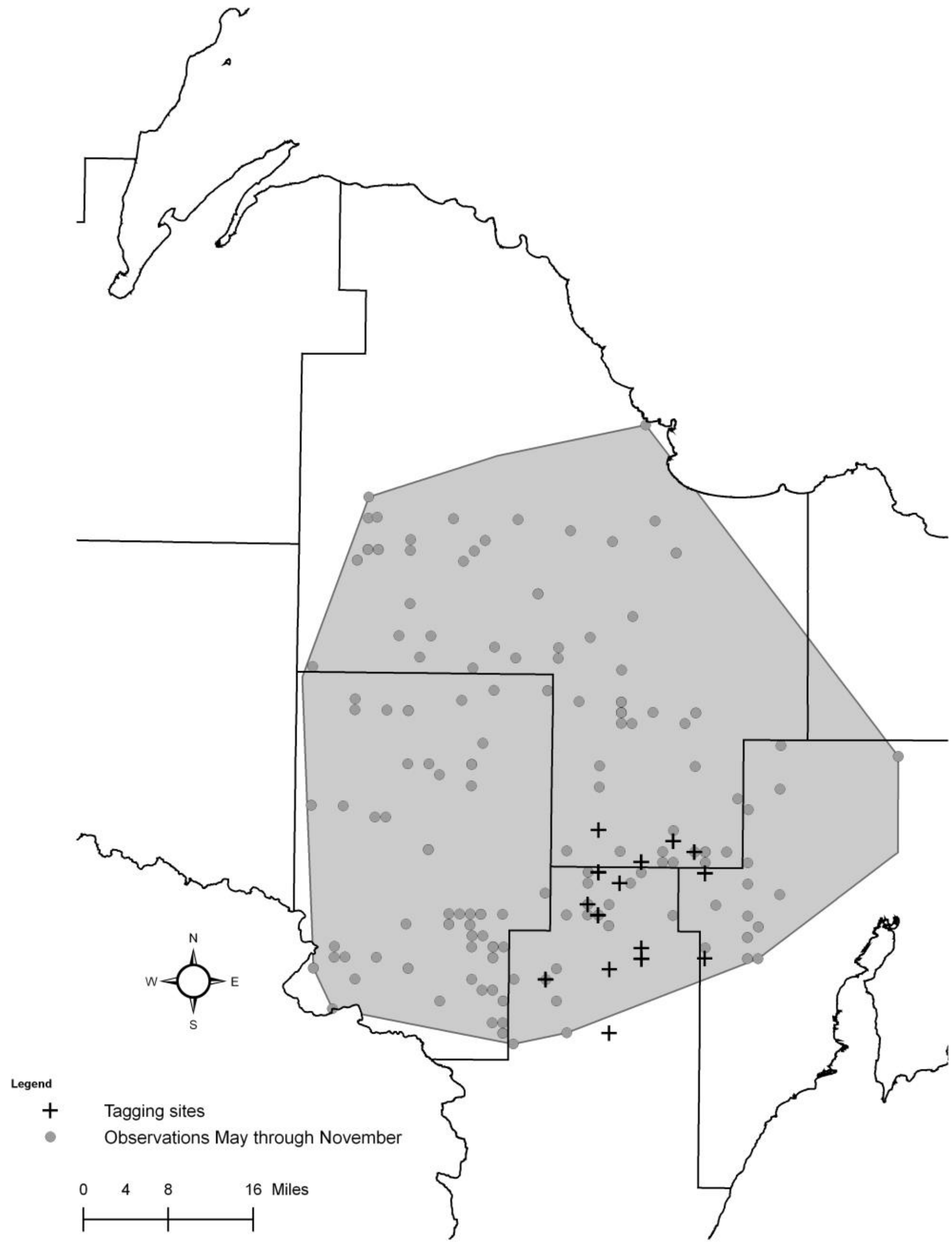

Figure 21. Observations of white-tailed deer ear-tagged in the Mead winter concentration area of Michigan's Upper Peninsula during 1989 and 1990. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

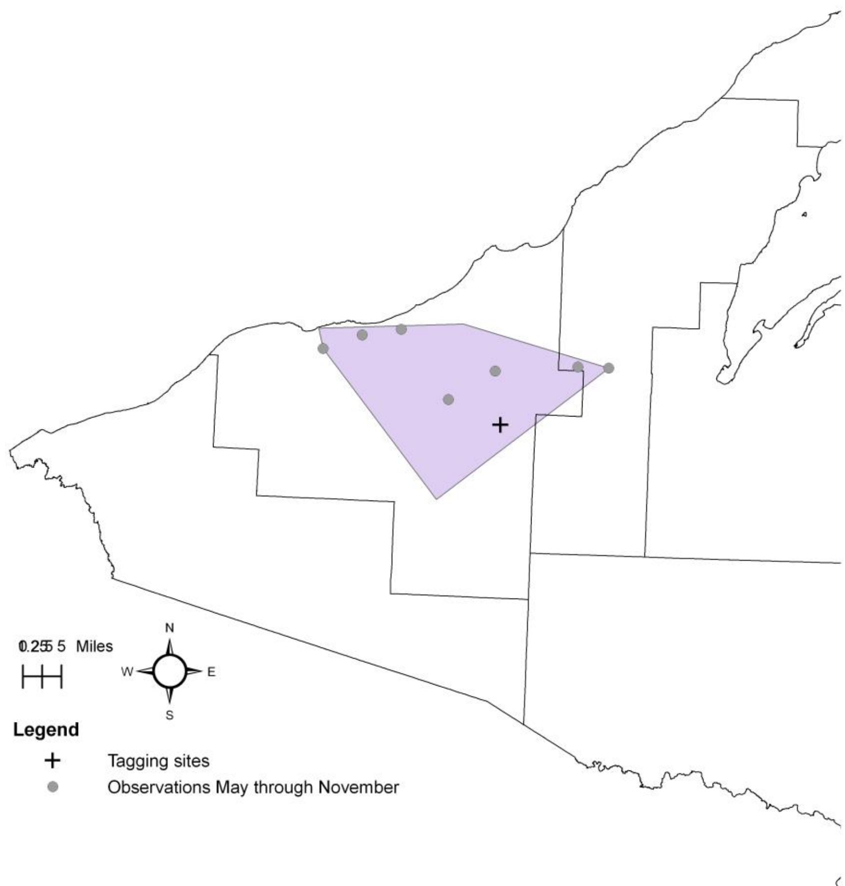

Figure 22. Observations of white-tailed deer ear-tagged in the Middle Branch winter concentration area of Michigan's Upper Peninsula during 2005 and 2006. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

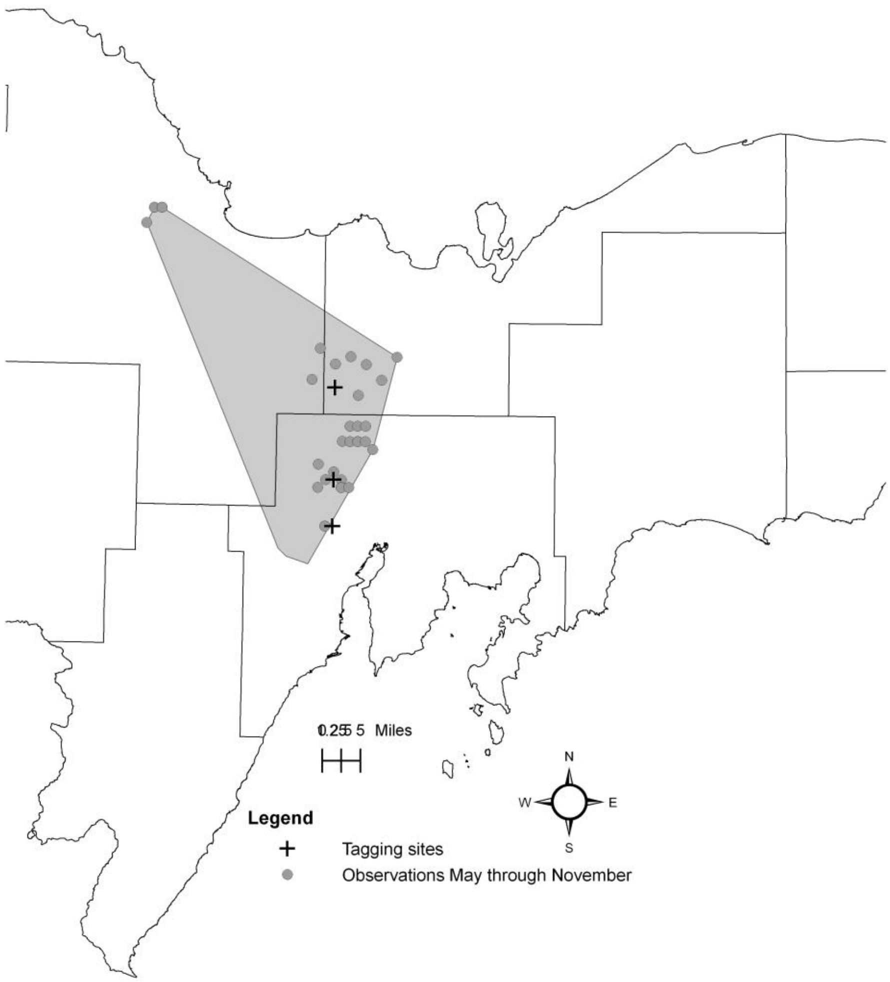

Figure 23. Observations of white-tailed deer ear-tagged in the North Perkins winter concentration area of Michigan's Upper Peninsula during 1995 and 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

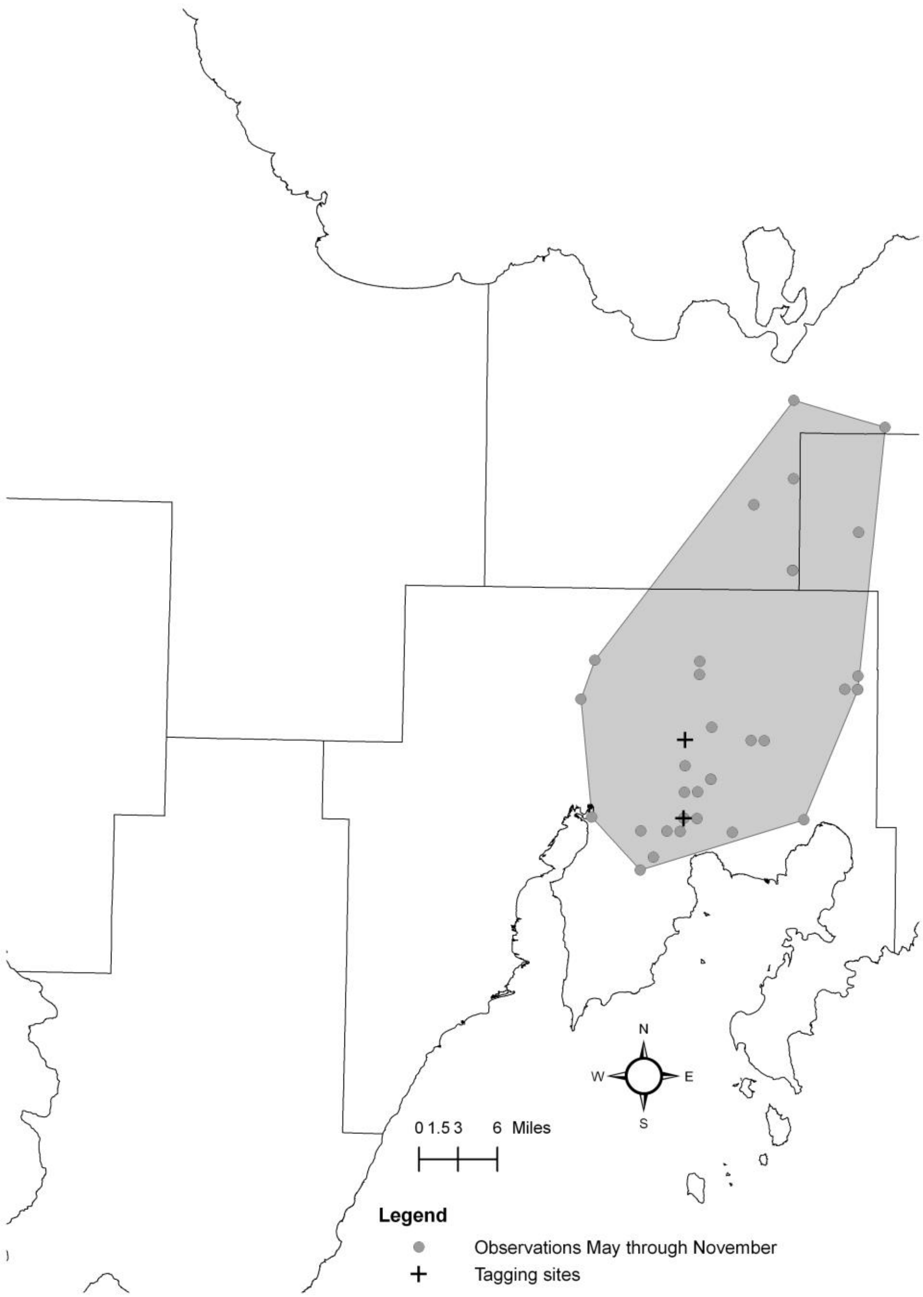

Figure 24. Observations of white-tailed deer ear-tagged in the Ogontz winter concentration area of Michigan's Upper Peninsula during 1991. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

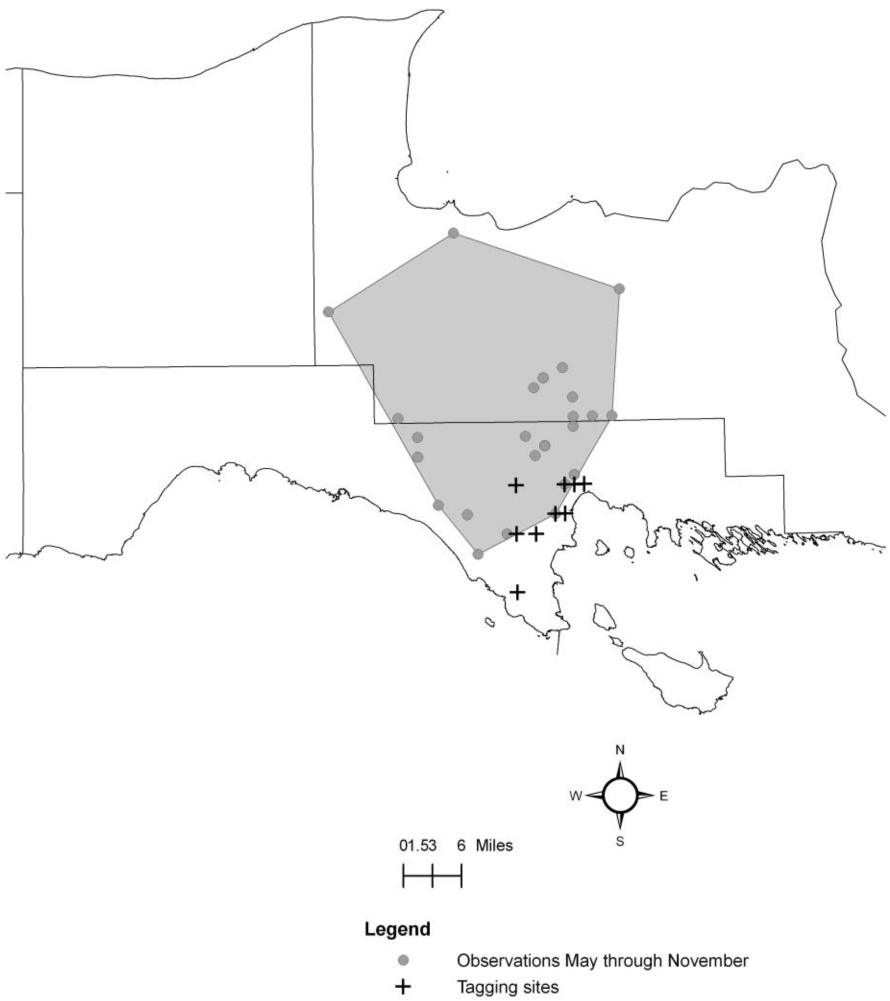

Figure 25. Observations of white-tailed deer ear-tagged in the River Bend winter concentration area of Michigan's Upper Peninsula during 1998 to 2001. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

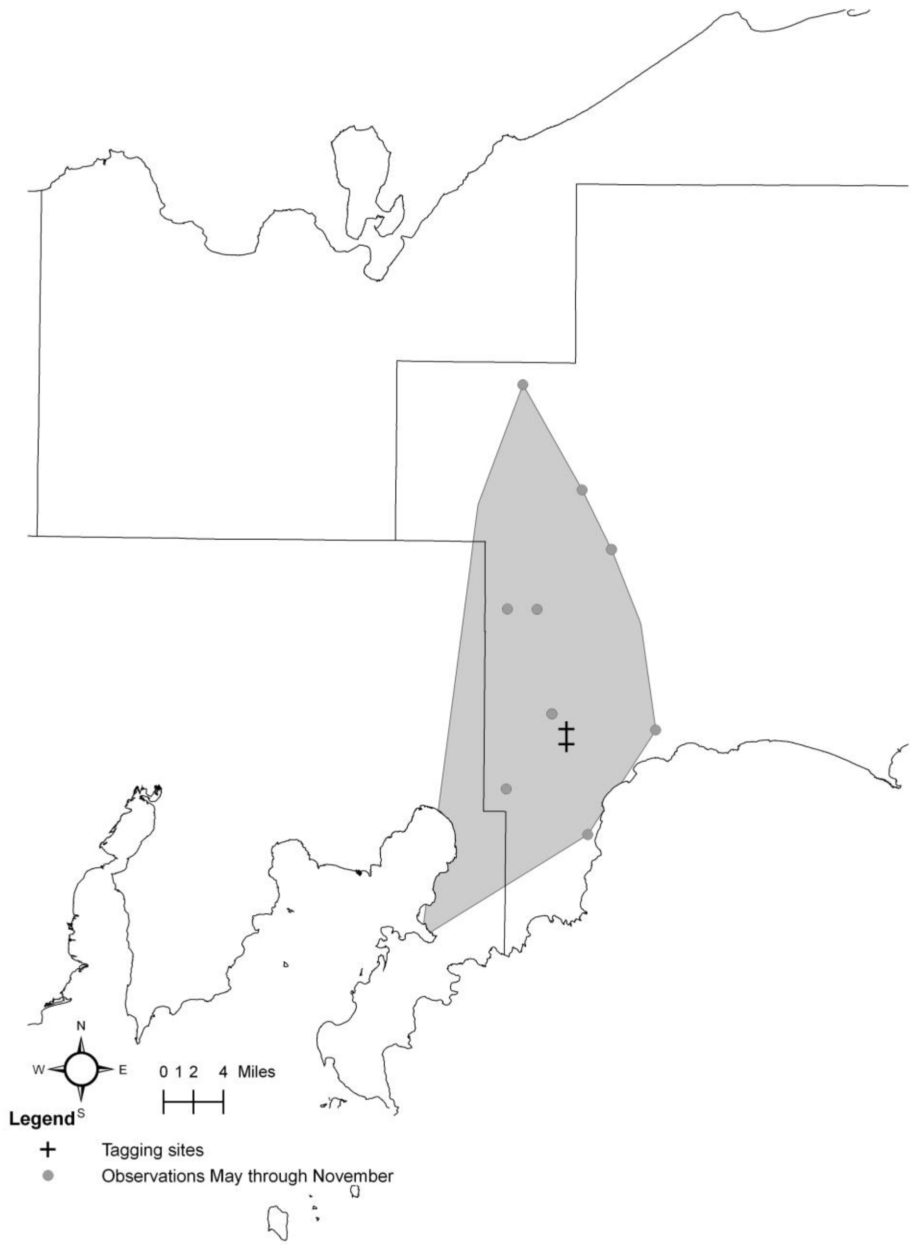

Figure 26. Observations of white-tailed deer ear-tagged in the Silver Creek winter concentration area of Michigan's Upper Peninsula during 1999 and 2000. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

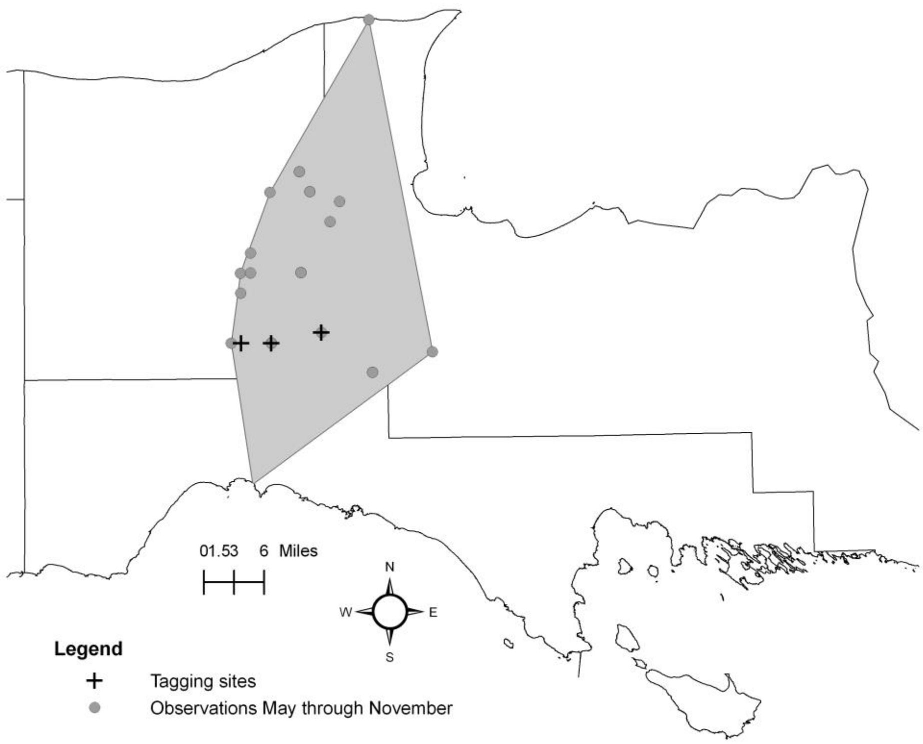

Figure 27. Observations of white-tailed deer ear-tagged in the Soo Junction winter concentration area of Michigan's Upper Peninsula during 1993, 1995, and 1996. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

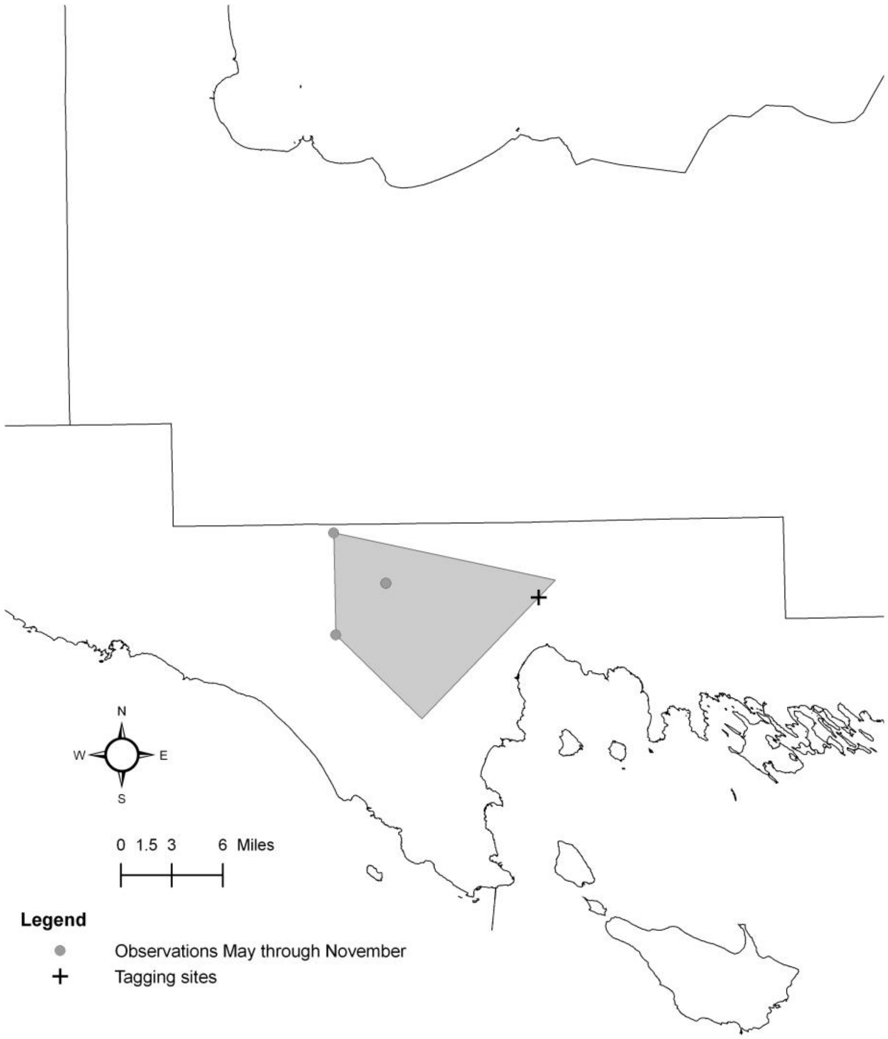

Figure 28. Observations of white-tailed deer ear-tagged in the St. Martins Bay winter concentration area of Michigan's Upper Peninsula during 1993. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

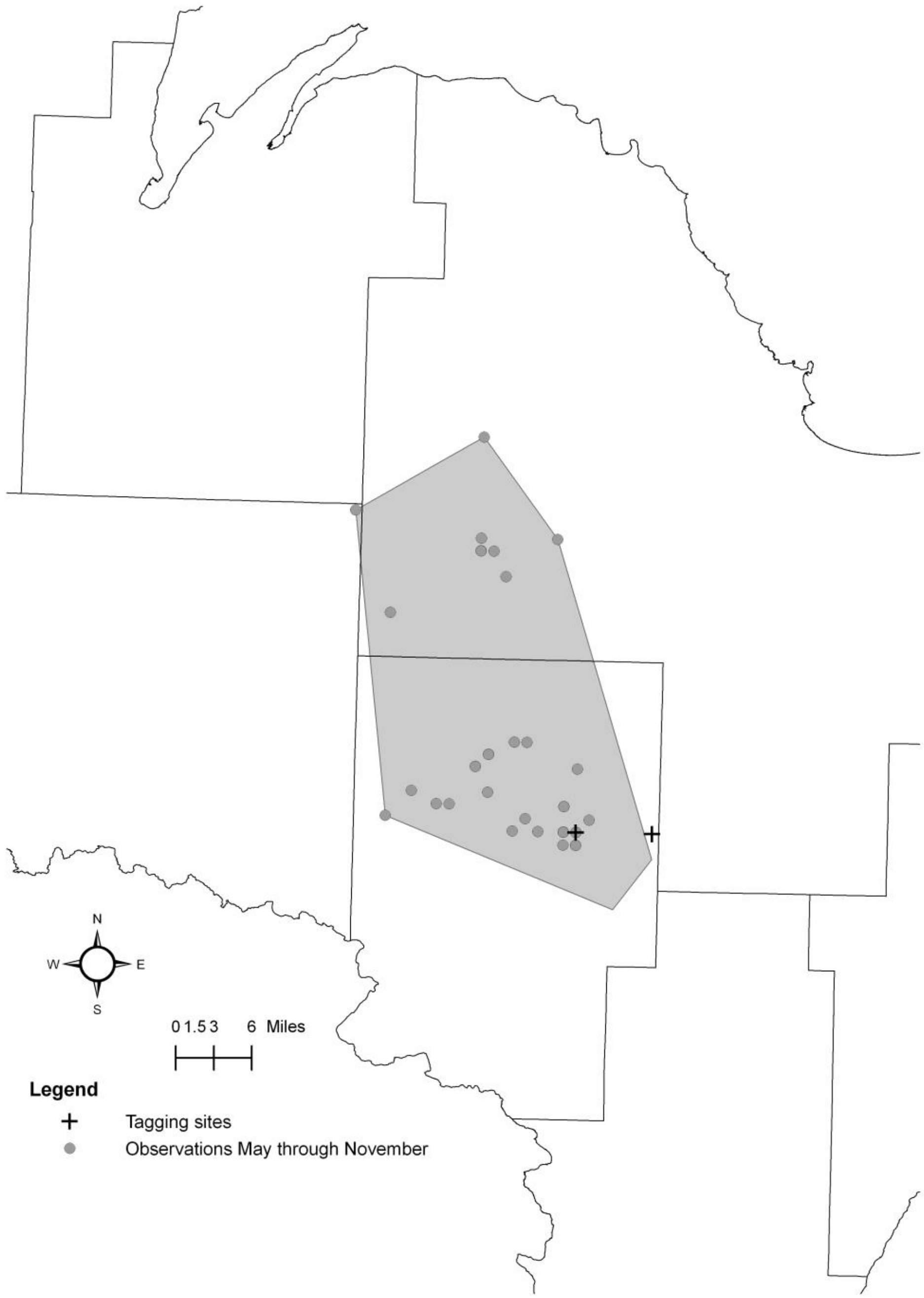

Figure 29. Observations of white-tailed deer ear-tagged in the Sturgeon River winter concentration area of Michigan's Upper Peninsula during 1997. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

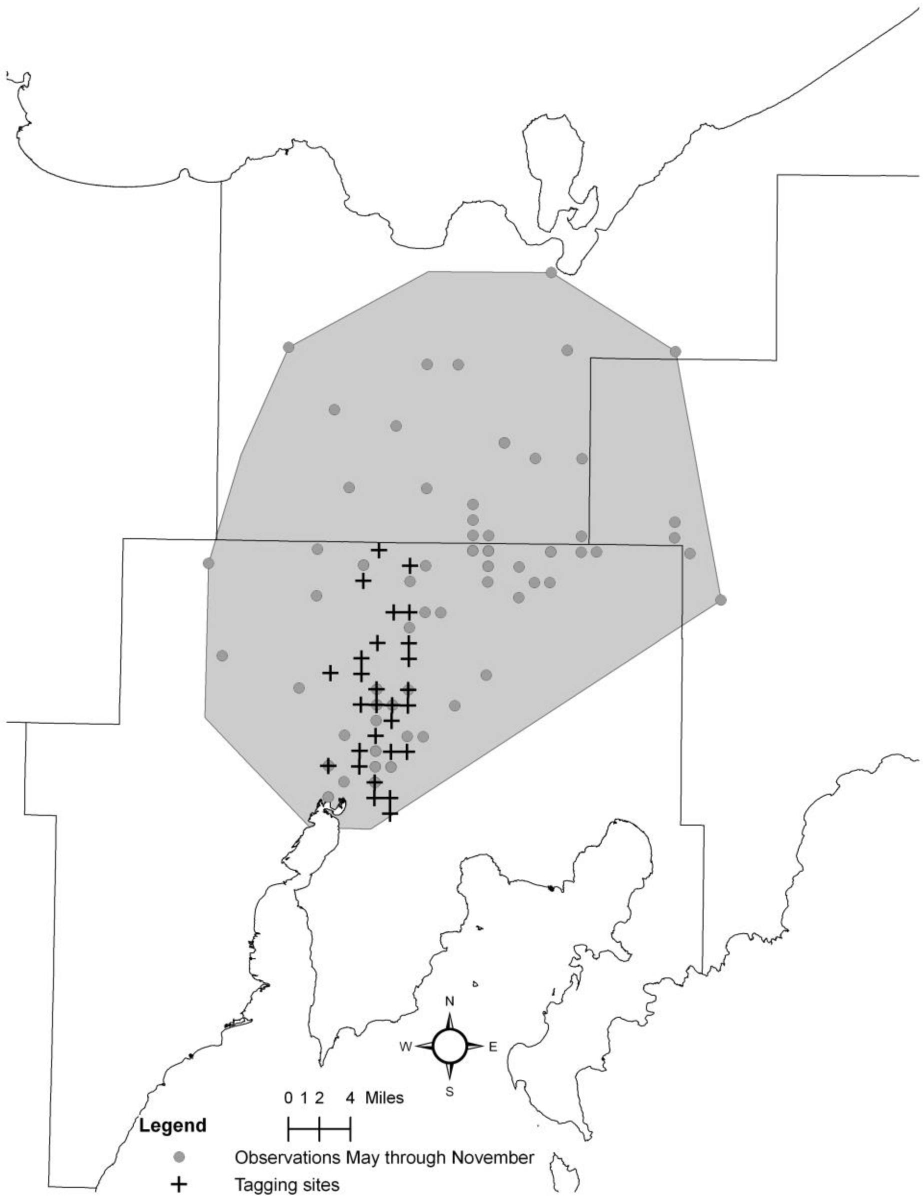

Figure 30. Observations of white-tailed deer ear-tagged in the Whitefish winter concentration area of Michigan's Upper Peninsula during 1991 to 1994. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.

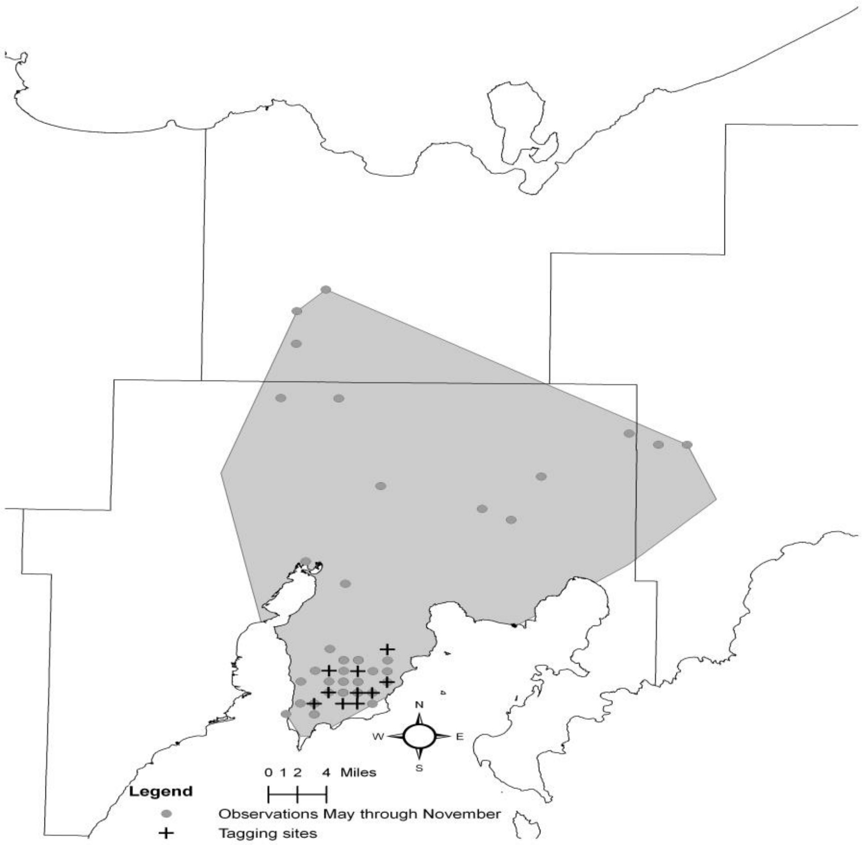

Figure 31. Observations of white-tailed deer ear-tagged in the Wilsey Bay winter concentration area of Michigan's Upper Peninsula during 1991 to 1994. Dots denote May-November observations and the shaded polygon encloses observations from all months of the year.