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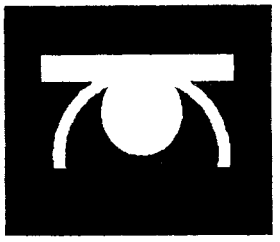

CENTER FOR WILDLIFE ECOLOGY

Illinois Forest Game Investigations

W-87-R-17

Final Report

by

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Illinois Natural History Survey

1 July 1994 through 30 June 1995

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Performance Report
Final Report

State: Illinois
Project No: W-87-R-17

Project Type: Research

Project Title: Cooperative Forest Wildlife Research

Sub-project: Illinois Deer Investigations

Period Covered: 1 July 1994 through 30 June 1995

Study No. 1; Title: Population dynamics and ecology of white-tailed deer in Illinois.

Study Objectives:

1. To assess the amount, distribution, and quality of white-tailed deer habitat in Illinois.

2. To relate spatial aspects of deer habitat to other important attributes such as hunter access, proximity to human habitation, and agricultural patterns.

3. To complete ongoing studies describing current natality rates, fawn recruitment, seasonal movements, and seasonal and annual mortality rates for previously marked deer in west-central and northern Illinois.

4. To develop interactive, menu driven, portable computer models and software packages to facilitate analysis of harvest data, predict effects of alternative harvest regimes, and help select appropriate strategies to achieve specific goals and objectives.

Job No. A; **Title:** Habitat inventory, classification, and analysis.

Objectives: (1) To investigate alternative techniques for classifying white-tailed deer habitat from remote sensing data; (2) To use these techniques and data sources to inventory deer habitat in Illinois; (3) To describe the habitat characteristics of sites selected by dispersing deer and to compare these characteristics with the habitats available within the boundaries of known dispersals from marking sites in northern, west-central, and east-central Illinois; (4) To develop HSI models for the purpose of assessing the relative quality of deer habitat using digital land use classifications from remotely sensed data and; (5) To integrate information relating to spatial distribution of habitat with other pertinent attributes relating to hunter success, human habitation, and agricultural patterns.

(a) Activity:
Job and reporting assigned to Dr. A. Woolf and J. Roseberry, Southern Illinois University, Carbondale.

(b) Target date of Achievement: 1 September 1995.

(c) Date of Accomplishment: On schedule.

(d) Significant Deviations: None.

(e) Remarks: None.

(f) Recommendations: None.

(g) INHS Costs: Federal--$11,778; State--$3,3926; Total--$15,704.

Job No. B; **Title:** Deer ecology and life history in west-central and northern Illinois.

Objectives: (1) To determine age specific natality and seasonal and annual survival rates of deer marked in west-central and northern Illinois; (2) To determine seasonal movement patterns and habitat selection of marked deer in west-central and northern Illinois; (3) To integrate these natality and survival data collected from this study within new population models of the Illinois deer herd.

(a) Activity:

Study areas

All study areas contained a mixture of public and private lands and included a wooded public park, which provided deer with abundant diurnal cover throughout the year, protection from severe winters, and refuge from firearm hunters. These core areas were surrounded by privately owned farms dominated by row crops. These farms provided relatively sparse winter cover and were usually open to archery and firearm hunting.

The 1,648-ha northern area (NOA) was in Dekalb County, only 1.6% forested in 1985 (Hahn 1987). The study area included Shabbona Lake Recreation area, a 479-ha public park surrounding a 128-ha lake. About 192 ha (40%) of the park was open to archery hunting. The study area consisted of 59% row crops, 14% second-growth hardwood forest, 7% reconstructed tallgrass prairie, 6% mixed species pine plantations, and 5% savanna; the remaining 9% consisted of a small suburban area, a golf course, and the lake. Deer densities averaged 10-12 per km^2 in late winter during our study.

The 5,942-ha west-central area (WCA) straddled the boundary between Brown and Adams counties, which were about 20% forested in 1985 (Hahn 1987). The study area included Siloam Springs State Park, which covers 1,329 ha. The study area consisted of 52% forest (8% open canopy successional forest <25 years old and 44%

closed canopy forest >50 years old), 39% row crops, 5% pasture or forage crops, and 3% tame hay fields or restored prairie. In 1990 and 1991, 79% (4,669 ha) of the study area was open to firearm hunting. In 1992, this increased to 91% (5,408 ha) as more public land was opened to controlled firearm hunting. Late winter deer densities varied from 12-25 deer per km^2 over the study area, averaging about 13 per km^2 on the state park and up to 25 per km^2 on the private farms.

For comparative purposes, we also include data collected 1980-85 on the Piatt County Study Area, east-central Illinois. This 2,953-ha area consisted of 64% row crops and 36% forest (22% upland and 14% bottomland forest). There was a 600-ha refuge from all hunting in the center of this area. Deer numbers averaged 4-6 per km^2 in late winter during our study (see Nixon et al. 1991 for more complete description of the Piatt County Study Area).

Capture and marking

Deer were livetrapped and marked using rocket propelled nets on the WCA (N = 230) and NOA (N = 122) between 1990 and 1994 (see APPENDIX 1 & 2 for a complete listing of all captures). All deer were aged as fawn, yearling, or adult using tooth replacement and wear, and were marked with numbered cattle-type plastic ear tags. A total of 60 deer (8 males, 52 females) and 32 deer (5 males, 27 females) were radio marked on the WC and NO areas, respectively. Females without radios were marked with plastic collars bearing fluorescent numbers.

Radio marked deer were located on the WCA using 2 truck-mounted, 8-element yagi antennas aligned in a null configuration. Each radio location was derived from 2 to 5 bearings taken from fixed locations scattered over the study area. Accuracy was established using transmitters placed in known locations throughout the area. Locations produced by radio fixes were validated using the computer program LOCATE 11 (Nams 1990). The small size and scattered nature of cover on the NO Illinois study area enabled deer to be radio located within the standard 1-ha

grid used for locating deer on our study areas using only a single antenna, a close approach, and direct observation.

Natality

On the WCA only, blood samples were collected from all does captured in 1990 and 1991 (68 does) and for fawn does only in 1992 and 1993 (25 does). Progesterone levels indicated that breeding activity among fawn does was low all 4 years and apparently declining (Table 1). Progesterone levels also indicated that all yearling and older does (N = 40) were pregnant when bled in 1990 and 1991.

Repeated observations of marked does allowed us to access annual breeding rates and fawn production by age class for marked does on both study areas. Breeding rates for fawn does differed among sites, from an average of 21% for west-central fawns to 70% for east-central fawn does ($G = 36.6$, $P<0.001$). As demonstrated by progesterone levels, observed breeding rates of fawns declined as the study progressed, from 50% (N = 4) in 1989 to 6% (N = 17) in 1992 (Table 2). Breeding rates of yearling and adult does did not differ among areas ($P>0.05$) (Table 2).

As described in a previous report(final report W-87-R-12,13,14), we do not believe natality rates found among fawn does on the WC study areas are typical of the WC region (Nixon et al. 1992). Grubaugh et al. (1988) found that 85% of fawns killed in highway accidents (N = 20) in west-central Illinois were pregnant. Their sample size was not large and it is likely their estimate of fawn breeding is too high for the region as a whole because this rate exceeds that of fawn does in both northern and east-central Illinois, where nutrition is optimum. It is true that dressed body weights of fawn does (29.6 kg) shot in west-central Illinois in 1991 were significantly lower ($F = 6.96$, 1,82 df, $P<0.01$) than doe fawn dressed weights in east-central Illinois (31.0 kg). Average weights from both areas were below the 36 kg body weight thought to be necessary for estrous to occur in fawn does (Verme and Ullrey 1984), yet nearly 70% of the doe fawns attain estrous at 6-7 months old in east-central Illinois. Blood protein levels were

actually higher ($P<0.05$) in west-central Illinois fawn does (mean = 6.0 ± 0.39 gm/dl) compared to east-central fawn does (mean = 5.1 ± 0.36 gm/dl) in the fall of 1991. We believe the reduced incidence of fawn breeding on our WC study area to be a physiological response to the higher number of yearling and older females present on this area compared to our other study areas. Average deer densities in winter were 3-4 times higher on the WCA compared with the ECA. Verme (1987) presented evidence of reduced breeding among doe fawns as deer numbers have increased in Ohio and Michigan, due to social domination of the fawns by their older female relatives. As noted in a previous report (Nixon et al. 1992), reductions in the incidence of fawn breeding have also been documented within several other refuge protected herds in Illinois.

We were able to estimate age specific fawn production and survival for each year based upon repeated observations of marked known-aged does and their fawns on each study area. Fawn recruitment to 1 year old was highest among does in east-central Illinois and lowest for does from west-central Illinois (Table 3). Adult breeders contributed most to fawn production each year, as a result of their greater numbers in the population and their higher individual production. The number of fawns seen per marked doe was significantly lower for west-central Illinois yearling ($F = 8.09$, 2,117 df, $P<0.01$) and adult ($F = 33.6$, 2,320 df, $P<0.001$) does compared with females in northern and east-central Illinois (Table 3). This reduction is not due to a reduced incidence of breeding among yearlings or adult does, but an apparent reduction in the number of live births per female as postpartum fawn survival appears to be comparable among regions (Table 3). Based on these data, there should be an average of 1.09, 1.10, and 1.35 fawns per doe present between January and late May on the NO, WC, and EC areas, respectively. These are the fawns that recruit into the yearling population each June.

Postpartum fawn losses were significantly higher for fawns born to 2-year old does 24%, ($G = 5.6$, 4 df, $P<0.025$) compared to those born to younger or older mothers. Surprisingly, primaparous

yearling mothers experienced the lowest loss of fawns (<10%) of the age classes examined. Older does (≥3 years) lost an average of 15.8% of their fawns in the west-central area, 19.7% on the northern area, and 13.8% on the east-central area before age 1.

Preweaned fawn losses (<4 months old) were higher than postweaning losses on the west-central (preweaned fawn loss = 61%) and northern (67%) areas but were lower compared with postweaning losses on the east-central area (preweaned fawn loss = 21%) ($G = 14.0$, 2 df, $P<0.01$). Fawn losses before weaning were not significantly different ($G = 2.4$, 4 df, $P>0.60$) among age classes of does (yearlings = 25%, 2-year = 43%, 3-year = 46%, 4-year = 56%, and 5-year = 30%) but were different among years ($G = 18.2$, 7 df, $P<0.02$), ranging between 11 and 82% of the total annual fawn mortality.

The loss of 1 or more fawns was not indicative of a higher probability that a doe would loss fawns in subsequent years ($X^2 = 0.01$, 1 df, $P>0.95$). On the northern study area, 2 of 13 does lost fawns in consecutive years, 9 of 13 lost 1 or more fawns during 1 of the 3 years of study, and 2 does lost no fawns during the study. Of 33 does monitored more than 1 year on the east-central area, only 3 does lost fawns in consecutive years, 18 lost fawns in at least 1 year, and 12 does lost no fawns during the 6-year study. On the west-central area, 5 does lost fawns in consecutive years, 15 lost at least 1 fawn during 1 year, and 13 raised all their fawns to 1 year of age during the 3-year study.

Fawn deaths prior to weaning were likely the result of predation, nutritional failures early postpartum, or if the doe was <3 years old and socially subordinate, the inability to rescue fawns that strayed into parturition areas of older, more dominant females (Mech 1984, Verme 1969, Ozoga et al. 1982). Fawn deaths after weaning were almost entirely harvest-related or the result of highway accidents. Fawn deaths due to severe winter weather are almost unknown in Illinois (Nixon et al. 1991).

Daughters usually move farther away from their mother's parturition range at age 22-24 months to give birth and for the first time since birth must protect themselves and their offspring

without kin support (Ozoga et al. 1982). Based on observations from all 3 study areas (N = 1,225), the frequency of association (number of times seen together / sum of all observations of both individuals [Hawkins and Klimstra 1970]) of mothers and daughters declined from 42% when daughters were yearlings to 24% when daughters were 2 years old ($G = 44.0$, 1 df, $P<0.001$). Year-to-year overlap of parturition ranges for the same doe increased from an average of 27 $\pm$ 3.9% (N = 15 does) between yearling and 2 years of age to an average of 43 $\pm$ 3.7% (N = 22) overlap of parturition ranges for does between 2 and 3 years old ($F = 7.8$, 1,35 df, $P<0.01$), as does settled on a permanent parturition range.

The higher mortality for fawns born to 2-year old mothers appears to relate more to social behaviors relating to loss of support by matriarchal does than to differences in habitat selection or in movement to areas where the hazard to fawns from hunting and highway accidents would be higher (see APPENDIX 3 for more discussion of maternal age and fawn survival).

Survival

Survival rates and cause specific mortality were calculated using the program MICROMORT (Heisey and Fuller 1985). All marked deer whose fate was known (>90% of all marked deer that survived capture) were used to determine survival. Seasonal and annual survival rates were compared among years and areas using a Z-statistic.

For purposes of analyzing annual survival patterns of both sexes, the year was divided into periods bounded by important behavioral or physiological changes that potentially affect survival. The male year was divided into prebreeding, breeding and postbreeding periods. The prebreeding period (15 April-30 September) was a time of weight gain and antlerogenesis. During breeding (1 October-15 January), males were searching for and defending access to estrous females. Human predation was high, and most of the annual mortality occurred during this time. During the postbreeding period (16 January-14 April), males attempted to regain body condition lost during breeding, antlers were shed, and

social ties with other males were reestablished. The female year was divided into parturition and early postpartum (16 May-15 July), prebreeding (16 July-30 September), breeding (1 October-15 January), and postbreeding (16 January-15 May) periods.

Yearling females averaged lower annual survival ($P<0.05$) compared to adults each year of study (Tables 4 & 5). Adult females survived better ($P<0.05$) during 1992 on the NOA and on the WCA during 1993 (Table 5). Yearling females survived better than yearling males on the NOA, but not on the WCA. Adult females survived better ($P<0.01$) than adult males on both study areas. Hunting and associated wounding contributed most to annual mortality among females and yearlings were more vulnerable to both archery and firearm hunting and also to auto accidents compared to adult does (Tables 4 & 5). Both study areas showed higher annual survival ($P<0.05$) for both yearlings (averages were NO = 0.74; WC = 0.0.73) and adults (NO = 0.85; WC = 0.87) during 1990-92 compared with females marked during 1980-85 in east-central Illinois (averages were yearlings = 0.62; adults = 0.71) (Nixon et al. 1991). This difference was due to higher harvest related mortality of does in east-central Illinois. Annual survival was not significantly reduced ($P>0.10$) for dispersing females compared with females that remained as residents on either study area.

Male survival rates are reported in more detail in APPENDIX 4. For yearling males, seasonal and annual survival rates were calculated separately for males that dispersed and those that remained on or close to their natal range in EC, WC, and NO Illinois (APPENDIX 4, Table 7). Survival was high and similar ($P>0.10$) for males marked on all study areas during the prebreeding (>95%) and postbreeding (>81%) periods. Survival during the breeding period was reduced ($P<0.01$) for males dispersing from our WC and EC study areas, but was not different for males marked on the NO study area. Annual survival of dispersing males was significantly reduced ($P<0.02$) compared to the annual survival of sedentary yearling males on all study areas (APPENDIX 4, Table 7).

More recent data available from the NOA have indicated that average annual adult male survival was overestimated as 0.87 in Table 8, APPENDIX 4. The corrected average annual survival of adult males marked on the NOA averaged 0.68 for 1990-93, close to annual averages reported in APPENDIX 4 for the WC (average = 0.66) and EC (0.65) areas.

Survival of males ≥2 years old was significantly better ($P<0.05$) than that of yearling males that dispersed from the EC and NO study areas, but it was similar ($P>0.10$) to survival of dispersing yearling males on the WC study area and sedentary yearlings on all 3 areas (APPENDIX 4, Tables 7 & 8). Mature males were somewhat more vulnerable to firearm hunting than archery hunting, the reverse of yearling males (APPENDIX 4, Tables 7 & 8).

These data indicate that survival of both sexes is quite high in EC, WC, and NO Illinois. Yearling females averaged >70% and adult females >80% annual survival during 1990-93. Yearling males that remained on or close to their natal ranges averaged >65% annual survival while dispersing yearling males averaged better than 50% annual survival. Adult males (≥2 years old) averaged about 65% survival per year during the study. Because hunting related deaths accounted for >90% of the annual mortality, current hunting pressures appear to be cropping about 20% of the adult females, 30% of the yearling females, 35-50% of the yearling males, and about 35% of the adult males. For males, current survival rates indicate that , for each 100 yearlings alive 1 October, <10 will reach the age of 5 years.

Our marking studies have allowed us to estimate the extent of deer deaths due to wounding by archery and firearm hunters. For archery hunters the ratio of wounding losses to legally reported deaths were: Yearling males = 8 wounded and killed for 28 legally reported (28.5%); Yearling females = 4 wounded for 8 reported taken (50%); Adult males = 5 wounded for 12 taken (42%); Adult females = 10 wounded for 12 reported killed (83%). The archery hunter ratios of wounded to legally taken deer would be about 3:1 for yearling males, 2:1 for yearling females, nearly 2:1 for adult males, and nearly 1:1 for adult females.

Firearm hunters wounded and lost a lower proportion of the deer hit by gunfire; Yearling males = 8 wounded and killed for 29 reported killed (28%); Yearling females = 5 wounded for 17 killed (29%); Adult males = 6 wounded for 27 killed (22%); Adult females = 9 wounded for 26 reported killed (35%). For firearm hunters a ratio of 1 wounded deer lost for 3 legally taken appears to hold for yearlings of both sexes and adult females. For adult males, the ratio falls to about 1 wounded for 4 legally taken, perhaps the result of a more intensive search by hunters for the large antlered adult males.

Dispersal

Dispersal behavior of both sexes was extensive on both study areas. The data summarizing male dispersal from our study areas is presented in APPENDIX 4, Pages 11-14, and will not be repeated here.

For females, dispersal behavior usually occurred in the spring at age 10-12 months and coincided with family breakup and the search for a parturition site if the fawn/yearling was pregnant or, if barren, a search for a site to minimize harassment from older females (Table 6). An average of 44% (15/34) marked yearling females dispersed from the NO study area and 22% (11/49) from the WC area ($G = 3.36$, $P<0.10$). Overall, male dispersal from these areas was significantly higher than female dispersal ($G = 24.24$, $P<0.001$).

Females marked on the NO study area dispersed an average of 38 ± 3.6 km ($N = 15$). All but 3 of these deer traveled east toward the metro-Chicago area, for no apparent reason as more forests were located south and west of the study area. Fourteen females dispersing from the WC area also averaged 38 ± 7.8 km and also tended to travel eastward (9 of 14). Proportionally more females dispersed from the ECA (50%) compared with the WCA (31%) or the NOA (42%) (Table 6). The proportion of female fawns dispersing from each area was not correlated ($P>0.10$) with the number of yearling and older females present on each area but may instead relate to the amount of permanent cover available in the spring

before field crops mature and provide cover. Females need cover to protect fawns from predators and other deer and such cover was relatively scarce in northern and EC Illinois (<5% of the landscape). The reproductive state of the fawn (whether pregnant or barren in the spring) also did not influence dispersals from our study areas ($P>0.05$).

A few females dispersed from our study areas at age 22-23 months. On the ECA 9 of 43 (21%), on the WCA 3 of 19 (16%), and on the NOA 3 of 12 (25%) marked yearling females either migrated seasonally or dispersed away from the study areas. All these females were pregnant when they dispersed and may have moved to locate a parturition site away from their mother for either their first (if barren as fawn) or second pregnancy. Two-year old females usually separate from their mother for the parturition and early fawn rearing periods (Ozoga et al. 1982).

Yearling males were more likely to die during a dispersal movement than were yearling females because males often dispersed in the fall during the hunting season while females only dispersed in the spring. For yearling females marked on both study areas ($N = 30$), only 3 (10%) died during a dispersal. For yearling males, 12 died during dispersal ($N = 50$), with most of these deaths occurring in the fall from hunting related causes (10/12). Annual survival was similar ($P>0.10$) for females that dispersed and those that remained sedentary on or close to their natal ranges after family breakup.

The effects of orphaning on dispersal movements, local movements, and survival were examined for 14 females (13 fawns, 1 yearling), either accidentally or intentionally orphaned, and compared with similar statistics for 108 non-orphaned females. Dispersal rates were higher ($P = 0.006$) for female orphans than for non-orphans. Ten of 14 (71%) orphans dispersed in spring or early summer. In contrast, only 36 of 108 (33%) non-orphans dispersed away from their natal range. The results of this study are more extensively discussed in APPENDIX 5, "Emigration and Survival of Orphaned Female Deer in Illinois".

Local movements

Northern Illinois--Seasonal home ranges were calculated for radio marked deer on both study areas using computer programs HOME RANGE (Ackerman et al. 1990) and RANGES IV (Nams 1990). Seasonal core areas were determined for each deer with a minimum of 19-20 acceptable radio fixes using the Harmonic Mean Estimator (Boulanger and White 1990). Home ranges and other local movements of males are summarized in APPENDIX 4, Pages 6-9.

Core home range size of females in northern Illinois varied considerably throughout the year ($F = 13.07$, 3,99 df, $P<0.01$), being larger during the postbreeding season and smallest during the parturition period (Table 7). The mean distance from the arithmetic center of activity to each radio fix (a measure of daily movement) summarized for all does each season also varied by season ($F = 12.9$, 3,99 df, $P<0.01$) in a similar fashion. Females were most active during postbreeding (516.5 $\pm$ 33.5 m) and least active during parturition and early postpartum (241.6 $\pm$ 14.3 m). The postbreeding period of midwinter-early spring for females is a time of stable social relationships, with related females associating together in clans and sharing the home ranges of the females in the group. Without the responsibilities of protecting and nurturing fawns, and the need to stabilize or gain weight to support a pregnancy 3-4 months into the gestation period, females are free to wander more freely than at other periods during the year. In contrast, females are restricted in movements during the parturition-early postpartum period, protecting neonates from predators and other deer.

West-central-- As demonstrated for does in northern Illinois, home range size varied ($P<0.01$) among seasons in west-central Illinois. Average parturition and prebreeding home ranges were nearly identical for the 2 regions (Table 7). Breeding status (whether pregnant or barren) did not influence home range size ($P>0.05$) during the parturition-early postpartum period although barren does did have somewhat larger ranges (barren = 31 ha; pregnant = 23 ha).

The west-central study area provided an opportunity to examine the importance of farm crops to deer in Illinois. One portion of the study area included Siloam Springs State Park, a forested area with few farm fields. Park does averaged larger ranges than does marked off the Park (Park = 46 ± 4 ha; Farmland = 32 ± 4 ha $P<0.02$). This difference may be attributed to the distances Park does had to travel to reach farm fields compared to farmland dwelling does. Park deer often bedded during the day in the Park forests and then traveled up to 1-2 km outside the Park to farm fields at night.

Analysis of variance for distances measured between arithmetic centers of activity (a measure of site fidelity between years for individual does) found no significant difference ($P>0.05$) among age classes (between 1 and 2, 2 and 3 etc.) or seasons. In general, these distances declined somewhat with age (for example, from an average of 188 ± 111 m between ages 1 and 2 years to 165 ± 176 m between ages 3 and 4 years for the parturition period) as does became more faithful to their home ranges.

Another measure of site fidelity involves measurement of the percent overlap of home ranges among seasons for individual does using the 100% harmonic mean calculation of home range size. Overlap differed among seasons ($F = 8.01$, 2,275 df, $P<0.001$) for all does and within seasons for related does ($P<0.001$) (Table 8). The postbreeding period exhibited the greatest overlap, a time of intermingling of both related and strange deer on localized feeding sites, and parturition the least overlap, when does are alone with their fawns. Among years, home range overlap differed for individual years for the breeding and postbreeding periods ($P<0.04$) (Table 8).

Ranges of barren yearling does overlapped more with relatives (78%, N = 14) than did ranges of pregnant adults (60%, N = 31). This difference was due to larger ranges of barren does during the parturition period compared to does with fawns (more likely to include more of the ranges of relatives), and the sharing of parturition ranges by mothers and daughters during parturition.

Habitat preference

Habitat preferences were compared for radio marked deer on each area. A 1-ha grid overlay of these areas was mapped into 1 of 7 (northern) or 1 of 6 (WC) vegetative types. Radio locations of each deer were placed within 1-ha grids overlaying the study areas and compared with the total home range (available habitat) encompassed by each deer during the life of the radio or deer. Habitat selections were compared with available habitat for each deer and tested for independence using chi-square analysis. Nondispersing yearling males in Illinois did not occupy habitats separate from does and fawns during the prebreeding period, as occurred with adult males, but continued to frequent habitats favored as parturition sites by resident females. Six of 7 and 12 of 14 radio-marked yearling males remained on summer ranges that overlapped those of several nursing females on the EC and NO study areas, respectively. On the EC area, prebreeding yearling males selected oak-hickory forest and avoided row crops in summer, with other habitats used in accordance with abundance, a pattern similar to females.

During the breeding season in EC Illinois, yearling males selected both upland and bottomland forest and avoided crop fields, again areas favored by does and fawns in the fall. During postbreeding, yearlings avoided crop fields and selected upland successional forest (<60 years old) and bottomland forest where cover was abundant.

In late spring into summer, adult males on the EC and NO areas moved from postbreeding ranges shared with does, fawns, and yearling males to areas dominated by agricultural crops or bottomland forests. About half of our marked males moved to their summer range prior to the onset of antlerogenesis and half after antler growth was well under way. For 6 adults on the ECA and 3 on the NOA, these movements averaged 1.2 and 0.65 km, respectively. Adult males often remained in crop fields for extended periods during summer. Without the constraints of fawn nurturing imposed on females, males were not required to make periodic returns to

permanent cover. Of 8 adult males radio- tracked on the EC site, 5 averaged >70% of their summer ranges in row crops, mainly maturing corn. During fall breeding and winter postbreeding, males occupied habitats similar to those occupied by females.

In summer in Illinois, we believe adult male whitetails seek to maximize nutrient intake by exploiting landscapes avoided by other sex-age classes. Males are apparently less adaptable to food competition than females (Clutton-Brock et al. 1982, Clutton-Brock et al. 1987), and their growth patterns appear to be more habitat-specific than growth patterns of females (Leberg et al. 1992). There is no evidence that the landscapes selected by males in summer in Illinois provide a less nutritious diet than is available to females, but such sites are free of female competition. This segregation by habitat allows males to rapidly gain weight and develop large, damage free antlers and females to locate where there was less risk of predation to neonates. See APPENDIX 4, for further discussion of seasonal habitat selections among males.

Northern Illinois--On the northern area, only diurnal selection or avoidance of habitats ($P<0.05$) were determined for radio-marked females ($N = 11$) as little radio tracking occurred at night. For the parturition and early postpartum period, females selected restored prairie (5 of 11), successional forest (<60 years) (7 of 11), and oak-hickory forest (4 of 11) and avoided row crops (7 of 11). For the prebreeding period, females also avoided row crops (7 of 11), selected successional forest (8 of 11), as well as prairie and oak-hickory forest (both 3 of 11). During the breeding and postbreeding periods, does selected oak-hickory forest (4 of 11), prairie (3 of 11), successional forest (3 of 11), pine plantations (2 of 11), and avoided crops (4 of 11).

West-central--During postbreeding, 6 of 13 does differed ($P<0.05$) in habitat use, four of 13 selected grassland, 3 avoided row crops, 2 selected row crops, and single does selected or avoided early successional forest and oak-hickory. During

parturition, 13 of 29 does showed a significant difference from the available habitat, with 6 avoiding early successional forest, 5 selecting early successional forest, 5 selecting grassland, 4 selecting oak-hickory forest, 4 avoiding grassland, and 2 avoiding oak-hickory forest. During summer, 10 of 25 does selected row crops, usually corn, 8 does avoided grassland, and 5 avoided early successional forest. Two adult does that selected grassland for parturition avoided grassland during the postpartum period. The use of corn away from forest cover may provide deer with some relief from biting insects that are very abundant in forest understories (Nixon et al. 1991). Fourteen of 31 does with fawns and 2 of 4 barren yearling does differed from expected frequencies of available habitats during breeding. Six selected grassland, 5 avoided grassland, 4 selected row crops and 4 avoided row crops, 3 selected successional forest and 3 avoided this same habitat, 3 avoided oak-hickory forest, and 2 selected oak-hickory.

These often contradictory selections and avoidance of particular habitats are not unexpected given the generalist nature of habitat selection by white-tailed deer throughout it's continental range. Selection or avoidance of a particular habitat probably depends as much on social relationships and social position in the dominance hierarchy as on selection or avoidance decisions based on nutrition or cover needs. Whitetails in Illinois can locate a nutritious diet in nearly all habitats available, winter or summer. The effect of habitat on fawn rearing success as affected by maternal age also seems to be contradictory, with does seemingly using all available habitats as parturition sites (see APPENDIX 3 for a more complete discussion of habitat selection pre- and postpartum by doe age class).

(b) Target date of Achievement: 1 September 1994.

(c) Date of Accomplishment: On schedule.

(d) Significant Deviations: None.

(e) Remarks: We have met the objectives of this job: to determine age specific natality and seasonal and annual survival rates, to determine habitat selections and movement patterns of both sexes for deer in WC and NO Illinois, and to provide these data to the IDOC and others for use in population models of the Illinois deer herd. Natality and survival data generated by these marking studies are currently being used in the new population computer model developed for the Illinois deer herd under Job NO. C, of this study.

(f) Recommendations: Current survival rates for marked deer on the study areas in west-central and northern Illinois indicate females are still being underharvested in the 1990's if the management goal includes stabilizing or reducing the size of the Illinois deer herd. Current mortality rates of adult females are generally <25% per year, far below the >30% level needed to slow the rate of increase in deer numbers. Statewide, prehunt deer numbers appear to be near 600,000 and farmers' response to resulting deer damage to crops may need to be monitored.

Because of the growing deer population, density dependent effects are becoming more evident on overcrowded public lands and some private refuges. Natality rates are declining on these areas, the result of high survival of females and the formation of extended families of does on these areas. Nutrition continues to be adequate on these areas as demonstrated by the continued high natality of yearling and older does because deer in Illinois derive much of their foods from farm fields. Maternal domination of fawn does apparently depresses reproductive activity through increased biosocial interactions caused by high doe densities (Verme 1987). This effect was present on the WC study area throughout our study and similar observations have been noted at several other sites in Illinois. Only removal of a higher proportion of females will improve doe fawn natality on these areas.

Future research efforts should include a determination of optimum deer population levels for public lands in Illinois. Deer

numbers must be held at levels that minimize farmer complaints and damage to vegetation, while at the same time providing for the opportunity to view deer in a natural setting, providing deer for hunting recreation, and, because of the importance of dispersing deer to hunting opportunities on surrounding private lands, protecting enough does to ensure sufficient dispersing fawns to restock hunted areas. It will not be easy to determine what optimum levels are or how they can be realistically maintained. Regulation of deer numbers will depend on management flexibility as the methods used to manage deer will likely vary from area to area , and it will be impossible to completely satisfy all the often conflicting viewpoints generated by deer throughout Illinois. But such research would certainly help the IDOC to manage the deer based on research data, not opinion, the only position that can hope to reconcile groups as diverse as PETA and Illinois' sportsman's groups.

(g) INHS Costs: None.

Job No. C.; **Title:** Population Analysis

Objectives: (1) To develop interactive, menu-driven, portable computer models and software packages to analyze population data, model herd performance, and predict outcome of alternative harvest strategies on herd size, herd composition, and hunter behavior and success; and (2) To assist the IDOC in integrating this system into their deer management program.

(a) Activity:
Job and reporting assigned to Dr. A. Woolf and J. Roseberry, Cooperative Wildlife Lab, Southern Illinois University, Carbondale.

(b) Target Date of Accomplishment: 1 September 1995.

(c) Date of Accomplishment: On Schedule.

(d) Significant Deviations: None.

(e) Remarks: None.

(f) Recommendations: None.

(g) INHS Costs: Federal--$11,778; State--$3,926; Total--$15,704.

Job No. D ; **Title:** Analyze and Report.

Objectives: (1) To analyze results and prepare products from Jobs A-C; and (2) To report and discuss findings and present products in a timely manner.

(a) Activity: Project summaries, an annual report of progress, and quarterly reports of progress were submitted to the funding agencies as required. Various topics dealing with deer hunting and life history and ecology were reported to the IDOC as requested.

Presentations discussing deer ecology in Illinois were given before various groups during the segment. Numerous queries from the press regarding deer ecology and life history were answered and ongoing discussions were held with IDOC personnel regarding deer herd management.

The following manuscripts were published during this study:

Nixon, C.M., and D.R. Etter. 1995. Maternal age and fawn rearing success for white-tailed deer in Illinois. Amer. Midl. Naturalist 129:290-297. (See APPENDIX 3, 10 extra copies included with this report).

Etter, D.R., C.M. Nixon, J.B. Sullivan, and J.A. Thomas. 1995. Emigration and survival of orphaned female deer in Illinois. Canadian J. Zoology 73:440-445. (See APPENDIX 5, 10 extra copies included with this report).

*Nixon, C.M., L.P. Hansen, P.A. Brewer, and J.E. Chelsvig. 1992. Stability of white-tailed doe parturition ranges on a refuge in east-central Illinois. Canadian J. Zoology 70:968-973.

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*Morgan, G.W., C.M. Nixon, J.C. Van Es, and J.H. Kube. 1992. Attitudes of Illinois farmers regarding deer and deer hunters, 1990. Tech. Bull. 6. Ill. Dept. Conservation, Springfield. 24pp.

*Nixon, C.M., L.P. Hansen, P.A. Brewer, J.E. Chelsvig, J.B. Sullivan, T. Esker, R. Koerkenmeier, D.R. Etter, J. Cline, and J. A. Thomas. 1994. Behavior, dispersal, and survival of male white-tailed deer in Illinois. Biological Note 139. Illinois Natural History Survey, Champaign. 30pp (APPENDIX 4).

***10 extra copies were included in the 1994 Annual Report for this study.**

The following reports are currently undergoing either internal or external review:

Hansen, L.P., C.M. Nixon, and J. Beringer. Role of refuges in regional deer population dynamics in the agricultural Midwest. This paper will be published by the Smithsonian Institution. (See APPENDIX 6 for Abstract).

Etter, D.R., C.M. Nixon, and J.B. Sullivan. Site fidelity and spatial relationships among sedentary female white-tailed deer in agricultural west-central Illinois. (See APPENDIX 7 for Abstract).

(b) Target Date of Achievement: 1 September 1995.

(c) Date of Accomplishment: On Schedule.

(d) Significant Deviations: None.

(e) Remarks: None.

(f) Recommendations: None.

(g) INHS Costs: Federal--$7,500; State--$2,500; Total--$10,000.

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DATE: 1 August 1995

Table 1. Number of fawn does breeding on the west-central study area based on progesterone levels in blood sera collected from does captured in January-March 1990-1993

Year	No. Does Examined	No. Does Breeding	Percent Breeding
1990	8	3	38
1991	20	3	15
1992	17	1	6
1993	7	0	0
Total	52	7	13

Table 2. Fawn production on 3 study areas in Illinois based on repeated observations of marked does postpartum. Number of does and number of fawns shown in parenthesis.

Year	Breeding Age: 6-8 Months Percent Breeding	6-8 Months No. Fawns/ Breeding Doe	18 Months Percent Breeding	18 Months No. Fawns/ Breeding Doe	30+ Months Percent Breeding	30+ Months No. Fawns/ Breeding Doe
			NORTHERN			
1989	100	1.0	100	2.0	100	1.67
	(3)	(3)	(2)	(4)	(3)	(5)
1990	25	1.0	100	1.33	100	1.83
	(4)	(1)	(6)	(8)	(6)	(11)
1991	78	1.0	100	2.00	100	1.77
	(9)	(7)	(7)	(14)	(13)	(23)
1992	70	1.0	100	1.80	100	1.63
	(10)	(7)	(10)	(18)	(19)	(31)
1993	--	--	0.88	1.71	0.96	1.91
			(8)	(12)	(24)	(44)
Means	69	1.0	0.97	1.75	0.98	1.78
	(26)	(18)	(33)	(56)	(65)	(114)
			WEST-CENTRAL			
1989	50	1.0	100	1.20	0.91	1.40
	(4)	(2)	(5)	(6)	(11)	(14)
1990	43	1.16	0.85	1.00	0.92	1.67
	(14)	(7)	(7)	(6)	(26)	(40)
1991	15	1.00	100	1.40	0.97	1.62
	(26)	(4)	(15)	(21)	(41)	(65)
1992	6	1.00	100	1.55	0.97	1.64
	(17)	(1)	(9)	(14)	(32)	(51)
1993	--	--	100	1.62	100	1.70
			(8)	(13)	(30)	(51)
Means	21	1.08	0.98	1.39	0.96	1.64
	(61)	(14)	(44)	(60)	(140)	(221)

Continued.

Table 2. Page 2.

			EAST-CENTRAL			
1980	83	1.00	100	1.33	100	1.80
	(6)	(5)	(3)	(4)	(5)	(9)
1981	92	1.18	100	1.83	100	2.17
	(12)	(13)	(6)	(11)	(6)	(13)
1982	64	1.14	100	1.87	100	2.08
	(11)	(8)	(8)	(15)	(13)	(27)
1983	78	1.00	100	1.78	100	2.11
	(9)	(7)	(9)	(16)	(26)	(55)
1984	60	1.11	100	1.71	100	1.96
	(15)	(10)	(7)	(12)	(27)	(53)
1985	58	1.14	100	1.71	100	1.97
	(12)	(8)	(7)	(12)	(32)	(63)
1986	--	--	100	1.75	100	2.00
			(4)	(7)	(15)	(30)
Means	70	1.09	100	1.75	100	2.02
	(65)	(46)	(51)	(77)	(124)	(250)

Table 3. Fawn production and recruitment to 1 year postpartum on 3 sites in Illinois.

	BREEDING AGE IN MONTHS								
	5-8			16-18			28+		
	NO	WC	EC	NO	WC	EC	NO	WC	EC
No. Does	32 [a]	33	37	20	20	20	48	47	43
% Breeding	69	85 [b]	76	97	98	100	98	96	100
Does Breeding	22	28	28	19	20	20	47	45	43
Fawns/doe	1.0	1.08	1.13	1.75	1.39	1.82	1.78	1.64	2.1
Total Fawns	22	30	32	33	28	36	84	74	90
Fawn deaths to 1 year	2	-- [c]	3	10	7	7	17	12	13
Fawns Recruited	20	--	29	23	21	29	67	62	77
Recruited Fawns/doe	0.62	--	0.78	1.15	1.05	1.45	1.39	1.32	1.79

[a] Regional age structure on 1 June provided by J. Roseberry, SIU-Carbondale.

[b] Fawn breeding rate for WC region from Grabaugh et al.(1988).

[c] No data.

Table 4. Survival and cause specific mortality rates of yearling females marked in Northern (NO) and West-central (WC) Illinois, 1990-92.

Year	Season	Location	Deer Days	No. Deaths	Survival	95% C.I.	Cause of Death					
							Auto	Archery	Firearm	Archery Cripple	Firearm Cripple	Misc. [b]
1990	Postbreed [a]	WC	732	0	1.00	–	–	–	–	–	–	–
	(119 days)	NO	714	0	1.00	–	–	–	–	–	–	–
1991		WC	1,064	1	0.89	0.72-1.00	–	–	–	–	–	0.11
		NO	714	0	1.00	–	–	–	–	–	–	–
1992		WC	2,739	1	0.96	0.88-1.00	0.04	–	–	–	–	–
		NO	1,309	0	1.00	–	–	–	–	–	–	–
1993		WC	1,666	0	1.00	–	–	–	–	–	–	–
		NO	1,547	1	0.92	0.79-1.00	0.08	–	–	–	–	–
1990	Parturition	WC	496	0	1.00	–	–	–	–	–	–	–
	(60 days)	NO	420	0	1.00	–	–	–	–	–	–	–
1991		WC	1,364	0	1.00	–	–	–	–	–	–	–
		NO	720	0	1.00	–	–	–	–	–	–	–
1992		WC	1,245	1	0.95	0.86-1.00	–	–	–	–	–	0.05
		NO	1,020	2	0.89	0.75-1.00	0.11	–	–	–	–	–
1990	Prebreed	WC	616	0	1.00	–	–	–	–	–	–	–
	(77 days)	NO	539	0	1.00	–	–	–	–	–	–	–
1991		WC	1,694	0	1.00	–	–	–	–	–	–	–
		NO	924	1	0.93	0.82-1.00	0.06	–	–	–	–	–
1992	Prebreed	WC	1,540	0	1.00	–	–	–	–	–	–	–
		NO	1,155	0	1.00	–	–	–	–	–	–	–

Continued.

Table 4. Page 2.

1990	Breed	WC	905	2	0.79	0.57-1.00	–	–	0.21	–	–	–
	(107 days)	NO	749	2	0.75	0.50-1.00	–	0.12	0.13	–	–	–
1991		WC	2,106	4	0.82	0.67-1.00	–	0.05	0.09	0.04	–	–
		NO	1,177	2	0.83	0.65-1.00	–	0.08	–	0.09	–	–
1992		WC	1,824	6	0.70	0.53-0.93	0.05	0.05	0.20	–	–	–
		NO	1,605	1	0.93	0.82-1.00	0.07	–	–	–	–	–
1990	Annual	WC	2,749	2	0.77	0.53-1.00	–	–	0.23	–	–	–
		NO	2,422	2	0.74	0.48-1.00	–	0.13	0.13	–	–	–
1991		WC	6,228	5	0.75	0.58-0.96	–	0.10	0.10	0.05	–	–
		NO	3,535	3	0.73	0.52-1.00	0.09	0.09	–	0.09	–	–
1992		WC	7,352	8	0.67	0.51-0.88	0.08	0.04	0.17	–	–	0.04
		NO	5,089	4	0.75	0.56-0.99	0.25	–	–	–	–	–

[a] Postbreed - 16 January-15 May; Parturition - 15 May-15 July; Prebreed - 16 July-30 September; Breed - 1 October-15 January.

[b] Includes drowning, poaching, fences, trains, canine predation, and nuisance removal.

Table 5. Survival and cause specific mortality rates for adult females marked in Northern (NO) and West-central (WC) Illinois, 1990-92.

Year	Season	Location	Deer Days	No. Deaths	Survival	95% C.I.	Cause of Death					
							Auto	Archery	Firearm	Archery Cripple	Firearm Cripple	Misc.
1990	Postbreed	WC	1,536	0	1.00	–	–	–	–	–	–	–
	(119 days)	NO	595	0	1.00	–	–	–	–	–	–	–
1991		WC	4,359	1	0.97	0.92-1.00	–	–	–	–	–	0.03
		NO	1,119	0	1.00	–	–	–	–	–	–	–
1992		WC	6,181	1	0.98	0.94-1.00	0.02	–	–	–	–	–
		NO	2,380	0	1.00	–	–	–	–	–	–	–
1993		WC	7,731	1	0.99	0.96-1.00	–	–	–	–	–	0.01
		NO	2,499	1	0.95	0.87-1.00	0.05	–	–	–	–	–
1990	Parturition	WC	1,550	0	1.00	–	–	–	–	–	–	–
	(60 days)	NO	600	0	1.00	–	–	–	–	–	–	–
1991		WC	2,728	0	1.00	–	–	–	–	–	–	–
		NO	780	0	1.00	–	–	–	–	–	–	–
1992		WC	4,999	2	0.98	0.94-1.00	0.01	–	–	–	–	0.01
		NO	2,100	0	1.00	–	–	–	–	–	–	–
1993		WC	4,680	0	1.00	–	–	–	–	–	–	–
		NO	2,700	2	0.96	0.90-1.00	0.02	–	–	–	–	0.02
1990	Prebreed	WC	1,925	0	1.00	–	–	–	–	–	–	–
	(77 days)	NO	770	0	1.00	–	–	–	–	–	–	–

Continued.

Table 5. Page 2.

1991		WC	3,453	1	0.98	0.93-1.00	0.02	–	–	–	–	–
		NO	1,771	0	1.00	–	–	–	–	–	–	–
1992		WC	6,079	1	0.99	0.96-1.00	–	–	–	–	–	0.01
		NO	2,695	0	1.00	–	–	–	–	–	–	–
1993		WC	6,006	0	1.00	–	–	–	–	–	–	–
		NO	3,311	0	1.00	–	–	–	–	–	–	–
1990	Breed	WC	2,644	2	0.92	0.82-1.00	–	–	–	0.04	–	0.04
	(107 days)	NO	1,070	1	0.90	0.74-1.00	–	–	0.10	–	–	–
1991		WC	4,463	4	0.91	0.83-1.00	–	–	0.05	0.02	–	0.02
		NO	2,568	3	0.88	0.77-1.00	–	0.04	0.04	0.04	–	–
1992		WC	7,664	12	0.85	0.77-0.93	–	0.09	0.04	0.01	0.01	–
		NO	3,745	2	0.94	0.87-1.00	–	0.03	–	0.03	–	–
1993		WC	8,396	6	0.92	0.87-0.98	–	0.04	0.04	–	–	–
		NO	4,601	8	0.83	0.73-0.94	0.02	0.11	–	0.04	–	–
1990	Annual	WC	7,655	2	0.91	0.80-1.00	–	–	0.05	–	–	0.04
		NO	3,035	1	0.89	0.70-1.00	–	–	0.11	–	–	–
1991		WC	15,003	6	0.86	0.77-0.97	0.03	–	0.05	0.03	–	0.05
		NO	6,309	3	0.84	0.69-1.00	–	0.05	0.05	0.06	–	–
1992		WC	24,923	16	0.79	0.70-0.88	0.03	0.09	0.04	0.01	0.01	0.03
		NO	10,920	2	0.93	0.85-1.00	–	0.03	–	0.04	–	–
1993		WC	26,813	7	0.91	0.84-0.97	–	0.04	0.04	–	–	0.01
		NO	13,111	11	0.73	0.61-0.88	0.07	0.12	–	0.05	–	0.03

[a] Seasonal Intervals = see Table 4.

Table 6. Dispersal of yearling females marked on 3 study areas in Illinois, 1980-92.

		No. of Females		
Area	Year	Sedentary	Disperse	% Dispersing
Northern	1990	4	3	43
	1991	5	6	55
	1992	10	5	33
	Total	19	14	42
West-Central	1990	7	4	36
	1991	14	7	33
	1992	14	5	26
	Total	35	16	31
East-Central	1980	4	4	50
	1981	5	9	64
	1982	14	3	18
	1983	8	10	56
	1984	10	8	44
	1985	11	8	42
	Total	42	42	50

Table 7. Seasonal harmonic mean core areas (mean ± S.E.) for females radio marked on the northern and west-central study areas, 1990-93.

Area	Seasons			
	Postbreed	Parturition	Prebreed	Breed
	HOME RANGE (HA)			
Northern	86.2 ± 11.4 (N = 27)	23.5 ± 3.7 (N = 25)	41.6 ± 6.9 (N = 28)	36.1 ± 5.2 (N = 23)
West-Central	50 ± 8 (N = 14)	22 ± 5 (N = 38)	41 ± 5 (N = 31)	51 ± 5 (N = 37)

Table 8. Mean percentage overlap of 100% harmonic mean home ranges among seasons for all does and within seasons for related does on the west-central area, 1990-1994.

	Within Seasons		Among Seasons	
Season	No.	% Overlap ± S.E.	No.	% Overlap ± S.E.
Postbreed	16	89 ± 5	42	78 ± 3
Parturition	52	67 ± 3	94	58 ± 2
Prebreed	38	71 ± 3	78	63 ± 3
Breed	34	75 ± 3	65	66 ± 3

APPENDIX 1. AGE, SEX, DATE OF CAPTURE, AND DISPOSITION OF DEER MARKED ON THE WESTERN CENTRAL STUDY AREA, BROWN AND ADAMS COUNTIES, FROM JANUARY 1990 - MARCH 1994.

Appendix 1. Age, sex, date of capture, and disposition of deer marked on the Western Central Study Area, Brown and Adams counties, from Jan. 1990 - Mar. 1994.

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	DISPOSITION
2	2	F	A	01-09-90	FOUND DEAD 12-14-90
3	3	F	A	01-08-90	HARVESTED 11-29-92
4	4	F	F	01-08-90	HARVESTED 12-16-90
5	165.430	F	A	01-14-90	
6	6	F	F	01-16-90	
7	7	F	A	01-22-90	
8	8	F	A	01-16-90	
9	9	F	A	01-22-90	HARVESTED 11-16-91
10	10	F	A	01-24-90	
11	11	F	A	01-24-90	
12	12	F	A	02-04-90	
13	13	F	F	02-09-90	DEAD 02-07-91
14	14	F	F	02-02-90	HARVESTED (IOWA)12-90
16	165.200	F	A	02-08-90	
17	165.030	F	F	02-13-90	MISSING
18	165.110	F	A	02-06-90	
19	--	M	F	02-20-90	HARVESTED 11-15-91
20	--	M	F	01-09-90	HARVESTED 11-15-91
21	--	M	F	01-14-90	HARVESTED 11-14-92
22	--	M	F	01-14-90	
23	--	M	F	01-17-90	
24	--	M	F	01-22-90	HARVESTED 11-17-90
25	--	M	F	01-24-90	HARVESTED 10-09-91
26	--	M	F	02-02-90	
27	--	M	F	02-06-90	HARVESTED 10-09-91
28	--	M	F	02-06-90	FOUND DEAD 12-90
29	--	M	F	02-16-90	
30	--	M	F	02-13-90	CAPTURE MORTALITY
31	--	M	F	02-20-90	FOUND DEAD 04-23-92
32	--	M	F	02-20-90	HARVESTED 11-15-90
33	--	M	F	01-17-90	HARVESTED 10-19-91
34	165.480	M	A	02-18-90	HARVESTED 11-05-90
35	165.820	F	F	02-20-90	
36	--	M	F	02-22-90	
37	--	M	F	03-03-90	
38	--	M	F	03-27-90	FOUND DEAD 03-05-92
39	--	M	F	03-07-90	KILLED 11-11-90
40	165.270	F	A	02-13-90	
41	165.658	F	A	03-20-90	FOUND DEAD 03-19-91
42	165.835	F	F	03-20-90	HARVESTED 12-15-91
43	165.230	F	A	03-21-90	FOUND DEAD 02-24-94
44	44	F	F	03-22-90	
45	45	F	F	02-22-90	
46	165.780	F	A	02-16-90	
47	165.250	F	A	02-13-90	
48	165.352	F	Y	02-20-90	HARVESTED 11-06-92

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	DISPOSITION
49	165.500	F	A	03-15-90	
50	165.368	F	A	02-20-90	
51	165.090	F	A	02-20-90	CRIPPLING LOSS
52	165.450	F	A	03-15-90	
53	165.412	F	Y	03-21-90	FOUND DEAD 07-11-92
54	166.428	F	A	01-14-91	HARVESTED 11-02-92
55	55	F	F	01-14-91	
56	56	F	A	01-14-91	HARVESTED 11-06-92
57	57	F	F	02-26-90	HARVESTED 11-16-91
58	58	F	A	02-26-90	HARVESTED 11-19-93
59	59	F	F	01-13-91	
60	165.480	M	A	12-18-90	LOST COLLAR 01-13-92
61	165.310	M	A	03-25-90	FOUND DEAD 11-02-90
62	--	M	F	03-18-90	CRIPPLING LOSS
63	--	M	F	12-20-90	
64	--	M	F	01-04-91	HARVESTED 10-05-91
65	--	M	F	01-03-91	
66	--	M	F	01-08-91	
68	--	M	F	01-07-91	
69	--	M	F	01-07-91	
70	--	M	F	03-03-90	
71	165.290	F	Y	03-27-90	
72	72	F	Y	01-04-91	
73	73	F	Y	12-20-90	
74	165.130	F	F	03-21-90	
75	75	F	F	12-28-90	
76	76	F	Y	12-28-90	HARVESTED 01-01-93
77	77	F	A	01-04-91	FOUND DEAD 10-02-91
78	165.130	F	A	01-18-91	
79	79	F	Y	01-14-91	HARVESTED 10-10-92
80	80	F	A	01-07-91	
81	81	F	A	01-14-91	CAPTURE RELATED
82	82	F	F	01-18-91	
83	83	F	F	01-21-91	
84	84	F	F	01-21-91	
85	85	F	A	01-21-91	
86	86	F	A	01-30-91	
87	87	F	F	01-30-91	HARVESTED 11-09-91
88	88	F	A	01-30-91	
89	89	F	A	01-30-91	HARVESTED 11-21-92
90	90	F	A	01-31-91	
91	91	F	F	01-31-91	
92	92	F	F	01-31-91	HARVESTED 12-02-93
93	93	F	Y	02-08-91	FOUND DEAD 05-11-93
94	94	F	A	02-10-91	
95	95	F	A	03-08-91	
96	96	F	F	03-15-91	
97	97	F	F	03-15-91	
98	98	F	A	03-24-91	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	DISPOSITION
99	99	F	F	03-24-91	
100	--	M	F	01-13-91	ROAD KILL 04-25-91
101	--	M	F	01-13-91	HARVESTED 11-16-91
102	--	M	F	01-18-91	FOUND DEAD 04-28-92
103	--	M	F	01-18-91	HARVESTED 11-20-92
104	--	M	F	01-30-91	
105	--	M	F	01-30-91	
106	--	M	F	02-08-91	
107	165.310	M	A	01-23-91	LOST COLLAR 11-24-91
108	--	M	F	02-08-91	HARVESTED 11-16-91
109	165.892	F	F	01-13-91	HARVESTED 12-05-93
110	165.850	F	F	01-08-91	
111	165.580	F	F	01-08-91	CRIPPLING LOSS
112	165.750	F	A	01-08-91	
113	165.070	F	F	01-13-91	
114	165.328	F	A	09-13-91	
115	165.990	F	Y	01-13-91	
116	165.835	F	A	01-13-91	CAPTURE MORTALITY
117	165.702	F	F	01-23-91	HARVESTED 11-16-91
118	118	F	F	03-24-91	
119	119	F	Y	01-14-92	
120	--	M	F	02-10-91	HARVESTED 12-04-92
121	--	M	F	02-10-91	
122	--	M	F	02-26-91	CRIPPLING LOSS
123	--	M	F	02-26-91	HARVESTED 11-10-91
124	--	M	F	03-08-91	CAPTURE MORTALITY
125	--	M	F	03-08-91	
126	--	M	Y	03-13-91	HARVESTED 11-20-92
127	165.270	M	Y	03-13-91	HARVESTED 11-01-92
128	--	M	F	03-13-91	HARVESTED 12-02-93
129	--	M	Y	03-15-91	HARVESTED 12-04-93
130	--	M	F	03-26-91	CRIPPLING LOSS
131	--	M	F	03-29-91	HARVEST 11-16-91
132	-	M	F	01-10-92	
133	-	M	F	12-22-91	HARVEST 11-20-92
134	-	M	F	01-08-92	
135	-	M	F	01-08-92	ROAD KILL 10-26-92
136	165.680	F	A	03-29-91	
137	165.050	F	A	03-07-91	ROAD KILL 08-19-91
138	165.644	F	F	03-07-91	CRIPPLING LOSS
139	165.390	F	F	03-07-91	ROAD KILL 01-19-92
140	140	F	F	12-20-91	
141	141	F	F	12-20-91	FOUND DEAD 06-25-92
142	166.390	F	F	03-21-91	
143	165.212	F	A	03-21-91	
144	144	F	F	01-14-92	HARVEST 10-03-93
145	145	F	A	01-23-92	CRIPPLING LOSS
146	46	F	A	01-29-92	
147	165.970	F	A	03-21-91	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	DISPOSITION	
148	148	F	A	01-16-92	HARVESTED	12-04-92
149	-	M	F	01-10-92	HARVESTED	11-19-93
150	165.702	M	Y	01-10-92	HARVESTED	11-13-93
151	51	F	Y	01-24-92		
152	-	M	F	01-08-92		
153	53	F	A	01-24-92	HARVESTED	11-16-92
154	54	F	F	01-29-92	HARVESTED	11-23-93
155	55	F	Y	01-29-92		
156	-	M	F	01-16-92	HARVESTED	11-20-92
157	57	F	A	01-31-92		
158	58	F	A	01-30-92		
159	165.010	F	F	01-30-92		
161	61	F	A	02-07-92		
162	62	F	F	02-08-92		
163	63	F	F	02-11-92	HARVESTED	12-03-92
164	64	F	F	02-13-92	FOUND DEAD	05-24-92
165	65	F	F	02-13-92		
166	66	F	F	02-17-92	HARVESTED	12-05-92
167	67	F	F	02-19-92	HARVESTED	12-04-92
168	68	F	A	03-10-92	HARVESTED	09-27-92
169	-	M	F	01-10-92		
170	-	M	Y	01-10-92		
171	71	F	A	02-20-92		
172	-	M	F	01-30-92	HARVESTED	11-13-93
173	73	F	Y	02-25-92		
174	74	F	A	02-25-92	HARVESTED	11-20-92
175	75	F	A	02-28-92		
176	76	F	A	02-28-92		
177	77	F	F	03-11-92		
178	78	F	F	03-11-92		
179	79	F	A	03-11-92		
180	80	F	Y	03-11-92	HARVESTED	10-23-93
181	81	F	A	03-12-92		
182	82	F	F	03-21-92		
185	-	M	F	01-31-92	HARVESTED	11-07-93
186	165.580	M	Y	01-06-92		
187	166.850	F	F	01-17-92	HARVESTED	11-04-92
188	-	M	F	01-13-92		
189	-	M	F	01-13-92		
190	-	M	F	01-23-92		
191	-	F	A	01-20-92	CAPTURE RELATED	
192	165.160	F	F	01-20-92		
193	-	M	F	01-20-92		
194	166.990	F	F	01-16-92		
195	166.670	F	A	01-16-92	ROAD KILL	02-12-92
196	-	M	F	01-24-92	HARVESTED	11-22-92
197	165.658	F	A	01-22-92		
198	166.410	F	F	01-22-92		
199	166.488	F	F	01-22-92		

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	DISPOSITION	
200	165.480	M	A	01-25-92	HARVESTED	11-01-92
201	-	M	F	01-28-92		
202	-	M	F	01-28-92	HARVESTED	11-19-93
203	-	M	F	02-04-92	HARVESTED	12-06-92
204	-	M	F	02-04-92	HARVESTED	11-03-92
205	-	M	Y	02-04-92	HARVESTED	10-02-92
206	-	M	F	02-07-92	HARVESTED	11-17-93
207	166.550	F	F	02-08-92		
208	-	M	F	02-08-92	HARVESTED	11-21-93
209	-	M	F	02-12-92		
210	-	M	F	02-11-92		
211	-	M	Y	02-17-92	HARVESTED	12-03-92
212	-	M	F	02-25-92	DISPATCHED	02-25-92
213	-	M	Y	02-26-92		
214	-	M	F	02-28-92		
215	-	M	F	03-08-92		
216	-	M	A	03-10-92	HARVESTED	11-21-92
217	-	M	F	03-10-92		
218	-	M	F	03-10-92	HARVESTED	11-21-92
219	-	F	F	03-17-92	CRIPPLING LOSS	
220	166.251	F	F	03-08-92		
221	166.670	F	Y	03-08-92		
222	166.788	F	Y	03-08-92		
224	-	M	F	03-12-92	ROAD KILL	11-05-92
225	-	M	F	03-12-92	HARVESTED	11-19-93
226	26	F	Y	03-23-92	ROAD KILL	06-28-92
227	27	F	F	03-23-92	ROAD KILL	11-05-92
228	28	F	Y	03-23-92		
231	-	M	F	03-21-92		
232	165.050	F	A	03-17-92	FOUND DEAD	11-07-92
233	-	M	F	03-21-92		
234	165.310	F	A	03-19-92		
235	165.390	F	F	03-19-92	HARVESTED	12-05-92
236	-	M	A	03-15-92		
237	-	M	F	03-22-92	HARVESTED	12-06-92
239	-	M	F	03-26-92	ROAD KILL	12-20-92
301	165.390	F	F	01-13-93	HARVESTED	11-19-93
302	165.050	F	F	01-13-93		
304	-	M	F	01-13-93		
305	165.850	F	F	01-30-93	FOUND DEAD	04-25-93
306	-	M	F	01-30-93		
307	-	M	F	01-30-93		
308	166.040	F	Y	02-13-93		
309	-	M	F	02-13-93		
310	165.480	F	A	02-13-93		
311	166.428	F	Y	02-13-93		
313	-	M	F	02-13-93		
314	-	M	F	02-20-93		
315	165.282	F	A	02-20-93	POACHED	05-07-93

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	DISPOSITION	
316	165.348	F	F	02-26-93		
317	-	M	F	02-26-93	HARVESTED	11-19-93
318	-	M	Y	02-26-93	HARVESTED	11-19-93
319	-	M	F	03-15-93	HARVESTED	11-19-93
320	-	M	F	03-15-93		
321	165.412	F	F	03-16-93		
322	-	M	F	03-16-93	HARVESTED	11-20-93
323	165.808	F	A	03-17-93		
324	166.360	F	F	03-17-93	BROKEN LEG	10-03-93
325	166.272	F	F	03-26-93		
326	166.797	F	A	03-17-93	HARVESTED	12-02-93
331	-	M	F	03-25-93		
332	-	M	F	03-25-93	HARVESTED	11-10-93
335	-	M	F	03-26-93	HARVESTED	11-06-93
336	166.562	F	Y	03-28-93	HARVESTED	11-20-93
338	166.100	F	F	03-24-93	HARVESTED	11-01-93
339	-	M	F	03-24-93		
340	165.910	F	A	03-24-93		
342	166.212	F	F	04-03-93		
343	166.650	F	F	04-03-93		
401	-	F	A	01-13-93	DISPATCHED! ORPHAN	
402	-	F	A	01-13-93	DISPATCHED! ORPHAN	
405	-	F	Y	01-30-93	DISPATCHED! ORPHAN	

APPENDIX 2. DEER MARKED AT SHABBONA LAKE STATE PARK, 1990-1992.

DEER MARKED AT SHABBONA LAKE STATE PARK 1990 - 1992.

EAR TAG NO.	PLASTIC OR RADIO COLLAR NO.	SEX	AGE	DATE MARKED	KNOWN FATE
102	#1	Female	Yearling	1-22-90	On park
103	--	Male	Fawn	1-22-90	Dead
109	--	Male	Fawn	2-13-90	Dead
108	#2 (Removed) Radio 165.430	Female	Fawn Recapture	2-13-90 2-6-91	On park
110	#4	Female	Adult	2-13-90	On park
104	#5	Female	Fawn	2-21-90	Left park
105	--	Male	Yearling	2-21-90	Left park
106	--	Male	Fawn	2-21-90	Dead
112	--	Male	Fawn	2-27-90	Dead
113	#7	Female	Adult	2-27-90	On park
114	#6	Female	Fawn	2-27-90	Dead
107	#84	Female	Adult	2-28-90	On park
111	#3 or E	Female	Yearling	2-28-90	Left park
116	#8	Female	Yearling	2-28-90	Dead
117	#12	Female	Yearling	3-7-90	On park
119	--	Male	Fawn	3-7-90	Left park
120	#11	Female	Yearling Recapture	3-7-90 3-20-92	On park
Radio	165.010	Female	Yearling	3-15-90	Dead

Continued.

EAR TAG NO.	PLASTIC OR RADIO COLLAR NO.	SEX	AGE	DATE MARKED	KNOWN FATE
115	--	Male	Fawn	3-15-90	Dead
Radio	165.162	Female	Yearling	3-15-90	On park
Radio	165.050	Female	Adult	3-15-90	Dead
118	--	Female	Fawn	3-27-90	Dead
121 Radio	165.680	Female	Adult Recapture	3-27-90 3-19-91	On park
122 Radio	165.750	Female	Fawn	3-27-90	Dead
123	#14	Female	Fawn Recapture	3-28-90 1-25-91	On park
124	#17	Female	Fawn	12-5-90	Dead
125	#8	Female	Yearling Recapture	12-5-90 3-24-92	On park
129	#21	Female	Fawn Recapture	12-10-90 1-30-91	Dead
127	165.070	Male	Yearling	12-10-90	Dead
126	165.010	Male	Adult	12-20-90	On park
128	--	Male	Fawn	1-3-91	On park
130	--	Male	Yearling	1-3-91	Dead
131	--	Male	Fawn	1-3-91	Left park
132	--	Male	Yearling	1-17-91	On park
133	#31	Female	Fawn	1-17-91	Dead

Continued.

EAR TAG NO.	PLASTIC OR RADIO COLLAR NO.	SEX	AGE	DATE MARKED	KNOWN FATE
134	--	Male	Adult	1-17-91	On park
135	--	Male	Adult	1-17-91	On park
136	#36	Female	Fawn	1-25-91	Left park
137	--	Male	Fawn	1-25-91	Dead
138	#39	Female	Adult	1-25-91	Dead
139	#38	Female	Fawn	1-30-91	On park
140	--	Male	Fawn	1-30-91	Left park
141	#13	Female	Fawn	1-30-91	On park
142	#25	Female	Adult	1-30-91	Dead
143	--	Male	Fawn	1-30-91	Dead
144	--	Female	Fawn	1-30-91	On park
146	--	Male	Fawn	2-6-91	Left park
145	165.860	Female	Fawn	2-6-91	On park
147	165.580	Female	Adult Recapture	3-6-91 3-10-92	On park
149	--	Male	Fawn	3-6-91	Left park
150	--	Male	Fawn Recapture	3-6-91 3-14-91	Dead
148	--	Male	Yearling	3-6-91	Dead

Continued.

EAR TAG NO.	PLASTIC OR RADIO COLLAR NO.	SEX	AGE	DATE MARKED	KNOWN FATE
151	#37	Female	Adult	3-14-91	On park
152	165.390	Female	Fawn	3-14-91	Dead
153	165.697	Female	Fawn	3-14-91	Left park
154	#2	Female	Yearling	3-14-91	On park
155	166.132	Female	Fawn	3-19-91	Left park
156	--	Male	Fawn	3-19-91	On park
	165.010		Yearling Recapture	11-21-91 12-18-91	
157	--	Male	Fawn	3-26-91	Dead
158	--	Male	Fawn	3-26-91	Left park
159	166.012	Female	Fawn	3-26-91	Left park
160	--	Male	Fawn	3-26-91	Left park
161	166.072	Female	Adult	3-26-91	Dead
162	17	Female	Fawn	11-21-91	Alive
163	24	Female	Fawn	11-26-91	Alive
164	--	Male	Fawn	11-26-91	Alive
165	23	Female	Fawn	11-26-91	Alive
166	10	Female	Fawn	11-26-91	Alive

Continued.

EAR TAG NO.	PLASTIC OR RADIO COLLAR NO.	SEX	AGE	DATE MARKED	KNOWN FATE
167	Radio 166.072	Female	Adult	11-26-91	Alive
168	Radio 165.070	Male	Adult	12-4-91	Alive
169	--	Male	Fawn Recapture	12-10-91 12-18-91	Alive
170	--	Male	Fawn	12-18-91	Alive
171	--	Male	Fawn	12-18-91	Alive
172	--	Male	Fawn	1-17-92	Alive
173	Radio 165.312	Female	Fawn	1-21-92	Alive
174	--	Male	Fawn	1-21-92	Alive
176	Radio 166.162	Female	Adult	1-21-92	Alive
177	Radio 166.192	Female	Fawn	1-28-92	Alive
178	Radio 166.103	Female	Adult	1-28-92	Alive
179	--	Male	Fawn	1-31-92	Alive
180	30	Female	Adult	1-31-92	Alive
181	Radio 166.040	Female	Fawn	2-5-92	Dead
182	--	Male	Fawn	2-11-92	Alive
183	--	M	Fawn	2-11-92	Alive
184	--	M Recapture (Ear Tag Replaced as #204)	Fawn	2-11-92 3-10-92	Alive Alive

Continued.

EAR TAG NO.	PLASTIC OR RADIO COLLAR NO.	SEX	AGE	DATE MARKED	KNOWN FATE
185	--	Female	Adult	2-11-92	Alive
186	Radio 165.970	Female	Fawn	2-19-92	Alive
187	Radio 165.260	Female	Fawn	2-19-92	Alive
188	--	Male	Fawn	2-19-92	Alive
189	--	Male	Fawn	2-19-92	Alive
190	57	Female	Yearling	2-25-92	Alive
191	Radio 166.040	Female	Fawn	2-25-92	Dead
192	--	Male	Fawn	2-25-92	Alive
193	Radio 165.050	Female	Fawn	2-19-92	Alive
194	--	Male	Fawn	2-19-92	Alive
195	Radio 165.390	Female	Fawn	2-19-92	Alive
196	Radio 165.644	Female	Adult	2-19-92	Alive
197	35	Female	Adult	2-25-92	Alive
198	Radio 165.240	Female	Yearling	2-25-92	Alive
199	--	Male	Fawn	2-28-92	Alive
200	40	Female	Fawn	2-28-92	Alive
201	26	Female	Yearling	3-6-92	Alive
202	46	Female	Fawn	3-6-92	Alive

Continued.

EAR TAG NO.	PLASTIC OR RADIO COLLAR NO.	SEX	AGE	DATE MARKED	KNOWN FATE
203	28	Female	Fawn	3-6-92	Alive
205	25	Female	Fawn	3-10-92	Alive
206	31	Female	Fawn	3-10-92	Alive
207	22	Female	Adult	3-10-92	Alive
208	--	Male	Fawn	3-13-92	Alive
209	Radio 165.282	Male	Adult	3-13-92	Alive
210	--	Male	Fawn	3-20-92	Alive
211	51	Female	Adult	3-24-92	Alive
212	Radio 166.040	Female	Fawn	3-24-92	Alive
213	21	Female	Fawn	3-24-92	Alive
314	--	Male	Yearling	3-27-92	Alive
215	--	Male	Yearling	3-27-92	Alive