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ILLINOIS NATURAL HISTORY SURVEY

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Illinois Forest Game Investigations

W-87-R-12, 13, 14

Final Report

by

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Illinois Natural History Survey

1 July 1989 through 30 June 1992

Performance Report
Annual Job Progress Report

State: Illinois
Project No.: W-87-R-14

Project Type: Research

Project Title: Cooperative Forest Wildlife Research

Sub-project No. V11; Title: Illinois Deer Investigations

Period Covered: 1 July 1989 through 30 June 1992.

This performance report covers research work undertaken during 1989-92. Except for Job No. 1-C, which is completed in this report, the remaining jobs have been renewed and will continue for 2-3 more years. Thus this report is a report of progress only for Jobs 1-A, 1-B, and 1-D.

Study No. 1; Title: Population dynamics of the Illinois deer herd.

Study Objectives:

1. To analyze the annual status and harvest of deer in each county using computer programs to develop a conceptual model (of deer abundance and harvest, hunter demands and success, and available habitats) that will provide current and future direction to management strategies on the county, regional, and statewide level.

2. To determine annual and seasonal sex and age specific mortality rates for deer using marked samples of deer captured in western and northern Illinois.

3. To sample the perceptions of rural landowners regarding deer abundance and their tolerance of current deer depredation levels, hunter behavior, and harvest regulations.

4. To refine county and regional deer population computer models using natality and mortality rates provided by this project and, by aligning population levels with landowner tolerance, to develop guidelines for manipulation harvests to maintain deer numbers within acceptable limits to most county guidelines.

5. To prepare reports from the results of project study investigations and to help defer the costs of printing these reports.

Job No. 1-A; Title: Population dynamics of the Illinois deer herd--harvest analysis and current status.

Objectives: To continue to analyze the annual status and harvests of deer, to refine county and regional deer population computer models using natality and survival estimates provided by this project, and to provide the IDOC with improved deer population projections, harvest potentials, and knowledge of hunter behaviors.

(a) Activity: The IDOC was provided with county and regional summaries of the 1989 and 1990 firearm deer harvests, including age and sex ratios of harvested deer and hunter success in each county. These data were added to the existing data base of harvest statistics for each county which dates from the beginning of firearm hunting in the county.

For the 1991 firearm harvest, all computer programs used to download county summaries from tape files to a PC were sent to the IDOC. Computer programs were modified to meet IDOC requirements as needed and in future years, downloading of

harvest files will be handled by the IDOC as a routine part of the reporting process for each harvest.

A computer model based on age and season specific survival and natality rates was used to estimate deer numbers by region (Figure 1) in Illinois for the period 1982-1989, when deer numbers appeared to be increasing rapidly throughout the state. This simple model, which did not include any density-dependent factors, added and subtracted deer from a base population of deer estimated to be present at the beginning of the computer simulation (in this case June 1982). Seasonal natality, recruitment, and survival rates were provided by a sample of 286 deer marked in E-central Illinois between 1980 and 1985 (Nixon et al. 1991).

Estimated prehunt deer numbers nearly doubled in Illinois between 1982 and 1989, from 2.2 Km^2 to 4.0 Km^2 (Table 1). Increases occurred in all regions of the state, with highest rates of increase found in Regions 2 (N-central), 7 (S-central) and 1 (Northern) (Table 1). Estimated deer densities were highest in 1989 in Region 8 (Figure 1), the region with the highest percentage of land in forest, and lowest in Regions 1 and 5, areas rapidly urbanizing and intensively farmed (Table 1).

This rapid increase in deer numbers during the 1980's has been the result of several factors:

(1) Annual underharvesting of the available deer resource, particularly of females. Because the deer herd has historically been at low densities throughout the 20th century, all segments of society including farmers desired more deer. Accordingly, IDOC county permit allocations were conservative and harvests were generally less than 20% of the available deer in most years.

(2) Hunter selection for males--The placement of the firearm season at or near the peak of the breeding season each year makes antlered males vulnerable to firearm harvest. Because most hunters desire a antlered male, the result has been harvests

dominated by these males. Nearly 70% of the archery harvest and 60% of the firearm harvest each year has been made up of antlered males.

(3) Refuge availability--Over 95% of the Illinois landscape is privately owned and many of these landowners restrict the number of deer hunters allowed on their farm each year. Scattered throughout the state are numerous public and private refuges from firearm hunting that allow deer, particularly females, to escape harvest.

(4) Reduction in illegal poaching--With a more conservation oriented rural public available in recent years, deer have enjoyed more protection on both public and private lands. Mortality rates of both sexes during the non-hunting season are quite low throughout the state (see Job 1-B).

(5) A benign environment--Winters have been very mild throughout the 1980's and winter mortality or stress due to snow cover and low temperatures has not occurred anywhere in Illinois in recent years.

(6) Fawn recruitment is high--Doe productivity is high in Illinois. More than 50% of the doe fawns breed at 6-7 months. Virtually all does $\geq$1 year old conceive and average more than 1 fawn per conception. Mortality of preweaned fawns is variable among years and regions but has generally been low during the 1980's (probably <20% statewide, <10% in the intensively farmed counties).

These factors are likely to continue to hamper efforts to stabilize or reduce deer numbers. The IDOC will need to exert efforts to reduce refuge availability and to increase hunter willingness to kill antlerless deer. There appears to be <150,000 firearm deer hunters in Illinois and they must be given every opportunity to kill 1 or more antlerless deer each year if deer numbers are to be reduced through firearm hunting.

(b) Target Date of Achievement: 1 September 1992.

(c) Date of Accomplishment: On schedule.

(d) Significant Deviations: None.

(e) Remarks: None.

(f) Recommendations: The productivity of Illinois deer coupled with a generally conservative approach to harvest management has permitted dramatic herd growth in most counties. It is now apparent that more aggressive and innovative harvest strategies will be necessary to effectively manipulate the size and composition of these populations. To do so will require development of interactive, menu driven, portable computer models and software packages to facilitate analysis of harvest data, predict effects of alternative harvest regimes, and to help select strategies to achieve specific harvest goals. These computer programs must then be integrated into the IDOC deer management program.

Until now, the data necessary to estimate natality and survival rates for regional deer herds have not been available in Illinois. Data generated from marking studies of deer at scattered sites in Illinois are now becoming available (see Job 1-B). The new computer programs will use the natality and seasonal survival data generated by these studies to provide the IDOC with computer models that more closely mimic actual population dynamics.

The computer software needed for future deer herd management will be developed during the next phase of study, under cooperative project W-78-R-15.

(g) Costs: Federal--$14,880; State--$4,960; Total--$19,840.

Job No. 1-B; Title: Estimates of regional doe natality rates, fawn recruitment, and yearling-adult survival.

Objectives: To determine seasonal and annual age specific survival rates and doe natality rates for deer in west-central and northern Illinois.

(a) Activity:

Capture and Marking

Deer were livetrapped from December through March for 1989-90, 1990-91, and 1991-92 on sites in Brown-Adams counties (west-central study area [WCSA] and DeKalb County (northern study area [NSA]). A total of 230 deer were marked on the 5,942 ha WCSA (Appendix 1) and 115 on the 1,800 ha NSA (Appendix 2).

A total of 57 deer (8 males, 49 females) and 32 deer (5 males, 27 females) were radio marked on the WCSA and NSA, respectively. Approximately 9,000 radio fixes and 2,000 radio fixes have been recorded to date on the WCSA and NSA areas, respectively. Radio-marked deer are providing data on seasonal movements and habitat use, natality and fawn recruitment, and survival.

Natality

Blood samples were collected from all does captured on the WCSA only in January-March 1990 and 1991 (68 does) and only from fawn does (18 does) in 1992. Progesterone levels indicated that breeding activity by fawn does was low all three years and apparently declining (Table 2). Progesterone levels found in blood sera for does $\geq$1 year old indicated that only 2 (1 adult and 1 yearling) of 52 does were not pregnant when captured (Table 3).

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 (Table 3).

These observations indicate fawn production and/or survival from all breeders to be higher on the NSA, with both study areas producing fewer fawns than does captured in east-central Illinois between 1980 and 1985 (Nixon et al. 1991).

Spotlight surveys and casual observations of all does and fawns (marked and unmarked) observed from mid-July to October each year on both study areas were similar (mean number of fawns/doe WCSA = 1.07, N = 504 does; NSA = 1.09, N = 229 does), but lower than early fall fawn:doe counts on the Piatt County Study Area (PCSA) in EC Illinois (1.33 fawns/doe). Data from marked does only (1.05 fawns/doe) were very similar to observations of fawn production of all does (1.07 fawns/doe) on the WCSA but fawn production from marked does (1.48 fawns/doe) were higher compared with observations of all does (1.09/doe) on the NSA (Table 4).

Fawn survival from birth through 12 months was determined for a small sample of marked does (21 on the NSA and 20 on the WCSA) on both study areas (Table 5). Estimates of fawn survival was based on repeated observations of marked does and their fawns from near birth until family breakup at 12 months of age. Fawn and yearling breeders were more successful raising fawns to independence than were older does on both areas. Overall survival of these fawns until family breakup at 12 months was high on both areas, 84% on the NSA and 92% on the WCSA (Table 5).

Comparing percent pregnant, number of fawns produced, and percent of births that were multiple ($\geq$2 fawns) for three age classes among WC, EC, and N Illinois illustrates the reduced fawn production found in WC Illinois (Table 6). If these natality and fawn recruitment rates are valid for all or most of the WC region, population projections based upon computer models using data from EC Illinois have produced estimated numbers too high and harvest rates too low for actual conditions in the region.

However, there is reason to believe the natality rates found among fawn does on the WCSA may not be typical of the WC region as a whole. Grabaugh et al. (1988)

found fawn breeding to exceed 60% for a sample of road-killed females collected at scattered sites throughout WC Illinois. Whether the low rate of breeding among our marked sample is the result of poor nutrition, with fawns unable to achieve the fat:lean body mass ratio thought necessary for estrous to occur in this species, or the result of social inhibition brought on by dominant older relatives in large social groupings (Verme 1987) is unclear at this time. We collected body weights and measurements and cavity blood from fawn does shot by hunters in WC and EC Illinois during the 1991 hunting season in an effort to access condition of these fawns in mid-November. It should be pointed out that most fawns harvested by hunters in WC Illinois were not shot on the WCSA and thus do not represent study area deer. These samples should, however, be typical of WC fawn does. Blood sera were analyzed for total protein and albumen levels by Dr. Walter Hoffmann, School of Veterinary Medicine, University of Illinois, Urbana-Champaign.

Dressed body weight was significantly lower ($F_{1,82} = 6.96$, $P<0.01$) among fawns from WC Illinois (mean = 65.9 $\pm$ 0.96 lbs.) compared with fawns in EC Illinois (mean = 68.9 $\pm$ 1.26 lbs.). However, body weights from WC does appear to be high enough to allow for the onset of estrous in December-January, the usual breeding period for these precocial breeders.

Total blood protein (WC mean = 6.0 $\pm$ 0.39 gm/dl; EC mean = 5.1 $\pm$ 0.36 gm/dl) also differed significantly ($P<0.05$) but with WC Illinois does averaging the higher value. Albumen levels were also higher in WC does but means were not significantly different (WC mean = 4.2 $\pm$ 0.16 gm/dl; EC mean = 3.7 $\pm$ 0.19 gm/dl). Total protein and albumen levels were used to compared fawn condition between regions because Nelson (1978) found significant differences in blood levels of these elements between fawns that ovulated and those that were barren on a refuge in southern Illinois. Mean levels for both total protein and albumen found on both the WC and EC regions were

higher than Nelson's data for both breeding and barren does on the Crab Orchard National Wildlife Refuge.

Yearling antler beam diameter measurements have been used as an indication of ovulation rates among fawn does in New York state (Severinghaus and Moen 1983). Antler beam diameters were similar ($P>0.05$) for a sample of yearling males from WC (mean = 24.6 + 0.63 cm, N = 38) and EC (mean = 23.7 + 0.72 cm, N = 30) and these measurements were both high enough to reflect relatively high fawn breeding rates, based on New York data (Severinghaus and Moen 1983).

In view of the very mild winters that occurred during our study, and the large forage base available for deer in WC Illinois including our study area, we believe that social pressures, and not nutritional deficiencies, are responsible for the reduced rate of fawn doe breeding on the WCSA. Reports of reduced or absent fawn breeding activity are becoming more numerous as refuge protected deer herds increase in Illinois (Chicago Metro Parks, Witham and Jones 1986); (Galena Territory 1991, D. Dufford, unpublished data); (Rock Cut State Park, 1991-92, J. Witham and T. Miller, unpublished data). A firearm harvest of the state park portion of the WCSA and increased firearm harvests of females on the remainder of the study area would likely reduce the social pressures on fawn does and lead to higher fawn breeding rates.

Survival

Survival rates were calculated for 3 periods, January-April, May-September, and October-December. Annual survival was the product of the 3 seasonal rates. Fawn survival could be calculated only for the January-April period, because fawns were marked only in winter each year. Survival was calculated as the number of deer known alive at the beginning of an interval minus all those known to have died during the interval.

Approximately half of both study areas were open to archery hunting each fall. Firearm hunting was allowed on the private farms in (WCSA) and surrounding (NSA) the study areas.

Seasonal survival was high (>90%) during the non-harvest period each year (Table 7). Highway accidents represent almost the only mortality threat to yearling and older deer in Illinois as poaching, free running hounds and farm dogs, and coyotes pose little threat to deer >1 year old during these months. As expected, harvest losses were highest for yearling males and lowest for adult females (Table 7).

Annual survival mirrored harvest losses and was lowest for yearling males and highest for adult females on all 3 study areas (Table 7). Yearling females survival was lower than that of adult females on all study areas, a reflection of greater losses to hunting. Yearlings may not be as wary of humans as adult does (Roseberry and Woolf 1991). Among study areas, annual survival was highest on the WCSA during our study, a reflection of the relatively light hunting pressures (relative to the potential available range in the region) occurring in much of WC Illinois at present (Table 7).

Dispersal

Dispersal and migratory movements were more prevalent on the more sparsely forested NSA compared with the WCSA during 1990 and 1991 (Table 8). The difference in combined fawn dispersal rates between areas approached significance ($P<0.10$). The dispersal rate for female fawns on the NSA was double that of the WCSA for 1990 and 1991 (Table 8). The NSA is situated at the head of the Indian Creek watershed and the surrounding landscape is dominated by crop fields and urban areas. In contrast, the WCSA is surrounded by more scattered crop fields and the landscape is dominated by woodlands. Deer may be more likely to remain close to their natal range on the WCSA because of higher availability of suitable habitat close by.

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

(c) Date of Accomplishment: On schedule.

(d) Significant Deviations: None.

(e) Remarks: None.

(f) Recommendations: We plan to continue to monitor marked deer on both study sites at least through 1993. Marked deer will provide at least an indication of the effectiveness of the new IDOC policy of increased harvest using many more antlerless only permits and promoting deer hunting through relaxed permit application procedures. In addition, the state park portion of the WCSA will permit firearm hunting for the first time which may result in a significant harvest of resident marked females.

(g) Costs: Federal--$37,200; State--$12,400; Total--$49,600.

Job No. 1-C; Title: Rural landowner attitudes toward deer and IDOC deer management.

Objectives: To determine rural landowner attitudes toward present deer abundance, deer damage, IDOC harvest management, and hunter behavior.

(a) Activity:

The new survey of landowner attitudes toward deer was designed as a follow-up to a similar survey conducted by the IDOC in 1982 (Kube 1983). In 1982, 2/3rds of the respondents considered deer numbers to be about right, 12% thought the herd was too large, and 21% believed deer numbers were too low. Most landowners did not hunt deer (72%), felt that deer permit quotas were about right (69%), allowed hunting on their farm (71%), and indicated that they had not suffered significant crop damage from deer (97%) (Kube 1983).

By 1989, deer numbers had nearly doubled over numbers estimated for 1982 (see Job 1-A) and landowner perceptions of deer were likely to have changed during the interval. It was decided to resurvey a sample of landowners following the 1989 growing season to determine current attitudes toward deer and deer hunting in Illinois.

The final report summarizing the results of the 1990 survey has been published as IDOC Technical Report 6 and is appended to this report (Appendix 3). This publication constitutes the final report for Job 1-C of this project.

(b) Target Date for Accomplishment: 1 September 1992.

(c) Date of Accomplishment: On schedule.

(d) Significant Deviations: None.

(e) Remarks: None.

(f) Recommendations: The IDOC should study the results of the landowner survey carefully as landowner attitudes will dictate the success of any future deer harvest

management. Nearly all of Illinois's deer range is privately owned and landowners control hunter access to virtually all of the deer herd. Of particular interest were landowner responses in 3 areas: (1) Statewide, nearly 1/3 of the respondents thought there were too many firearm hunters in 1989. If this response translates into farm closure to firearm deer hunters, it could reduce hunter access to deer at a time when more, not fewer deer should be harvested; (2) The number of farms that are presently closed to deer hunting, particularly in Regions 2 and 5. These farms represent refuges for deer and their closure can limit any effective herd control; (3) The low number of landowners who have used IDOC expertise to control deer. The message that help in controlling deer is available has not been received by most of the rural landowners.

The IDOC needs to provide the public with more information regarding deer biology as it relates to potential problems on the farm, the necessity to harvest more deer each fall, the best methods available to control deer access to the farm, and most important, to demonstrate that IDOC personnel will assist the landowner in controlling unruly deer hunters. More farms must be opened to firearm hunting if the deer herd is to be stabilized or reduced in future years.

(g) Costs: Federal--$14,880; State--$4,960; Total--$19,840.

Job No.1-D; Title: Data analysis and preparation of reports.

Objectives: To prepare reports from the results of project investigations and to help defer the cost of printing these reports.

(a) Activity:

The following reports were published during the R-12,13,14 segments:

Nixon, C.M., P.A.Brewer, and L.P. Hansen. 1990. White-tailed doe tolerates nursing by non-offspring. Trans. Ill. Acad. Sci. 83(1,2): 104-106.

Nixon, C.M., L.P. Hansen, P.A. Brewer, and J E. Chelsvig. 1991. Longevity of female white-tailed deer on a refuge in Illinois. Trans. Ill. Acad. Sci. 84(1.2): 84-91.

_____, _____, _____, and _____. 1991. Ecology of white-tailed deer in an intensively farmed region of Illinois. Wildlife Monograph 118. The Wildlife Society, Washington, D.C. 77pp.

_____, _____, _____, and _____. 1992. Stability of white-tailed doe parturition ranges on a refuge in east-central Illinois. Canadian J. Zoology 70:968-974.

Nixon, C.M., and L.P. Hansen. 1992. Habitat relationships and population dynamics of deer in the intensively farmed midwestern United States. Pp. 22-29 in R.D. Brown, Ed. The Biology of Deer. Springer-Verlag, New York.

Morgan, G.W., C.M. Nixon, J.C. Van Es, and J.H.Kube.1992. Attitudes of Illinois farmers regarding deer and deer hunting. Tech. Rept. 6. Illinois Dept. Conservation, Springfield, IL. 24 P.

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 deer life history and ecology were reported to the IDOC as requested.

(b) Target Date of Achievement: 1 September 1992.

(c) Date of Accomplishment: On Schedule.

(d) Significant Deviations: None.

(e) Remarks: None.

(f) Recommendations: None.

(g) Costs: Federal--$7,440; State--$2,480; Total--$9,920

Literature Cited

Grabaugh, J.W., V.C. Pederson, and F.D.Loomis. 1988. Reproductive performance of white-tailed deer (Odocoileus virginianus) in west-central Illinois. Trans. Illinois Acad. Sci. 81(1,2):189-196.

Kube, J.H. 1983. Population studies of white-tailed deer. Job Completion Rept. of Surveys and Investigations Reports. Project W-63-R-26. Illinois Dept. Conservation, Springfield, IL.

Nelson, T.A. 1984. The productivity and survival of white-tailed deer fawns on the Crab Orchard National Wildlife Refuge. Ph.D. Thesis. Southern Illinois University, Carbondale, IL. 165p.

Nixon, C.M., L.P. Hansen, P.A. Brewer, and J.E. Chelsvig. 1991. Ecology of white-tailed deer in an intensively farmed area in Illinois. Wildl. Monograph 118. The Wildlife Society, Washington, D.C. 77p.

Roseberry, J.L., and A. Woolf. 1991. A comparative evaluation of techniques for analyzing white-tailed deer harvest data. Wildl. Monograph 117. The Wildlife Society, Washington, D.C. 59 pp.

Severinghaus, C.W., and A.N. Moen. 1983. Prediction of weight and reproductive rates of a white-tailed deer population from records of antler beam diameters among yearling males. N. Y. Fish & Game J. 30:30-38.

Verme, L.J. 1987. Decline in doe fawn reproduction in southern Michigan deer: a biosocial-effect hypothesis. Mich. Dep. Nat. Resour., Fed. Aid in Wildl. Restor. Perf. Rep., Proj. W-127-R-5, Job 1.9. 11pp.

Witham, J.H., and J.M.Jones. 1986. Biology, ecology, and management of deer in the Chicago metropolitan area. Illinois. Dept. Conservation, Fed. Aid. in Wildl. Restor. Perf. Rep. Proj. W-87-R-7. 46pp.

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Table 1. Estimated density and rate of increase of regional deer herds between 1982 and 1989.

Region	Estimated No. Deer 1982	Estimated No. Deer 1989	Deer Density No./Km^2 1982	Deer Density No./Km^2 1989	Annual Rate of Increase
1	7,923	14,788	0.9	1.7	1.09
2	25,752	56,940	0.9	2.1	1.12
3	55,618	94,285	3.1	5.4	1.08
4	50,836	83,952	3.8	6.3	1.07
5	12,130	24,905	0.9	1.8	1.11
6	22,305	44,194	1.6	3.2	1.10
7	60,740	112,299	2.2	4.2	1.09
8	55,171	92,606	5.8	9.7	1.08
9	9,018	15,675	3.3	5.8	1.08
State	299,493	539,644	2.2	4.0	1.09

Table 2. Number of fawn does breeding on the west-central study area based on progesterone levels in blood sera collected from captured does January-March 1990-1992.

Year	No. Does Examined	No. Does Breeding	Percent Breeding
1990	8	3	38
1991	20	3	15
1992	17	1	6
Total	45	7	15

Table 3. Breeding rates of marked does observed on the west-central and northern study areas in 1990 and 1991.

Breeding Age	Percent Breeding No.	Breeding	%	No. Does	Production No. Fawns	Fawns/ Doe	Fawns/ Breeder
			WEST-CENTRAL				
Fawns							
1989-90	8	3	38	8	3	0.4	1.0
1990-91	20	3	15	20	4	0.2	1.3
Yearling							
1989-90	5	4	80	5	7	1.40	1.75
1990-91	4	4	100	4	7	1.75	1.75
Adult							
1989-90	20	20	100	20	37	1.85	1.85
1990-91	23	22	100	23	39	1.69	1.77
			NORTHERN				
Fawns							
1989-90	5	2	40	5	2	0.40	1.00
1990-91	6	5	88	6	5	0.83	1.00
Yearling							
1989-90	5	5	100	5	7	1.40	1.40
1990-91	1	1	100	1	2	2.00	2.00
Adult							
1989-90	4	4	100	4	9	2.25	2.25
1990-91	8	8	100	8	13	1.63	1.63

Table 4. Mean number of fawns observed with marked does ≥1 year old in the fall on the east-central, west-central and northern study areas.

Area	Number Pregnancies	No. Fawns Observed	Mean No. Fawns/doe
East-central	145	256	1.76
Northern	46	68	1.48
West-central	144	151	1.05

Table 5. Survival of fawns through 12 months based upon repeated observations of marked does on the west-central and northern study areas.

Breeding Age	Number Pregnant	No. Fawns Born	No. Fawns alive 6 Mo.	No. Fawns alive 12 Mo.
		NORTHERN		
Fawn	6	6	6	6
Yearling	6	12	12	11
Adult	9	20	18	15
		WEST-CENTRAL		
Fawn	4	4	4	4
Yearling	3	6	6	6
Adult	13	26	24	23

Table 6. Summary of fawn production for marked does on the east-central, northern, and west-central study areas.

Age at Parturition	East-central	Northern	West-central
		Pregnant (%)	
1	70	64	15
2	100	100	89
≥3	100	100	98
		No. Fawns/Doe	
1	0.8	0.63	0.20
2	1.81	1.50	1.55
≥3	2.02	1.83	1.77
		Multiple Births (%)	
1	13	0	0
2	81	50	75
≥3	87	75	70

Table 7. Seasonal and annual survival for deer marked in east-central, northern, and west-central Illinois. Survival rates are calculated as the number of deer alive at the beginning of the interval minus any deaths during the interval.

Sex & Age	Jan-Apr Mean	May-Sep Mean	Oct-Dec Mean	Annual Mean
		WEST-CENTRAL		
FM	1.0	--	--	--
FF	1.0	--	--	--
YM	1.0	0.96	0.46	0.44
YF	0.98	1.00	0.63	0.62
AM	0.94	1.00	0.70	0.66
AF	0.98	0.99	0.88	0.86
		NORTHERN		
FM	0.98	--	--	--
FF	0.94	--	--	--
YM	0.87	0.92	0.48	0.38
YF	1.00	0.95	0.74	0.71
AM	1.00	1.00	0.93	0.93
AF	0.98	1.00	0.87	0.87
		EAST-CENTRAL		
FM	0.99	--	--	--
FF	0.97	--	--	--
YM	0.93	0.96	0.44	0.39
YF	0.99	0.91	o.66	0.59
AM	0.95	0.97	0.40	0.36
AF	1.00	0.96	0.78	0.75

Table 8. Movement behavior of marked deer on the west-central and northern study areas, whether deer were sedentary (S), dispersers (D), or migratory (M) after family breakup in May-June.

Marking Age	1990 No.	S	D	M	1991 No.	S	D	M
				WEST-CENTRAL				
Fawn								
Male	15	7	8	0	14	5	9	0
Female	9	7	2	0	13	9	2	2
Yearling								
Male	0	--	--	--	5	4	1	0
Female	7	7	0	0	9	7	0	2
Adult								
Male	2	2	0	0	2	2	0	0
Female	16	15	0	1	29	29	0	0
				NORTHERN				
Fawn								
Male	6	1	5	0	11	2	9	0
Female	6	3	3	0	11	5	5	1
Yearling								
Male	0	--	--	--	2	2	0	0
Female	6	4	1	1	3	3	0	0
Adult								
Male	0	-	-	-	3	3	0	0
Female	5	4	0	1	11	10	0	1

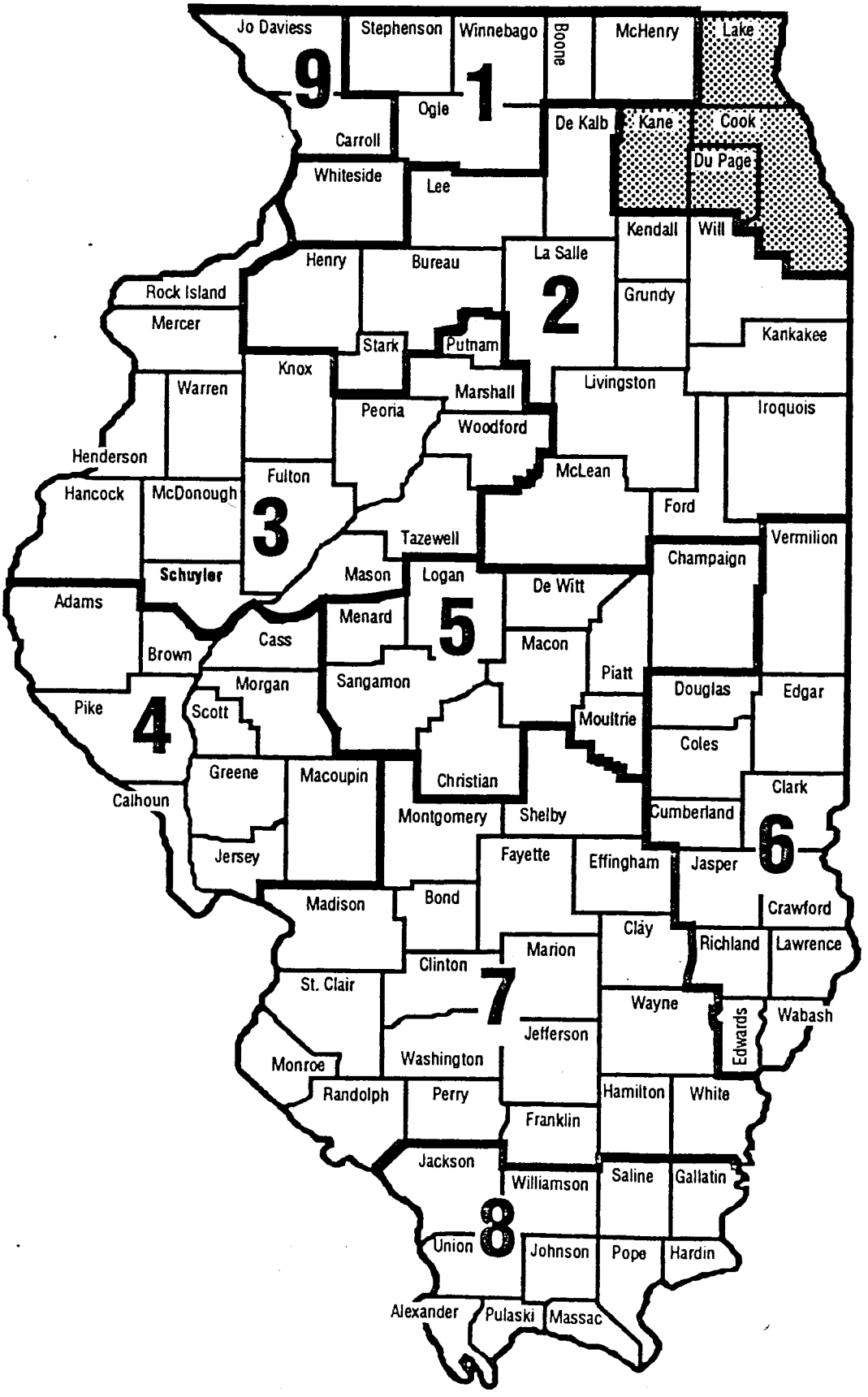

Figure 1. Regional boundaries used for simulation modeling of deer abundance in Illinois 1980-89.

APPENDIX 1. List of deer captured on the West-Central Study Area, 1990-1992.

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
2	2	F	A	01-09-90	DEAD 12-14-90
3	3	F	A	10-08-90	
4	4	F	F	01-08-90	KILLED 12-16-90
5	5	F	A	01-14-90	VOID RECAPTURED 1991
5	165.430	F	A	02-26-91	
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	KILLED 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	KILLED 12-90 IN IOWA
16	15	F	A	02-08-90	VIOD RECAPTURED 1991
16	165.200	F	A	01-04-91	
17	165.030	F	F	02-13-90	MISSING
18	165.110	F	A	02-06-90	
19	--	M	F	02-20-90	ARCHERY KILL 11-15-91
20	--	M	F	01-09-90	KILLED 11-15-91
21	--	M	F	01-14-90	
22	--	M	F	01-14-90	
23	--	M	F	01-17-90	KILLED 10-19-90

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
24	--	M	F	01-22-90	KILLED 11-17-90
25	--	M	F	01-24-90	
26	--	M	F	02-02-90	
27	--	M	F	02-06-90	ARCHERY KILL 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	
32	--	M	F	02-20-90	KILLED 11-15-90
33	--	M	F	01-17-90	ARCH KILL 10-19-91
34	165.480	M	A	02-18-90	KILLED 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	
39	--	M	F	03-07-90	KILLED 11-11-90
40	--	F	A	02-13-90	
41	165.658	F	A	03-20-90	DEAD 03-19-91
42	165.835	F	F	03-20-90	KILLED 12-15-91
43	165.230	F	A	03-21-90	
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	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
48	165.352	F	Y	02-20-90	
49	165.500	F	A	03-15-90	
50	165.368	F	A	02-20-90	
51	165.090	F	A	02-20-90	ARCH CRIPPLE 12-31-91
52	165.450	F	A	03-15-90	
53	165.412	F	Y	03-21-90	
54	166.428	F	A	10-19-92	ORIG. CAPT. 01-14-91
55	55	F	F	01-14-91	
56	56	F	A	01-14-91	
57	57	F	F	02-26-90	KILLED 11-16-91
58	58	F	A	02-26-90	
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	DEAD 11-02-90
62	--	M	F	03-18-90	GUN CRIPPLING LOSS
63	--	M	F	12-20-90	
64	--	M	F	01-04-91	KILLED 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	PEN RAISED DEER
71	165.290	F	Y	03-27-90	
72	72	F	Y	01-04-91	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
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	
77	77	F	A	01-04-91	FOUND DEAD 10-02-91
78	78	F	A	01-18-91	
79	79	F	Y	01-14-91	
80	80	F	A	01-07-91	
81	81	F	A	01-14-91	
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	ARCHERY KILL 11-09-91
88	88	F	A	01-30-91	
89	89	F	A	01-30-91	
90	90	F	A	01-31-91	
91	91	F	F	01-31-91	
92	92	F	F	01-31-91	
93	93	F	Y	02-08-91	
94	94	F	A	02-10-91	
95	95	F	A	03-08-91	
96	96	F	F	03-15-91	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
97	97	F	F	03-15-91	
98	98	F	A	03-24-91	
99	99	F	F	03-24-91	
100	--	M	F	01-13-91	ROAD KILL 04-25-91
101	--	M	F	01-13-91	GUN KILL 11-16-91
102	--	M	F	01-18-91	
103	--	M	F	01-18-91	
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	GUN KILL 11-16-91
109	165.892	F	F	01-13-91	
110	165.850	F	F	01-08-91	
111	165.580	F	F	01-08-91	ARCH CRIPPLE 10-14-91
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	GUN KILL 11-16-91
118	118	F	F	03-24-91	
119	119	F	Y	01-14-92	
120	--	M	F	02-10-91	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
121	--	M	F	02-10-91	
122	--	M	F	02-26-91	GUN CRIPPLE 11-22-91
123	--	M	F	02-26-91	ARCHERY KILL 11-10-91
124	--	M	F	03-08-91	CAPTURE MORTALITY
125	--	M	F	03-08-91	
126	--	M	Y	03-13-91	
127	165.270	M	Y	03-13-91	
128	--	M	F	03-13-91	
129	--	M	Y	03-15-91	
130	--	M	F	03-26-91	GUN CRIPPLE 12-14-91
131	--	M	F	03-29-91	GUN KILL 11-16-91
132	-	M	F	01-10-92	
133	-	M	F	12-22-91	
134	-	M	F	01-08-92	
135	-	M	F	01-08-92	
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	GUN CRIPPLE 12-20-91
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	
142	166.390	F	F	03-21-91	
143	165.212	F	A	03-21-91	
144	144	F	F	01-14-92	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
145	145	F	A	01-23-92	
146	46	F	A	01-29-92	
147	165.970	F	A	03-21-91	
148	148	F	A	01-16-92	
149	-	M	F	01-10-92	
150	165.702	M	Y	01-10-92	
151	51	F	Y	01-24-92	
152	-	M	F	01-08-92	
153	53	F	A	01-24-92	
154	54	F	F	01-29-92	
155	55	F	Y	01-29-92	
156	-	M	F	01-16-92	
157	57	F	A	01-31-92	
158	58	F	A	01-30-92	
159	59	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	
164	64	F	F	02-13-92	
165	65	F	F	02-13-92	
166	66	F	F	02-17-92	
167	67	F	F	02-19-92	
168	68	F	A	03-10-92	
169	-	M	F	01-10-92	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
170	-	M	Y	01-10-92	
171	71	F	A	02-20-92	
172	-	M	F	01-30-92	
173	73	F	Y	02-25-92	
174	74	F	A	02-25-92	
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	
181	81	F	A	03-12-92	
182	82	F	F	03-21-92	
185	-	M	F	01-31-92	
186	165.580	M	Y	01-06-92	
187	87	F	F	01-17-92	
187	166.850	F	F	03-17-92	RECAPT. RADIO FITTED
188	-	M	F	01-13-92	
189	-	M	F	01-13-92	
190	-	M	F	01-23-92	
191	-	F	A	01-20-92	DISPATCHED 01-20-92
192	165.560	F	F	01-20-92	
193	-	M	F	01-20-92	
194	166.990	F	F	01-16-92	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
195	166.670	F	A	01-16-92	ROAD KILL 02-12-92
196	-	M	F	01-24-92	
197	165.658	F	A	01-22-92	
198	166.410	F	F	01-22-92	
199	166.488	F	F	01-22-92	
200	165.480	M	A	01-25-92	
201	-	M	F	01-28-92	
202	-	M	F	01-28-92	
203	-	M	F	02-04-92	
204	-	M	F	02-04-92	
205	-	M	Y	02-04-92	
206	-	M	F	02-07-92	
207	166.550	F	F	02-08-92	#112'S FAWN
208	-	M	F	02-08-92	
209	-	M	F	02-12-92	
210	-	M	F	02-11-92	
211	-	M	Y	02-17-92	
212	-	M	F	02-25-92	DISPATCHED 02-19-92
213	-	M	Y	02-26-92	
214	-	M	F	02-28-92	
215	-	M	F	03-08-92	
216	-	M	A	03-10-92	
217	-	M	F	03-10-92	
218	-	M	F	03-10-92	

EAR TAG #	COLLAR # OR FREQUENCY	SEX	AGE	DATE MARKED	COMMENTS
219	-	F	F	03-17-92	
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	
225	-	M	F	03-12-92	
226	26	F	Y	03-23-92	
227	27	F	F	03-23-92	
228	28	F	Y	03-23-92	
231	-	M	F	03-21-92	
232	165.050	F	A	03-17-92	
233	-	M	F	03-21-92	
234	165.310	F	A	03-19-92	
235	165.390	F	F	03-19-92	
236	-	M	A	03-15-92	
237	-	M	F	03-22-92	
239	-	M	F	03-26-92	

APPENDIX 2.

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

APPENDIX 3. Attitudes of Illinois Farmers Regarding Deer and Deer Hunters, 1990.