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Population Dynamics and Ecology of White-Tailed Deer in Illinois

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W-87-R-20.

POPULATION DYNAMICS AND ECOLOGY OF WHITE-TAILED DEER IN ILLINOIS

FINAL REPORT

Federal Aid Project W-87-R-20

Submitted by:

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Presented to:

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STATE OF ILLINOIS

W-87-R-20

Project Period: 1 July 1995 through 30 June 1998

Project: Cooperative Forest Wildlife Research - Illinois Deer Investigations

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NEED: The widespread distribution and abundance of white-tailed deer (*Odocoileus virginianus*) in Illinois has created new management challenges and problems. Managers and administrators must now consider the interests and concerns of nonhunters and urban dwellers as well as hunters, farmers, and rural landowners. The ability of deer to exist and thrive in areas of relatively dense human habitation also limits management options for controlling herd size through recreational hunting. Knowledge of the amount, distribution, and quality of potential deer habitat and its spatial relationship with sensitive areas such as human developments and agricultural areas is necessary to effectively manage this important and visible resource. There is also a recognized need for management to become more proactive and less reactive. More innovative harvest strategies and permit systems will be needed to control herd size as deer populations expand into non-traditional habitats and allowable hunter densities approach maximum. This in turn will necessitate the use of more sophisticated methodologies for monitoring and evaluating population performance and predicting the effects of alternative management options.

OBJECTIVES:

1. To inventory and quantify land use/land cover on a county basis and relate to white-tailed deer population densities and management strategies.
2. To determine relationships between land use/land cover patterns and negative deer/human interactions, especially automobile accidents.

3. To determine relationships between land use/land cover and susceptibility of deer to control by recreational hunting.

4. To examine the current multiple permit type system and its effects on harvest rates, harvest composition, and hunter satisfaction.

5. To examine pregnancy rates, numbers of lactating does (particularly yearlings) at check stations, and factors affecting the harvest of fawns in representative Illinois counties and their implications for deer management.

EXECUTIVE SUMMARY

Segment 20 of Illinois Department of Natural Resources (IDNR) Federal Aid Project W-87-R (Cooperative Forest Wildlife Research - Illinois Deer Investigations) represents the final year of a 3-year grant proposal. The original grant proposal was amended in Segment 18; Study 1, Job 4 and all of Study 2 were discontinued before the segment actually began. This project final report covers the jobs remaining under Study 1 and Study 3.

Study 1. Population Dynamics and Ecology of White-tailed Deer in Illinois

Study 1 included 5 objectives that were addressed in 4 jobs and their findings and results analyzed comprehensively in Job 1.6 (Analysis and Report) that largely consists of this Final Performance Report and the attached manuscripts and related products. Following is a brief description of the major accomplishments and findings of Jobs 1.1-1.5 in Study 1.

Job 1.1. Habitat Inventory, Classification, and Analysis.–Objectives were to (1) inventory and quantify land use/land cover on a county basis and relate to white-tailed deer population densities and management strategies, and (2) incorporate the findings into IDHAMP to enhance predictive capabilities. Satellite imagery and a proximity-based habitat model were used to inventory and analyze the potential deer habitat in each of the state’s 102 counties. We found that the amount of deer habitat in Illinois was sufficient to support estimated population levels, and that the gross amount of the key habitat component, forest cover, probably is increasing slightly. There was no evidence that relative use of available habitat at the county level was being adversely affected by non-urban human population density. However, high levels of continuous human presence may reduce deer carrying capacity in certain types of habitat.

A manuscript accepted for publication (Roseberry and Woolf 1998) that details methods and findings is provided as the final report for this job. Also, digital files on tape and floppy disks of habitat maps and data in formats suitable for incorporation into IDHAMP (Roseberry 1998), HAMS (Roseberry and Hao 1996), or for use in ArcView® (ESRI, Redlands, CA) are provided as products to meet all objectives of Job 1.1.

Job 1.2. Deer/Human Nonhunting Interactions.–The objective was to determine relationships between land use/land cover patterns and negative deer/human interactions, especially automobile accidents. Locations of sites with ≥15 deer/vehicle accidents on state roads during 1989-93 were obtained from the Illinois Department of Transportation. We used a combination of satellite imagery and aerial photography to examine landscape and highway variables around these accident sites. Analyses were conducted at 2 spatial scales: county-level and individual highway segment.

Logistic regression models were developed that successfully differentiated between high accident sites and randomly selected control highway segments. Details of methods, results, and findings are in the attached thesis (Finder 1998) that serves as the final report for this job.

Job 1.3. Harvest Efficiency.–Objectives were to (1) determine relationships between land use/land cover and susceptibility of deer to control by recreational hunting, and (2) incorporate the findings into IDHAMP to enhance predictive capabilities. We calculated susceptibility or vulnerability of deer to harvest in each Illinois county where firearm hunting is permitted (Foster 1996), a variety of landscape metrics for each county using FRAGSTATS software (McGarigal and Marks 1995), and indices of human influence on the landscape.

This job was completed in Segment 19; methods, results, and findings were presented in a Master's thesis (Foster 1996) in lieu of a final report. We now include in this final report a published paper (Foster et al. 1997) that summarizes methods, results, and important findings.

Job 1.5. Multiple Permit Systems and Types.–Objectives were to (1) examine the current multiple permit type system and its effects on harvest rates, harvest composition, and hunter satisfaction, and (2) incorporate the findings into IDHAMP to enhance predictive capabilities. Success rates and harvest composition were determined for individual permits (n = 269,000) and hunters (n = 180,500) during the 1995 season, and analyzed according to permit type and number of permits held. Findings are presented and discussed in the accompanying final report for this job. In addition, IDHAMP was modified to facilitate more realistic simulation of alternative harvest strategies based on issuance of multiple permit types currently in use. The revised program and User's Guide/Reference Manual were provided to appropriate IDNR staff.

Study 3. Deer Reproduction/Recruitment

Study 3 was composed of a single objective incorporated into Job 3.1 with the results analyzed and reported in Job 3.2 (Analysis and Report). Plans are underway to continue Job 3.1 during additional segments of W-87-R. Following is a summary of the major accomplishments and preliminary findings of Job 3.1.

Job 3.1. Factors affecting fawn:doe ratios in the harvest.–The objective was to examine pregnancy rates, numbers of lactating does (particularly yearlings) at check stations, and factors affecting the harvest of fawns in representative Illinois counties and their implications for deer management. The 1996 pilot study did not detect significant differences in prevalence of lactation between counties with high versus low harvest doe:fawn ratios. However, all regions except West-Central Illinois showed higher lactation rates in counties with a high harvest doe:fawn ratio. The 1997 collections did not reveal significant differences in conception rates, ovulation rates, or prevalence of lactation among counties sampled. Further sampling and analyses are planned for the next project segment. Also, analyses of the potential influence of hunter selectivity and the multiple permit structure on the harvest doe:fawn ratio is underway. A completion report in the form of a Master's thesis will be submitted in Segment 21 as a supplement to the findings of this job.

LITERATURE CITED

Finder, R. A. 1998. Relationships between landscape patterns and white-tailed deer/vehicle accidents. M.S. Thesis, Southern Illinois University at Carbondale, IL. 79pp

Foster, J. R. 1996. Effects of landscape pattern on susceptibility of white-tailed deer to harvest in Illinois. M.S. Thesis, Southern Illinois University at Carbondale, IL. 77pp.

Foster, J. R., J. L. Roseberry, and A. Woolf. 1997. Factors influencing efficiency of white-tailed deer harvest in Illinois. Journal of Wildlife Management 61:1091-1097.

McGarigal, K., and B. J. Marks. 1995. FRAGSTATS: spatial pattern analysis program for quantifying landscape structure. U.S. Forest Service General Technical Report PNW-351.

Roseberry, J. L. 1998. Illinois deer harvest analysis and modeling program (IDHAMP). Version 1.2: User's guide and reference manual. Cooperative Wildlife Research Laboratory, Southern Illinois University at Carbondale, IL. 34pp.

Roseberry, J. L., and Q. Hao. 1996. Interactive computer program for landscape-level habitat analysis. Wildlife Society Bulletin 24:340-341.

Roseberry, J. L., and A. Woolf. 1998. White-tailed deer habitat-population density relationships in Illinois. Wildlife Society Bulletin (submitted).

STUDY 1. POPULATION DYNAMICS AND ECOLOGY OF WHITE-TAILED DEER IN ILLINOIS

JOB 1.1. HABITAT INVENTORY, CLASSIFICATION, AND ANALYSIS

Objectives: To (1) inventory and quantify land use/land cover on a county basis and relate to white-tailed deer population densities and management strategies, and (2) incorporate the findings into IDHAMP to enhance predictive capabilities.

Digital files of habitat maps and data were provided agency staff as products that meet all job objectives. These files include the following: 102 county-level habitat maps suitable for incorporation into the Habitat Analysis and Modeling System (HAMS; Roseberry and Hao 1996); a statewide habitat map formatted for ArcView® software and compatible with the Illinois GIS (hardcopy map attached); and an updated IDHAMP (Roseberry 1998) data file containing habitat data by county.

A manuscript (Roseberry and Woolf 1998) that details methods and findings for this job is attached. Following is an abstract of the manuscript.

White-tailed deer (*Odocoileus virginianus*) have reached population densities in the agricultural Midwest that would not have been predicted 20-30 years ago. To help explain this phenomenon, we inventoried and analyzed potential deer habitat in Illinois using classified satellite imagery and a proximity-based habitat model. Statewide prehunt deer densities (ca 1992) were estimated at 4-5/km^2 of total area and 30-37/ km^2 of forest based on population reconstruction and modeling. Habitat suitability indices explained 81% of the variation in deer population densities at the county level. The amount and distribution of deer habitat in Illinois was primarily dependent upon intensity of agricultural land use which in turn was dictated by soil productivity and terrain. We found no evidence that relative use of available habitat at the county level was being adversely affected either by habitat fragmentation or human presence on the landscape.

LITERATURE CITED

Roseberry, J. L. 1998. Illinois deer harvest analysis and modeling program (IDHAMP). Version 1.2: User's guide and reference manual. Cooperative Wildlife Research Laboratory, Southern Illinois University at Carbondale, IL. 34pp.

Roseberry, J. L., and Q. Hao. 1996. Interactive computer program for landscape-level habitat analysis. Wildlife Society Bulletin 24:340-341.

Roseberry, J. L., and A. Woolf. 1998. White-tailed deer habitat-population density relationships in Illinois. Wildlife Society Bulletin (submitted).

JOB 1.2. DEER/HUMAN NONHUNTING INTERACTIONS

Objective: To determine relationships between land use/land cover patterns and negative deer/human interactions, especially automobile accidents.

A Master's thesis (Finder 1998) is attached in lieu of a final report for this job. Following is an abstract of that thesis.

Motor vehicle collisions with white-tailed deer (*Odocoileus virginianus*) in Illinois present several problems including danger to humans, vehicle damage, and deer mortality. Knowledge of factors influencing deer movements onto roads and highways is needed to reduce deer/vehicle collisions on existing roads, and for planning future roads. In order to build models to predict deer/vehicle accident numbers, I used geographic information and remotely-sensed data to measure variables that may be associated with these accidents. Using individual counties as the unit of analysis, I investigated relationships between deer/vehicle accidents and deer densities, deer habitat, human habitation patterns, traffic volume, and land ownership. Multiple regression results indicated that the combination of human and deer population densities explained most of the variance in deer/vehicle accident numbers at the county level ($R^2 = 0.68$, $P < 0.0001$). Other predictors included percentage of land in farms, percentage of timberland privately-owned, and percentage of wooded habitat per county. Percentage of land in farms and percentage of woods were negatively related to deer/vehicle accident densities, whereas percentage of timberland privately-owned, human population densities, and deer densities were positively related.

Topographic features and highway variables potentially conducive to deer/vehicle accidents were measured on aerial photographs and topographic maps within a 0.8 km radius around high accident sites ($\geq$15 accidents from 1989-1993) and around randomly selected control sites. Land cover composition and spatial structure were quantified around these sites with the computer program FRAGSTATS, using a statewide land cover classification derived from Landsat V TM satellite imagery. A logistic regression model predicted that greater distance to forest cover decreased the probability of a road segment being a high deer/vehicle accident site. The presence of adjacent gullies, riparian travel corridors crossing the road, and public recreational land within the 0.8 km radius increased this probability. A model using only landscape metrics predicted that greater landscape diversity and shorter distances between forest patches increased the probability of an area being a deer/vehicle accident site. Both models showed some discrimination between high and low accident sites. Therefore, proactive management of negative deer/human interactions may be accomplished through remote sensing and geographical information systems.

LITERATURE CITED

Finder, R. A. 1998. Relationships between landscape patterns and white-tailed deer/vehicle accidents. M.S. Thesis, Southern Illinois University at Carbondale, IL. 79pp

JOB 1.3. HARVEST EFFICIENCY

Objectives: To (1) determine relationships between land use/land cover and susceptibility of deer to control by recreational hunting, and (2) incorporate the findings into IDHAMP to enhance predictive capabilities.

This job was completed and reported in Segment 19. A published paper (Foster et al. 1997) that summarizes methods, results, and findings from that report is attached.

LITERATURE CITED

Foster, J. R., J. L. Roseberry, and A. Woolf. 1997. Factors influencing efficiency of white-tailed deer harvest in Illinois. Journal of Wildlife Management 61:1091-1097.

JOB 1.5. MULTIPLE PERMIT SYSTEMS AND TYPES

Objectives: To (1) examine the current multiple permit type system and its effects on harvest rates, harvest composition, and hunter satisfaction, and (2) incorporate the findings into IDHAMP to enhance predictive capabilities.

INTRODUCTION

Deer hunting in Illinois is regulated by various types of permits. Issuance of regular firearm (shotgun) permits is based on quotas established for each of the 98 Illinois counties open to deer hunting. Currently, shotgun permits account for >70% of the total Illinois deer harvest. In 1991, IDNR began to issue multiple permits to individual hunters including some that restricted harvest to antlerless deer (fawns and does). Currently, landowners or resident tenants can obtain a free permit to hunt on their property or they can pay for a permit to hunt anywhere in their county of residence. Those issued free permits received 1 antlerless-only and 1 either-sex permit good for both the 1st and 2nd season. Landowners paying for their permit can obtain 1 full season either-sex permit and 1 full-season antlerless only permit. Landowners and non-landowners also can apply for 1 full season, county-wide, any-deer permit and 1 bonus antlerless-only permit that are issued by lottery. Additional drawings for either-sex and antlerless-only permits (full season and 2nd season only) are conducted after the initial lottery to distribute permits remaining in county quotas.

METHODS

Datasets describing number of permits issued and harvest composition by individual hunter and permit type during the 1995 season were assembled by IDNR Forest Wildlife staff from information provided by IDNR Division of Systems and Licensing. These datasets were then analyzed using various computer software including PARADOX (Borland Int., Inc., Scotts Valley, CA), and in-house FORTRAN (Microsoft Corp., Redmond, WA) programs. Inferential statistics were not used because the entire population of interest was represented by the data.

In this report, permit types are described by a 3-part designation: the 1st word refers to method of issuance (REGULAR [lottery], PAID landowner, or FREE landowner); the 2nd refers to season (FULL season, or SECOND season only); and the 3rd refers to type of deer allowed (EITHER sex, or ANTLERLESS only).

FINDINGS AND DISCUSSION

Permits Issued

Approximately 269,000 shotgun deer hunting permits were issued to 180,500 individual hunters in Illinois during the 1995 firearm season. Almost three-fourths (73.4%) of these were REGULAR permits, 24.3% were FREE, and 2.3% were PAID (Fig. 1). Of this total, 71.0% were EITHER and 29.0% were ANTLERLESS permits; while 92.5% were FULL and 7.5% were SECOND.

Success by Permit Type

Success rate for FULL permits was highest among PAID (46.9%) and lowest among FREE (28.4%); success of REGULAR permits was 44.2% (Table 1). The relatively high success rate for PAID permits probably reflects the fact that holders of this type of permit actively requested them and were hunting in their county of residence. The relatively low success for FREE permits may be due to a combination of factors including a) one-half of the permits were not specifically requested, b) these hunters were restricted to a more limited area (their property), and c) check station compliance might be somewhat lower among this group. It is interesting to note that total permit success was higher (40.3%) among holders of FREE landowner permits who also purchased 1 or more other types of permits.

Permit success rates were higher for ANTLERLESS than for EITHER permits among all 3 types of permit holders (REGULAR, PAID, FREE) (Table 1). This finding suggests that hunters tended to use their ANTLERLESS tag for the first doe or fawn they killed, thus saving their EITHER permit for a possible second deer (for which their success rate was lower).

Among REGULAR permit holders, success for FULL permits (44.2%) was almost twice as high as for SECOND permits (23.0%). The relative difference was somewhat greater among EITHER than among ANTLERLESS permits (Table 2). Lower success for SECOND permits would be expected because of deer population attrition due to first season harvest, and the fact that holders could hunt a maximum of only 4 days rather than 7.

Harvest Composition by Permit Type

Considering only FULL permits, females comprised 29.7% of the harvest from EITHER permits compared to 70.6% from ANTLERLESS permits (Table 3). Proportional harvest of females from ANTLERLESS permits was virtually identical among REGULAR, PAID, and FREE permit holders. In contrast, FREE permit holders killed only 16.4% females with their EITHER tags compared to 31.0 and 31.6% for PAID and REGULAR permit holders, respectively. However, because FREE permit holders had equal numbers of EITHER and ANTLERLESS permits, their total female harvest (45.1%) was slightly greater than for the REGULAR or PAID group. The percentage of deer tagged with ANTLERLESS permits that were actually yearling or adult males averaged 5.8% from 1991 through 1996 (range 4.1 - 7.3%).

Holders of SECOND permits killed relatively more females (51.2%) than did FULL season permit holders (42.3%) (Table 4). This finding was not unexpected as the 2nd season harvest traditionally contains relatively more females than the 1st season harvest. Possible reasons for this were discussed by Roseberry and Woolf (1988).

The percentage of permits resulting in a female kill was computed for each permit type by combining overall percent success with percent females in the their harvest. The most efficient permit in terms of harvesting females was the PAID/FULL/ANTLERLESS with a success rate of 39.8%, followed closely by REGULAR/FULL/ANTLERLESS at 37.1% (Fig. 2). Female harvest efficiency was intermediate (23.2 and 21.4%) for REGULAR/SECOND/ANTLERLESS and FREE/SECOND/ANTLERLESS permits. Female harvest efficiency was lowest for all types of EITHER permits with only 4.3% of the FREE/EITHER/FULL permits resulting in a female kill.

Number of Permits Held

Of the 180,500 individual shotgun deer hunters in 1995, 54.6% held just 1 permit, 42.9% had 2 permits, and 2.5% had 3 or more permits (maximum 12). The 2-permit group held 57.5% of all permits and killed 56.7% of all deer (Fig. 3). The vast majority (87.9%) of the single permit holders held a REGULAR/FULL/EITHER permit while 8.4% had a REGULAR/SECOND/ EITHER. Just over 47% of the 2-permit group consisted of the REGULAR/FULL/EITHER and REGULAR/FULL/ANTLERLESS combination while 40.7% had a FREE/FULL/EITHER and a FREE/FULL/ANTLERLESS permit. Almost 71% of the 3-permit group held some combination of 3 REGULAR permits while 24.4% had a combination of 2 FREE and 1 REGULAR permit. The perception that many individual hunters acquire numerous permits was not substantiated by the data. Only 280 of 180,000+ hunters (< 2/10s of 1%) had 5 or more permits (Table 5). These hunters killed 748 deer (less than 1% of the total harvest). Only 9.6% of the PAID permit holders and 3.6% of the FREE permit holders purchased additional REGULAR permits.

Permit success rate was highest (53.5%) among holders of 3 permits and lowest (37.7 and 38.3%, respectively) for holders of 1 and 2 permits (Table 5). The 1-permit group probably contained the largest proportion of casual hunters whereas the 2-permit group contained a relatively large number of free landowner permit holders who, as a group, had the lowest overall success rate.

Contrary to another general perception, holders of multiple permits did not harvest a disproportionate number of bucks. In reality, just the opposite was true. There was a general tendency for hunters with relatively more permits to harvest relatively more females (Table 5).

Harvest by Individual Hunters

Still another misconception among some is that a number of individual hunters are taking large numbers of deer, especially bucks. Figure 4 clearly shows this perception to be incorrect. Over 52% of all hunters killed no deer, 37.9% harvested 1 deer, 8.9% took 2 deer, and only 0.6% took 3 or more deer (maximum 9). Eighty percent of the successful hunters took only 1 deer, 18.8% harvested 2, and 1.2% took 3 or more deer during the 1995 shotgun season in Illinois (Fig. 4). Only 53 of the >180,000 hunters took 3 or more adult males. In fact, hunters that killed multiple deer tended to take a higher percentage of females than hunters that harvested only 1 or 2 animals (Table 6).

Effect of Permit System on Harvest Rates and Composition

Initiation of the multiple permit system in 1991 including issuance of antlerless-only permits appeared to have an immediate and positive impact on the relative harvest of females. Percentage of females in the total shotgun harvest averaged 38.0% from 1985 through 1990 (range 35.6 - 40.1%) compared to 44.0% since 1991 (range 43.2 - 45.2%) (Fig. 5). Based on IDHAMP simulations, the estimated mean harvest rate of females increased from 0.103 during 1985-1990 (range (0.098 - 0.109) to 0.144 during 1991-1996 (range 0.134 - 0.160) (Fig. 6).

LITERATURE CITED

Roseberry, J. L., and A. Woolf. 1988. Evidence for and consequences of deer harvest data biases. Proceedings. Annual Conference Southeastern Association Fish and Wildlife Agencies 42:306-314.

Table 1. Percent success by type of shotgun deer permit[a], Illinois, 1995.

	Either		Antlerless Only		Total	
	Number Issued	Percent Success	Number Issued	Percent Success	Number Issued	Percent Success
Regular	136,619	41.7	40,933	52.4	177,552	44.2
Paid	4,729	43.9	1,466	56.4	6,195	46.9
Free	32,818	26.4	32,675	30.5	65,493	28.4
Total	174,166	38.9	75,074	42.9	249,240	40.1

[a]Full-season permits only.

Table 2. Percent success for full and second season shotgun permits[a], Illinois, 1995.

	Either		Antlerless Only		Total	
	Number Issued	Percent Success	Number Issued	Percent Success	Number Issued	Percent Success
Full Season	136,619	41.7	40,933	52.4	177,552	44.2
Second Only	17,188	21.5	3,037	31.0	20,255	23.0
Total	153,807	39.5	43,970	50.9	197,777	42.0

[a]Regular (lottery) permits only.

Table 3. Percent female harvest by type of deer permit[a], Illinois, 1995.

	Either		Antlerless Only		Total	
	Number Killed	Percent Female	Number Killed	Percent Female	Number Killed	Percent Female
Regular	56,991	31.6	21,437	70.8	78,429	42.3
Paid	2,076	31.0	827	70.6	2,903	42.3
Free	8,662	16.4	9,958	70.1	18,620	45.1
Total	67,729	29.7	32,222	70.6	99,952	42.8

[a]Full-season permits only.

Table 4. Percent female harvest for full and second season only shotgun deer permit[a], Illinois, 1995.

	Any Deer		Antlerless Only		Total	
	Number Killed	Percent Female	Number Killed	Percent Female	Number Killed	Percent Female
Full Season	57,991	31.6	21,437	70.8	78,428	42.3
Second Only	3,699	45.2	942	74.7	4,641	51.2
Total	60,690	32.5	22,379	70.9	83,069	42.9

[a]Regular (lottery) permits only.

Table 5. Harvest according to number of permits held by individual hunters, Illinois, 1995.

Number of Permits Held	Total Hunters	Total Permits	Total Harvest	Hunter Success	Permit Success	Percent Females In Harvest
1	98,548	98,548	37,198	37.7	37.7	38.0
2	77,368	154,736	59,270	57.6	38.3	45.8
3	3,150	9,450	5,060	80.3	53.5	44.6
4	1,154	4,616	2,210	85.0	47.9	48.1
5	175	875	412	86.3	47.1	44.9
6	75	450	236	93.3	52.4	52.5
7-12	30	248	100	90.0	40.3	58.0
Total	180,500	268,923	104,486	47.4	38.9	43.0

Table 6. Distribution of deer harvest among individual hunters, Illinois, 1995.

Number of Deer Taken	Hunters		Percent Females In Harvest
	Number	Percent	
0	94,982	52.6	----
1	68,446	37.9	40.3
2	16,111	8.9	48.6
3	759	0.4	47.8
4	159	0.1	51.1
5	30	<0.1	48.6
6	7	<0.1	57.4
7	1	<0.1	71.4
8	3	<0.1	50.0
9	1	<0.1	55.6

Fig 1. Proportion of total permits issued and harvest by permit type (Lottery or regular, paid landowner, free landowner).

Fig 2. Percentage of permits that resulted in harvest of a female deer. PFA - PAID/FULL/ANTLERLESS, RFA - REGULAR/FULL/ANTLERLESS, R2A - REGULAR/SECOND/ANTLERLESS, FFA - FREE/FULL/ANTLERLESS, PFE - PAID/FULL/EITHER, RFE - REGULAR/FULL/EITHER, R2E - REGULAR/SECOND/EITHER, FFE - FREE/FULL/EITHER.

Fig 3. Percentage of hunters holding 1, 2 or $\geq$3 permits, and the percentage of total permits issued and deer harvested they accounted for.

Fig 4. Percentage of hunters that took 0, 1, 2, and $\geq$3 deer.

Fig 5. Percentage of antlerless permits issued vs. proportion of females in the harvest, 1985 - 1996.

Fig 6. Percentage of antlerless permits issued vs. estimated harvest rate of females, 1985 - 1996.

JOB 1.6. ANALYZE AND REPORT

Objectives: To (1) analyze results and prepare products from Jobs 1.1, 1.2, 1.3, and 1.5; and (2) to report and discuss findings and present products in a timely manner.

Objectives of this job were met through preparation of quarterly, annual, and this final report. Also, digital files, map products, and amended software were provided IDNR staff whenever specified in job objectives.

STUDY 3. DEER REPRODUCTION/RECRUITMENT

JOB 3.1. FACTORS AFFECTING FAWN:DOE RATIOS IN THE HARVEST

Objective: To examine pregnancy rates, numbers of lactating does (particularly yearlings) at check stations, and factors affecting the harvest of fawns in representative Illinois counties and their implications for deer management.

INTRODUCTION

Since 1987, the white-tailed deer harvest fawn:doe ratio (HFDR) in Illinois has steadily declined. One possible cause of this phenomenon is a change in fawn recruitment. During the 1996 deer firearms season, we conducted a pilot study to investigate female fawn reproduction. We looked at yearling females potentially bred as fawns because fawn reproductive rates respond more rapidly to population changes than any other demographic parameter. Thus, trends in fawn reproduction may be an indicator of trends in population size and a benchmark for management decisions (Sauer and Severinghaus 1977). Based on our findings from data collected during the 1996 firearm season, we decided to collect reproductive tracts from hunter harvested female deer during the 1997 firearms deer season.

With data provided by the IDNR, we analyzed HFDR by permit type in 12 counties throughout Illinois for years 1980-1995. We focused our analysis on differences in HFDR by permit type between high and low HFDR counties, as well as differences in HFDR among permit types on a statewide basis. Also, we investigated change in hunter selectivity between pre- and post 1987. Continuing work is focused on quantifying magnitude of change and factors influencing hunter selectivity.

METHODS

1996 Pilot Study

We collected data from female yearlings and fawns harvested during the first 2 days of the first shotgun season (22 and 23 Nov. 1996) in 8 counties throughout Illinois. These counties were chosen for 3 reasons: (1) an adequate sample was obtainable, (2) they had either a constant high or low HFDR, and (3) they represented 4 major regions of the state (North, West-Central, South-Central, South). Two counties were selected from each region, 1 with a high HFDR and 1 with a low HFDR. Data collected included weights of female yearlings and fawns, and lactation status and teat lengths of yearling females.

Hunters who harvested yearling females were asked if the harvested deer had been lactating. If the udder was present on the carcass, we examined it to verify hunter response. Yearlings were then weighed to the nearest pound using a 200 pound capacity hanging scale with 2-pound increments. We measured yearling weight to test the hypothesis that non-lactating yearlings weigh more than lactating yearlings, due to energetic costs of gestation and lactation.

After recording yearling weight, all teats present were measured to the nearest millimeter with a 15 cm plastic ruler. Teats removed during evisceration were noted. Teat lengths were measured to test the hypothesis that lactating female yearlings had longer teats (due to suckling) than non-lactating female yearlings.

We used independent t-tests (PROC TTEST; SAS Inst. 1990) to compare weights and teat length by lactation status. Fisher's Exact Tests were used to test for differences in percent lactation between counties with high HFDR and counties with low HFDR within the same region using PROC FREQ (SAS Inst. 1990). Mean weights were generated for fawns for each region using PROC MEANS (SAS Inst. 1990).

1997 Female Reproductive Tract Collection

Postcards describing white-tailed deer reproductive tract removal procedures were sent to approximately 38,000 hunters in 14 Illinois counties. The hunters were informed that the collection would take place only during the first deer shotgun season and only at check stations in the 14 designated counties. These counties were selected on the basis of previous HFDR and geographic location. Hunters were asked to remove the reproductive tracts from harvested females and bring them to check station operators when registering their deer. Check station operators collected reproductive tracts only from does harvested in the county they were working and only when the age of the doe was determined by the tooth wear and replacement technique (Severinghaus 1949). The operator then removed the ovaries from the reproductive tract and placed them in a container. If only 1 ovary was present it was collected as well. The age of the doe was labeled on 3 sides of the container and placed in a bucket containing 10% formalin. After the 3 days of collection, all of the buckets containing ovaries were returned to the Cooperative Wildlife Research Laboratory at Southern Illinois University at Carbondale.

Ovarian analysis was performed using the gross sectioning method originally described by Cheatum (1949). Conception rates for the fall-winter 1996 breeding season were determined by the percentage of yearling and older deer with corpora albicantia (CA) (pigmented "scars") present in their ovaries. The number of shed ova per doe for the same breeding season was estimated by counting the number of corpora albicantia present in both ovaries. The number of shed ova per doe that had ovulated to date in the current breeding season was determined by counting corpora lutea of pregnancy in both ovaries. Differences in breeding by age class between high and low HFDR counties were tested using a chi square test. The level of significance was $P = 0.05$.

Lactation data also were collected during the 1997 Illinois deer shotgun season. When registering a doe, hunters were asked if they noticed milk in the udder during evisceration. These data were recorded with the age of the animal and county of harvest on the IDNR check station data sheets. We obtained check station data sheets for the same 14 counties in which we collected ovaries and tallied the number of does lactating and not lactating for each age class (1.5, 2.5, and 3.5+) by county. All high HFDR county data were then combined by age class, as were the low HFDR county data. The difference in percent does lactating between high and low HFDR counties was tested using a 2x2 contingency table. Lactation data were compared to the percent does with CA to estimate fawn summer mortality.

RESULTS

1996 Pilot Study

A total of 368 yearling females was examined; 105 (28.5%) were lactating. Teats from lactating females were longer ($P < 0.0001$) than teats from non-lactating females (Table 1). Although we hypothesized lactating female yearlings would weigh less than non-lactating female yearlings, the West-Central region was the only region that showed a difference in weights ($P < 0.01$; Table 2).

Although Fisher's Exact Test did not detect a significant difference in prevalence of lactation between counties with high and low HFDRs, all regions except West-Central showed a higher lactation rate in the counties with a high HFDR (Table 3). Average weights for 333 female fawns by region ranged from 23.9-30.0 kg (Table 4).

1997 Female Reproductive Tract Collection

The percent does with CA averaged 41.6, 93.3, and 96.2 for yearling, 2.5 year-olds, and 3.5+ year-olds respectively (Table 5). Percent does with CA and number of CA per doe did not differ among regions (Tables 6 and 7). Also, percent does with CA did not differ between high and low HFDR counties, and no difference existed in the number of CA per breeding doe between high and low HFDR counties (Table 8). No differences were detected between lactation rates in high and low HFDR counties; however, the percent does with CA differed ($P < 0.01$) from the percent does lactating in both high and low HFDR counties (Tables 9 and 10).

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Table 1. Mean[a] teat lengths (mm) of female yearling white-tailed deer collected in 8 counties of Illinois during the first 2 days of the first shotgun season (22 and 23 November 1996).

Lactation Status	*n*	$\bar{x}$	SD	*t*	*P*
Lactating	57	15.2	3.4	-11.5	0.0001
Non-lactating	196	9.4	3.1		

[a]For each deer, 1-4 teats were measured depending upon number present; if >1, analysis was based on mean length.

Table 2. Dressed body weights (kg) of female yearling white-tailed deer collected in 4 regions of Illinois during the first 2 days of the first shotgun season (22 and 23 November 1996).

Region	Lactation Status	*n*		SD	*t*	*P*
North	Lactating	22	44.8	3.5	-0.1018	0.9193
	Non-lactating	48	44.7	4.8		
West-Central	Lactating	18	42.9	4.0	2.84	0.0082
	Non-lactating	79	46.0	4.6		
South-Central	Lactating	46	43.9	4.4	0.4076	0.6845
	Non-lactating	73	44.2	4.4		
South	Lactating	19	40.5	5.4	-1.35	0.1869
	Non-lactating	63	38.7	4.9		

Table 3. Prevalence of lactation among female yearlings in selected counties for 4 regions of Illinois during the first 2 days of the first shotgun season (22 and 23 November 1996).

County	Fawn:Doe Ratio	*n*	Percent Lactation	*P*[a]
North Region				
Whiteside	High	31	32.3	0.549
Ogle	Low	39	30.7	
West-Central Region				
Hancock	High	56	14.3	0.759
Macoupin	Low	36	22.2	
South-Central Region				
Fayette	High	71	42.3	0.292
Randolph	Low	48	33.3	
South Region				
Pulaski	High	16	31.3	0.216
Jackson	Low	66	21.2	

[a]P-values are results of Fisher's one tailed test.

Table 4. Dressed body weights (kg) of female fawns collected in 4 regions of Illinois during the first 2 days of the first shotgun season (22 and 23 November 1996).

Region	*n*	$\bar{x}$	SD
North	67	28.4	4.5
West-Central	75	30.0	3.6
South-Central	109	28.5	4.3
South	82	23.9	4.5

Table 5. Occurrence of corpora albicantia (CA) and corpora lutea (CL) in female white-tailed deer collected from designated high and low harvest fawn:doe ratio (HFDR) counties during the 1997 Illinois deer shotgun season. Sample sizes are given in parentheses.

		Occurrence of corpora albicantia						Occurrence of corpora lutea		
		1.5-year-old does		2.5-year-old does		Does 3.5 years or older		1.5-year-old does	2.5-year-old does	Does 3.5 years or older
Region	County class	% with CA	No. per doe[1]	% with CA	No. per doe	% with CA	No. per doe	No. per doe[1]	No. per doe	No. per doe
1	High	28.6 (7)	1.00 (2)	100 (6)	2.50 (6)	100 (2)	2.00 (2)	2.17 (6)	2.50 (6)	2.50 (2)
	Low	50.0 (4)	2.50 (2)	100 (12)	2.83 (12)	100 (6)	2.50 (6)	2.25 (4)	2.73 (11)	2.00 (6)
2 ,5[2]	High	57.1 (7)	1.75 (4)	100 (7)	2.57 (7)	100 (1)	3.00 (1)	2.14 (7)	3.14 (7)	2.00 (1)
	Low	100 (6)	2.67 (6)	100 (2)	2.00 (2)	--	--	2.50 (6)	3.00 (2)	__
3	High	60.0 (5)	1.33 (3)	100 (4)	2.75 (4)	100 (7)	2.00 (7)	1.50 (4)	2.67 (3)	2.29 (7)
6	High	44.4 (9)	2.25 (4)	83.3 (12)	2.10 (10)	83.3 (6)	2.20 (5)	2.17 (6)	2.00 (11)	2.20 (5)
	Low	44.4 (9)	1.00 (4)	100 (11)	1.91 (11)	100 (6)	2.17 (6)	2.33 (9)	2.33 (9)	2.17 (6)
7	High	37.5 (16)	1.50 (6)	100 (14)	2.79 (14)	100 (6)	2.33 (6)	2.23 (13)	2.50 (14)	2.67 (6)
	Low	47.6 (21)	1.40 (10)	92.0 (25)	2.04 (23)	100 (9)	2.56 (9)	2.28 (18)	1.80 (25)	2.22 (9)
8	High	50.0 (8)	2.00 (4)	100 (3)	2.33 (3)	85.7 (7)	2.00 (6)	2.00 (8)	1.33 (3)	2.43 (7)
	Low	35.3 (17)	2.33 (6)	87.1 (31)	1.89 (27)	100 (19)	2.00 (19)	1.71 (14)	2.23 (30)	2.06 (16)

[1]Based only on does with both ovaries present and having (CA) or (CL) present.

[2] High HFDR county was selected from region 2 and low HFDR county was selected from region 5.

Table 6. Differences in conception rate by age and county class among does harvested in Illinois deer management regions. Regions were combined according to geographic location. Ovaries were collected from does harvested during the 1997 shotgun season.

		% does with corpora albicantia (*n*)						
Age	County class	Region 1	Regions 2,5	Regions 3,4	Regions 6,7	Region 8	χ^2	*P*
1.5	High	28.6 (7)	57.1 (7)	42.9 (7)	40.0 (25)	50.0 (8)	0.57	0.97
	Low	50.0 (4)	100 (6)	41.2 (17)	46.7 (30)	35.3 (17)	2.25	0.69
2.5	High	100 (6)	100 (7)	88.9 (9)	92.3 (26)	100 (3)	0.05	0.99
	Low	100 (12)	100 (2)	83.3 (24)	94.4 (36)	87.7 (31)	0.20	0.99
3.5+	High	100 (2)	100 (1)	100 (10)	91.7 (12)	85.7 (7)	0.06	0.99
	Low	100 (6)	--	86.7 (15)	100 (15)	100 (19)	0.11	0.99

Table 7. Differences in numbers of corpora albicantia per breeding doe by age and county class among Illinois deer management regions. Regions were combined according to geographic location. Ovaries were collected from does harvested during the 1997 Illinois deer shotgun season.

		No. corpora albicantia per doe[1] (*n*)						
Age	County class	Region 1	Regions 2,5	Regions 3,4	Regions 6,7	Region 8	χ^2	*P*
1.5	High	1.00 (2)	1.75 (4)	1.33 (3)	1.80 (10)	2.00 (4)	0.48	0.98
	Low	2.50 (2)	2.67 (6)	1.71 (7)	1.29 (14)	2.33 (6)	2.03	0.73
2.5	High	2.50 (6)	2.57 (7)	2.75 (8)	2.50 (24)	1.89 (27)	0.06	0.99
	Low	2.83 (12)	2.00 (2)	2.10 (20)	2.00 (34)	2.00 (6)	1.06	0.90
3.5+	High	2.00 (2)	3.00 (1)	2.30 (10)	2.27 (11)	2.00 (6)	0.14	0.99
	Low	2.50 (6)	--	2.69 (13)	2.40 (15)	2.00 (19)	0.89	0.83

[1]Based only on does with both ovaries present and having corpora albicantia.

Table 8. Comparisons of conception rates and numbers of corpora albicantia per breeding doe by age class between does harvested from high and low harvest fawn:doe ratio (HFDR) counties in Illinois. Ovaries were collected from does harvested during the 1997 shotgun season.

	Percent does with corpora albicantia (*n*)				No. corpora albicantia per breeding doe[1] (*n*)			
Age	High HFDR counties	Low HFDR counties	χ^2	*P*	High HFDR counties	Low HFDR counties	χ^2	*P*
1.5	42.6 (54)	47.3 (74)	0.22	0.64	1.70 (23)	1.86 (35)	0.07	0.79
2.5	94.1 (51)	90.5 (105)	0.60	0.44	2.54 (48)	2.09 (95)	0.84	0.36
3.5+	93.8 (32)	96.4 (55)	0.32	0.58	2.23 (30)	2.48 (50)	0.03	0.87

[1]Based only on does with both ovaries present and having corpora albicantia.

Table 9. Percent does lactating in high harvest fawn:doe ratio (HFDR) counties versus percent does lactating in low HFDR counties. Lactation data were collected at 14 designated counties in Illinois during the 1997 deer shotgun season.

	Percent does lactating (*n*)			
Age	High HFDR counties	Low HFDR counties	χ^2	*P*
1.5	33.3 (409)	29.9 (605)	1.26	0.26
2.5	53.8 (394)	56.9 (636)	0.95	0.33
3.5+	63.5 (260)	60.8 (309)	0.41	0.52

Table 10. Percent does with corpora albicantia (CA) versus percent does lactating for data collected in high and low harvest fawn:doe ratio counties during the 1997 Illinois deer shotgun season.

	High HFDR County Data				Low HFDR County Data			
Age	% with CA (n)	% Lactating (n)	χ^2	*P*	% with CA (n)	% Lactating (n)	χ^2	*P*
1.5	42.6 (54)	33.3 (409)	1.85	0.174	47.3 (74)	29.9 (605)	9.18	0.002
2.5	94.1 (51)	53.8 (394)	30.21	< 0.001	90.5 (105)	56.9 (636)	42.94	< 0.001
3.5+	93.8 (32)	63.5 (260)	11.78	< 0.001	96.4 (55)	60.8 (309)	18.65	< 0.001

JOB 3.2. ANALYZE AND REPORT

Objectives: To analyze results and prepare reports for Job 3.1 in a timely manner.

Objectives of this job were met through preparation of quarterly, annual, and this final report. Also, periodic meetings were held with IDNR, Division of Wildlife Resources, Forest Wildlife Program staff to discuss findings and project progress.

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