The white-tailed deer in Governor Dodge State Park. Report 109 [1981]

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DEPARTMENT OF NATURAL RESOURCES

RESEARCH

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THE WHITE-TAILED DEER IN GOVERNOR DODGE STATE PARK

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ABSTRACT

Populations, harvest characteristics, productivity and fall foods of white-tailed deer were studied from 1976-79 in the 2,034-ha Governor Dodge State Park situated in southwestern Wisconsin. Park deer freely interchange with deer from the surrounding area.

A mean 1976-79 prehunt population estimate of 466 deer (24.2/km^2) was determined from trail counts and sex-age-kill data. Dead deer searches in April 1979 estimated a fall-to-spring loss of 177±77 ($P < 0.05$) animals. These losses represented deer shot but not retrieved during the 1978 season (21%), those dying of starvation during the severe winter of 1978-79 (68%), and those lost to other unknown causes (11%).

Ninety-five percent of the yearlings in the 1977-79 sample of 132 bucks had forked antlers. Park deer were heavier than deer from the Sandhill Wildlife Area in central Wisconsin.

The daily hunter success rate (50%) was greatest during the last two days of the season: 42% of all deer registered were taken during the opening weekend. Ancillary 1979 data from 261 hunter questionnaires indicated that a high quality hunt occurred at the park.

Analysis of 203 pairs of deer ovaries disclosed that most yearling and adult does bore fawns, 21% of the fawns conceived and gross productivity was estimated at 1.00 fawn/doe. Spotlight counts and summer observations produced similar net productivity estimates.

Acorns were the most common food found in 75 rumen samples collected during November 1976.

Changes to Hunter's Choice permits in 1980 and a muzzle-loader-only season in 1981 will increase the numbers of hunter permits required to maintain the average of 1976-79 harvest, possibly causing a shift in the sex and age of deer harvested.

Additional research employing radio-tagging, ovary analysis, intensive fawn/doe observations, and aging would aid future deer management within the park and supplement the available data base for southern Wisconsin deer population analysis.

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INTRODUCTION

The white-tailed deer has a high popularity in Wisconsin in terms of hunter participation and public interest. Various aspects of Wisconsin deer ecology have been studied such as natural history (Dahlberg and Guettinger 1956), deer hunting history (Bersing 1956), the role of forest openings in the summer deer range (McCaffery and Creed 1969), and road kills as indexes to deer populations (McCaffery 1973). Statewide deer populations have been monitored annually since the early 1960's, but most of the more intensive research on local herd dynamics within a small unit of range has been conducted in northern or central Wisconsin.

During 1960-79, deer populations greatly increased in the central and southwestern portions of the state. Major negative effects of the rapidly growing southern Wisconsin deer herd have been more deer-vehicle accidents (Stroebe 1971; Pils and Martin 1979), increased deer damages to crops (Stroebe 1971; Pils 1979a), and crowded hunting conditions (Wozencraft 1978). Wildlife managers are faced with the problem of managing herd size on the basis of how many deer people will tolerate in the south rather than the amount of available winter ranges as in the north (Stroebe 1971).

Estimates of deer population density in mangement units are based on the sex-age-kill method (Eberhardt 1960 and Creed and Haberland 1980). However, productivity rates, fawn sex ratios, and adult buck mortality rates currently used to derive sex-age-kill estimates need refinement for southern Wisconsin management units. The objectives of this investigation were to help determine population characteristics, harvest rates, and productivity of deer in the agricultural range. In addition, foods were analyzed during 1976 to sample forage utilization by agricultural range deer.

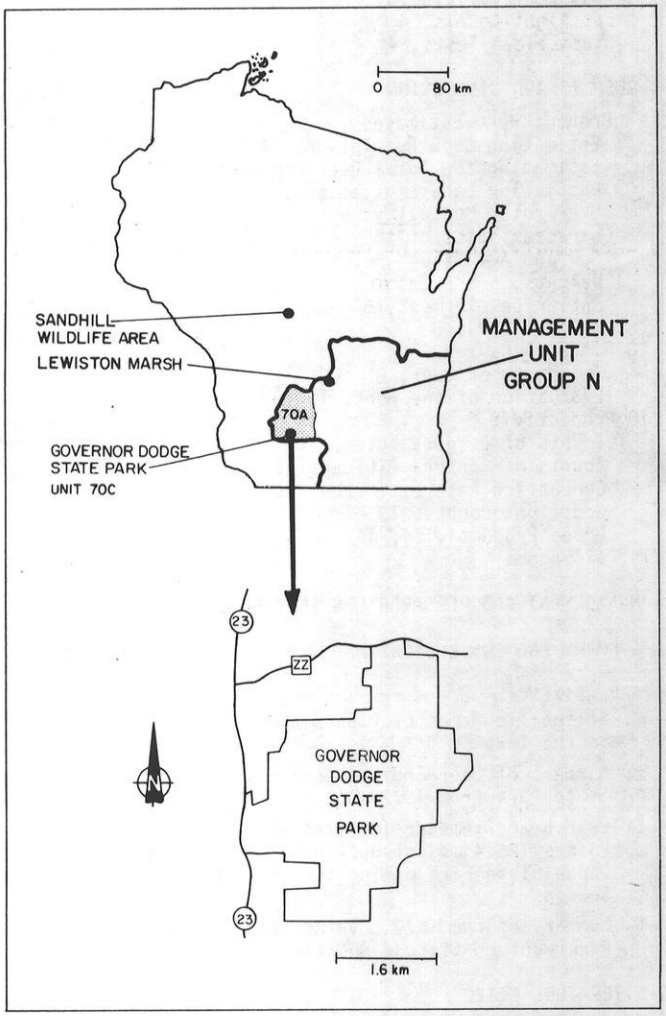

FIGURE 1. Location of Governor Dodge State Park and the Sandhill Wildlife Area.

STUDY AREA

Governor Dodge State Park (GDSP) located 72 km west of Madison in the driftless area of southwestern Wisconsin (Fig. 1) was chosen as the study area because of its high deer densities and history of controlled hunting. However, deer freely enter and leave the park so that it is not possible to define a "park population" of deer. The 2,034-ha park is surrounded by a 1.2-m-high, 2-strand wire fence which allows deer easy access to and from the park. The rolling hills of GDSP, ranging up to 373 m in height, are composed of a layering of limestones, shales, and sandstones.

Two small creeks lying in the main valleys of the park are the upper branches of Mill Creek which runs northward to the Wisconsin River. The creeks have been dammed to create Cox Hollow (39 ha) and Twin Valley (62 ha) lakes.

The soils of the park vary from rich loam on the ridgetops and in the flatter valleys to sandy loams and sands on the slopes and below the sandstone precipices.

The forests within the park are primarily deciduous consisting of white oak, black oak, and bur oak stands and openings. The sandstone areas support red pine, white pine and a few jack pine. Many open fields were formerly pasture or cropland and are now dominated by smooth brome, quackgrass and bluegrass (Append. A). Forty mammal species have been seen in the park including signs of coyotes and domestic dogs, which are the only potential predators of deer in the park, other than man (Append. A).

Since a primary park policy is to preserve native plants, GDSP personnel were concerned that high numbers of deer in the park would destroy stands

of white pine and eastern juniper. The extremely severe winter of 1970-71, characterized by deep snow and below normal temperatures, led to the initiation of deer hunting in GDSP. The first 9-day hunting season, utilizing the variable quota system, was initiated in November 1972.

The Wisconsin variable quota system permitted the limited harvest of antlerless deer to maintain populations at prescribed overwinter goals. GDSP was designated as a separate Management Unit (quota area) and assigned a quota of 100 deer of either sex for 1972. The quota was raised to 150 deer from 1973-79. The system permitted 4 hunters to obtain 1 permit; however, only 1 person could hunt in the park at a time.

METHODS

POPULATION ESTIMATES

During the winter months, public use of GDSP is minimal, and is primarily limited to cross-country skiers. Because the park is a relatively undisturbed wintering area, it attracts deer from the surrounding private lands. Many of these deer are thought to enter GDSP during the fall and gun deer season and remain there until spring. While all of these deer do not spend the entire winter within park boundaries, herd densities remain at a much higher level than found on private lands in the adjacent portions of Iowa County. The October-March GDSP herd is undoubtedly a composite group that includes deer which inhabit both the park and adjacent private lands during the year, and deer which move into GDSP only during the fall and/or winter months.

Annual GDSP deer populations were estimated by two methods.

Sex-Age-Kill

The first technique utilized a pooled sex-age-kill estimate (Creed et al. 1978). The sex-age-kill data were combined with legal kill statistics to estimate deer numbers by first estimating the buck population and then expanding the estimated number of bucks to the total deer.

Trail Count Expansion Factor

McCaffery (1976) estimated prehunt fall deer densities by comparing deer trail counts with other indexes of deer abundance. Although density estimates from trail counts were calculated from two formulas cited in McCaffery (1976), deer/km^2 could also be approximated by multiplying the mean number of trails/transect by 2 (McCaffery 1979:3). Deer trails were counted along 26, randomly distributed, 0.4 km transects during November (prehunt) 1976-79. Numbers of deer trails observed intersecting the transects were recorded for each 80-m transect interval. Procedures for defining trails, tallying results and estimating deer abundance were reported by McCaffery (1976).

HARVEST CHARACTERISTICS

Sex, Age and Weight Measurements

Hunters were required to check in and out of the park entrance daily, thus facilitating data collection. Sex and age data were collected during the regular 9-day November 1976-79 gun deer hunting season. Weights and antlers were measured in 1977-79. All deer were aged by the tooth wear criteria of Ryel et al. (1961). Field-dressed deer were weighed on a standard beam-balance scale. The number of points over 7.6 cm were counted and the maximum and minimum right beam diameters 5 cm from the base were measured using a metric caliper. The two beam measurements were averaged to obtain the mean beam diameter.

Reproductive Tract and Rumen Collection

Female reproductive tracts were also collected and analyzed. DNR personnel provided each hunter with an instruction sheet, a park map, orange or yellow marking flags and a plastic bag. Hunters shooting does either removed the uterus themselves and returned it to the check station, or marked the viscera location by placing numbered flagging both on a nearby tree or bush and at the point were the deer was dragged to a road or trail. DNR personnel then located the viscera from hunter information and removed the reproductive tract. Corpora lutea and corpora albicantia were counted using the technique of Cheatum (1949: 285-289).

Rumina were also collected during the 1976 hunting season. One handful of rumen contents was taken from each deer or viscera examined and placed in a 1-liter jar partially filled with a 10% formalin solution. Foods found in the rumina were analyzed by the method of Chamrad and Box (1964: 473-77).

Hunter Surveys

During the 1979 GDSP deer season, personnel from the University of Wisconsin-Madison Department of Rural Sociology asked hunters to complete a 24-question survey designed to compare levels of hunter satisfaction with those gathered at the 1979 Sandhill Wildlife Area (SWA) (Fig. 1) experimental deer hunt (Trent 1980). Hunter motivation and enjoyment were measured from subjective questions concerning the quality of the hunt. Results were expressed in a manner similar to the findings of Heberlein and Laybourne (1978).

DEAD DEER SURVEYS

Following the extremely severe winter of 1978-79, two 5-man crews counted dead deer along the same transects used to count deer trails. A dead deer was recorded if either a carcass, or at least one-half a hair mat, was discovered (Thompson 1979). All deer found with lower jaws were aged and a femur from the carcass was broken open to determine the color and quality of the bone marrow. If the marrow was jelly-like and red or largely missing, starvation was considered the cause of death, while white, creamy marrow represented mortality other than starvation such

as hunting wounds or unknown factors (Thompson 1979). Mean numbers of dead deer found per transect were expanded to estimate total losses in the park.

SPOTLIGHT COUNTS

Random spotlight counts were run from a vehicle throughout the park during October-November 1976-79 to evaluate this technique as an index to annual fawn production on the agricultural range (Pils 1979b). The fawn:doe ratios were used to compute sex-age-kill estimates for the park. Spotlight surveys started approximately 1-hour after sunset and required a driver who drove at 30 km/hour and a spotter-recorder who used a 200,000 candlepower "Maxi Venus" 12-volt searchlight to sweep the area adjoining roads and drivable trails.

STATISTICAL TESTS

Unless otherwise noted, $P < 0.05$ is used as the criterion of statistical significance. Means are usually accompanied by two standard errors.

RESULTS AND DISCUSSION

PREHUNT HERD ESTIMATES

Estimating Buck Populations

Spring dead deer surveys elsewhere in Wisconsin find few adult bucks, suggesting that legal (and illegal) harvest is the major source of mortality for that sex and age cohort, at least on our most heavily hunted ranges. Thus the population of adult bucks can be estimated for some year in the past by adding up the subsequent legal harvest of adult bucks alive in that particular year until the youngest age-class of the year of interest passes out of existence or becomes extremely small. This is usually the case after three or four hunting seasons (Creed and Haberland 1980). For example, 42 bucks were shot during 1976. Fifteen 2.5-year-old or older bucks were taken during 1977. In 1978, 2 bucks were 3.5 years old or older. In 1979, no bucks were 4.5 years old or older. Adding up all the bucks that were alive in 1976, we have 42 + 15 + 2 + 0 = 59 adult bucks known to be alive in 1976. Assuming this represents 80% of all bucks alive in 1976, we obtained a GDSP fall buck population estimate of 74 (59/.80 = 74). Similar estimates for the GDSP were 81 in 1977, 79 in 1978, and 82 in 1979. Until recently, adult bucks were estimated to comprise 20-25% of the fall deer population. The total deer population was estimated by multiplying the buck population by 4 or 5. This expansion factor has now been refined for individual Management Unit Groups and is used to project total deer numbers from the calculated buck populations (Creed and Haberland 1980: 84-85). The new expansion factor (E.F.) is calculated as follows:

$$E.F. = 1.00 + (B/D) + (B/D)(F)$$

where,

B = corrected yearling buck proportion

$$= \frac{\text{proportion yearling bucks in adult buck kill}}{\text{male/female fawns aged (Append. B)}}$$

D = proportion yearling does in adult female harvest

F = fawns/doe (table 10)

TABLE 1. Comparison of deer trail counts during November, 1976-79 including expansion to prehunt population estimates in Governor Dodge State Park.

Year	No. Transects	No. Trails/ 0.4 km Transect (±S.E.)	Est. Deer Density/Km^2 (Trails x 2)		Governor Dodge Area (Km^2)		Est. GDSP Population
1976*	26	15.8 (±1.4)	31.6	x	19.3	=	610
1977**	23,26	10.8 (±0.7)	21.6	x	19.3	=	417
1978**	23,26	13.3 (±1.1)	26.6	x	19.3	=	514
1979	26	10.3 (±0.8)	20.6	x	19.3	=	398
1976-79 Avg.	-	12.6 (±1.0)	25.2	x	19.3	=	486

*Six of the 26 transects were counted twice. The average values were used.

**Three of the 26 transects were run by a different individual in 1978, so only 23 are compared with 1977; but the 26 were used for comparison with 1979. The means and S.E.'s for 1977 and 1978 are given for the 26 transects.

Age data from 392 GDSP adults were pooled to obtain B and D; spotlighting data (98 fawns and 98 does) gave an F value of 1.00. An average E.F. for 1976-79 in GDSP, which may have been biased by unequal hunter selectivity and differential vulnerability to hunting by various ages and sex classes, was calculated. Spotlight counts may also have been biased by differential visibility and varying behavior of fawns, does and bucks at GDSP. The following values were obtained:

(1) B = [(141/175)/1.25] = 0.645;
D = (60/216) = 0.278; and
B/D = (0.645/0.278) = 2.32.

(2) The fawn segment of the population can then be expressed as (B/D)(F) = (2.32)(1.00) = 2.32.

(3) E.F. = 1.00 + 2.32 + 2.32 = 5.64.

The 42 bucks harvested in 1976 represented 57% of the buck population in 1976. Assuming this level of exploitation continued through 1979, the average buck population from 1976-79 was 79. If the calculated expansion factor for 1976 (5.64) also applied for the subsequent years, the average 1976-79 estimate by the sex-age-kill method was 446 deer, or 23.2/km^2.

Estimating the Total Deer Population

Trail Counts

Mean numbers of trails observed/0.4 km transect during early November were highest during 1976 and lowest during 1979 (Table 1). These values represent density estimates of 31.6 and 20.6 deer/km^2, respectively, and a 4-year mean estimate of 25.2 deer/km^2. Based on trail counts, the mean 1976-79 prehunt population estimate at GDSP was 486 deer (Table 1). Subjective interpretation of what constituted a "distinct path" caused by "repeated use" by deer (McCaffery 1976) and confusion of deer trails with cottontail runways were the potential sources of bias during trail counts.

Composite Prehunt Population Estimate

Prehunt or fall density estimates from trail counts (486) and sex-age-kill (446) were averaged to obtain the composite GDSP prehunt population for 1976-79 of 466 deer or 24.2 deer/km^2.

Fall density estimates were calculated for Deer Management Unit 70a surrounding GDSP (Fig. 2) by obtaining Unit 70a buck harvest data from 1976-79 (F. Haberland pers. comm.) and expanding these estimates to prehunt densities using the technique of Creed and Haberland (1980). Compared to density estimates for GDSP populations, the estimates for the four counties comprising Deer Management Unit 70a were 16-52% lower (Fig. 2). This suggests alternative hypotheses that either (1) GDSP has higher deer densities (because of better habitat, less disturbance, lower harvest) than surrounding regions, and/or (2) deer move into the park during the fall and hunting season.

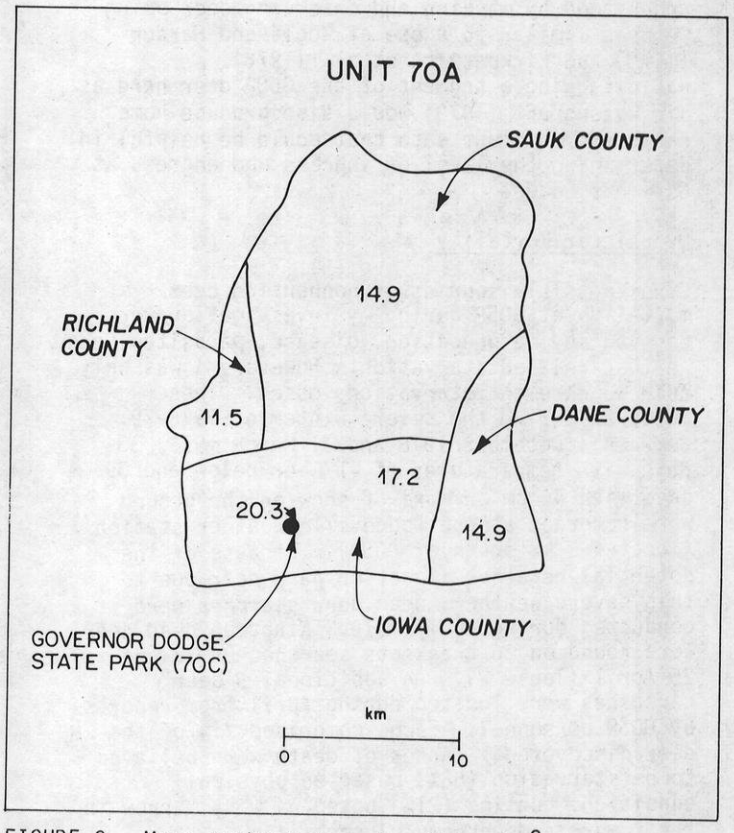

FIGURE 2. Mean prehunt deer densities km^2 from 1976-79 in the four counties comprising Deer Management Unit 70a.

Population Data Limitations

The pooled sex-age-kill method was used to estimate a combined prehunt population at GDSP for 1976-79. Annual reconstructions of deer populations were not attempted because age and kill data would have had to have been gathered in years after the study. The amount of ingress and egress at the park may have been a factor but was not definable and estimators independent of the harvest data were unavailable, except for trail counts.

Teer et al. (1965) used harvest independent transects to estimate populations. Woolf and Harder (1979) felt that herd sex ratios and population age structure could not be evaluated by using harvest data. Instead, they used population reconstructions, direct counts, pellet group counts and several variations of mark-recapture methods to census deer. Kirkpatrick et al. (1976) found a significant loss of animals to unknown causes in Indiana including wounding mortality, poaching, accidents and dispersal. Use of harvest data to assess GDSP survivorship would, therefore, be biased by deer movements in and out of the park and by our inability to account for all deer losses. Because of the known potential biases, such estimates were not attempted. A minimal postseason count of 180 deer was made by helicopter on 10 April 1974 by University of Wisconsin and DNR personnel (O. Rongstad pers. comm.).

Population dynamics of GDSP deer could be better understood by marking and observing deer using methods similar to those of Woolf and Harder (1979) and Kirkpatrick et al. (1976). Radio-tagging a segment of the GDSP deer herd as did Wozencraft (1978) would also produce home range and movement data that could be helpful in determining the level of ingress and engress at Governor Dodge.

Overwinter Mortality

Other possible sources of nonhunting deer mortality at GDSP during my investigation were dog and coyote predation, disease, parasites, and weather related starvation. However, I was only able to document starvation losses. These occurred during the severe winter of 1978-79. Between 1 December 1978 and 31 March 1979, 33 days with temperatures of -17C or below and 39 days with 46 cm or more of snow on the ground were recorded at the Dodgeville weather station (located 5 km south of GDSP). Because of the potential negative impact on park deer due to this severe weather, dead deer searches were conducted during April 1979. Nineteen dead deer were found on 26 transects searched on 17 and 25 April (Table 2). An additional 9 deer carcasses were located during April from reports by GDSP personnel. Fawns comprised 71% of the 28 deer discovered. Causes of death were believed to be starvation (68%) based on physical condition; hunting (21%) based on waxy marrow in the femur, and unknown causes (11%).

When the mean number of dead deer/transect was expanded for the total park area, an estimated 177 $\pm$ 77 ($P < 0.05$) deer died in GDSP during the winter of 1978-79. Woolf and Harder (1979: 46) conducted intensive dead deer searches, but were doubtful of the validity of sample area searches for estimating deer mortality. Although, GDSP losses suggest that extensive deer mortality can result from winters with heavy snowfall combined with severe temperatures even in high quality deer range, the relationship between population density, winter severity, and deer range in terms of winter mortality is not clear.

CHARACTERISTICS OF THE DEER HARVEST

Sex and Age Structure

In the 8 years of deer seasons at GDSP beginning in 1972 (Append. B), an average of 137 deer have been taken annually. In the 4-year investigation (1976-79, Table 3), adult bucks comprised 31.0% of the harvest with yearlings being 81% of these. None older than 4.5 years were taken.

Buck fawns (16.9%) and doe fawns (13.5%) made up 30.4% of the total harvest.

The adult does comprised 38.4% of the harvest. Yearling does (27.7%) and 2.5 year olds (28.7%) constituted 56.5% of the adult doe kill. The low yearling doe percentage may be an artifact of sample size.

The high proportion of yearling bucks is indicative of the high exploitation rate (annual mortality) among bucks. The high turnover rate reflects hunter selection. This mortality rate is typical in southern Wisconsin where deer are more easily hunted. Heberlein and Laybourne (1978) found that 84% of hunters are motivated to try to "get a shot at the big one." At GDSP interviews indicated a preference for antlered deer despite the any-deer provision.

Doe age composition largely reflects productivity. Exploitation of does is limited by the allowable harvest (permits) or season lengths throughout the state, but at GDSP antlerless take is controlled through number of hunters admitted.

The age structure found at GDSP may be influenced in part by the free intermix with deer from the outside.

Weights

Field-dressed weights were recorded from 422 deer (Table 4). Fawns were the only age class that did not significantly differ in weight between the sexes. Adult doe weights appeared to plateau at 2.5 years; however, only ten 6.5+ year old females were weighed. Mean buck weights were not different after an animal reached 2.5 years; however, no deer older than 4.5-5.5 years were weighed. Severinghaus (1979) reported that dressed weights taken from 5,276 New York deer peaked from 5.5-6.5 years in bucks and from 4.5-5.5 years for does. All GDSP deer examined exhibited ample fat deposits and did not display any gross signs of nutritional deficiencies. All age classes of GDSP deer were significantly heavier than their SWA counterparts located in a poorer deer range (Fig. 3). Weights of Governor Dodge fawns and yearlings were similar to those reported for New York and Indiana deer (Table 5). However, GDSP fawns and yearlings were heavier than those shot in the overcrowded Lewiston Marsh in southern Wisconsin (Wozencraft 1978) and in Rachelwood Park, Pennsylvania (Woolf and Harder 1979). These comparisons suggest an inverse relationship between density and deer weights.

Antler Development

Antler beams were well-developed in the younger bucks at GDSP (Fig. 4, Append. C). Only 5 of the 97 yearling bucks aged with both antlers intact had spikes, suggesting adequate availability of quality forage in and near the park. Numbers of points on adult bucks (1.5 years+) ranged from 2 to 12. Severinghaus et al. (1950: 567) found that variations in antler development reflected variations in forage adequacy. However, antler beam diameters and mean number of points were not significantly smaller at the less densely populated SWA, an area of relatively poorer forage and range quality when compared to range in and around GDSP (Fig. 3).

Illegal Kill

Even though all deer were legal targets at GDSP, 15 shot deer were found incidental to searches for hunter-reported viscera during 1976-79. These deer represented a minimum loss equivalent to 3% of the legal GDSP harvest in those years. Six (40%) were fawns, 1 was a 3.5-year-old buck and the remaining 8 were adult does. All deer found, with the exception of 1 doe, were within

TABLE 2. Causes of death of 28 deer found in Governor Dodge State Park during April 1979.

Cause of Death	Fawns Male	Fawns Female	Fawns Unknown Sex	Adults Male	Adults Female	Unknown Age and Sex	Total
Found on Survey Transects							
Starvation	4	7	1	1	1	0	14
Hunting	2	0	0	0	2	0	4
Unknown	0	0	0	0	1	0	1
Subtotals	6	7	1	1	4	0	19
Found incidental to other work							
Starvation	3	2	0	0	0	0	5
Hunting	1	0	0	0	1	0	2
Unknown	0	0	0	0	1	1	2
Subtotals	4	2	0	0	2	1	9
Totals	10	9	1	1	6	1	28

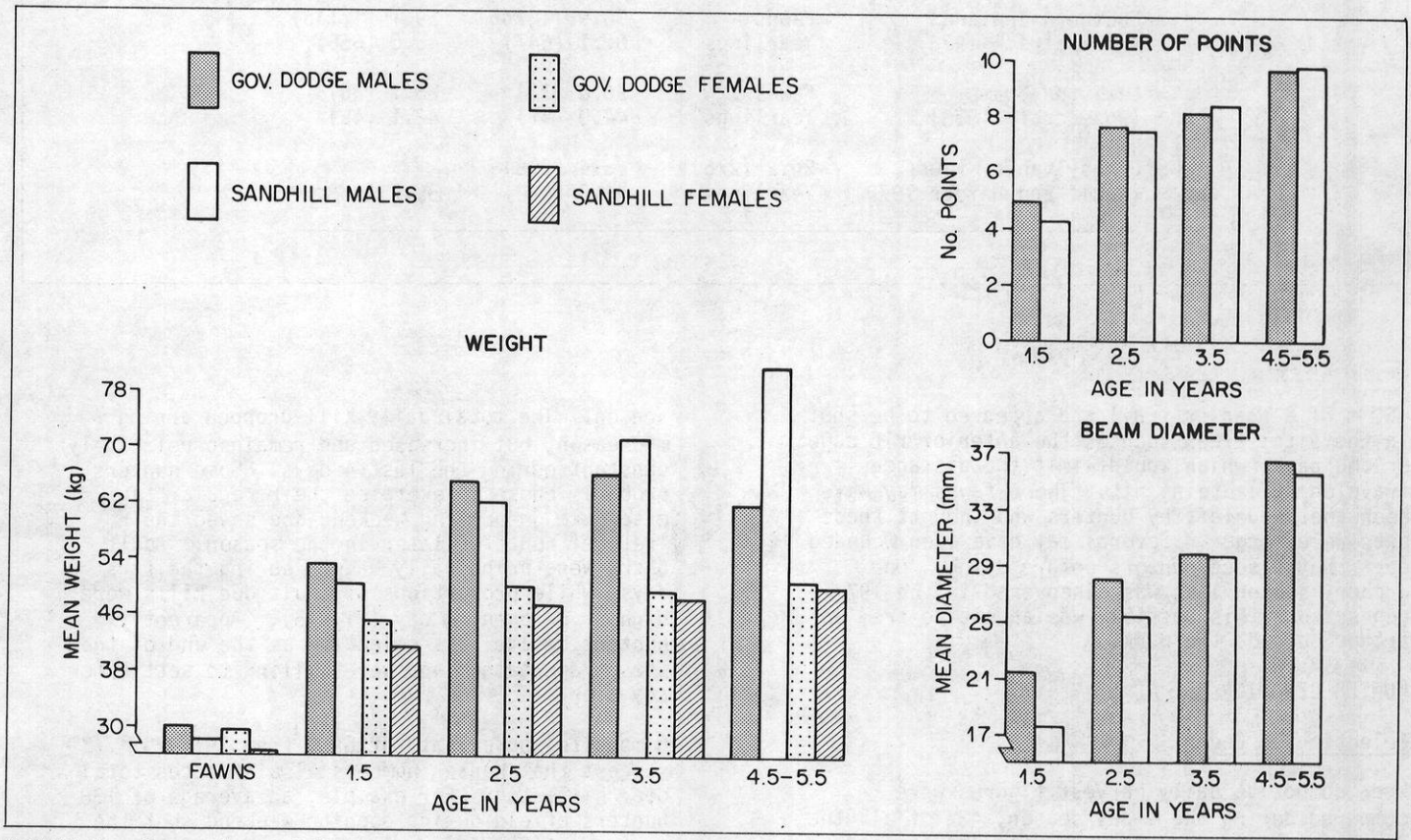

FIGURE 3. Comparison of 1977-79 weights (kg), beam diameters (mm) and number of points between deer from Governor Dodge State Park and Sandhill Wildlife Area.

TABLE 3. Ages of 562 deer shot at Governor Dodge State Park during the 1976-79 seasons.

Age (Years)	Number Aged Males (%)	Females (%)
Fawn	95 (16.9)	76 (13.5)
1.5	141 (25.1)	60 (10.7)
2.5	22 (3.9)	62 (11.0)
3.5	9 (1.6)	44 (7.8)
4.5-5.5	3 (0.6)	35 (6.2)
6.5-8.5		13 (2.3)
9.5-12.5		2 (0.4)
	270 (48.1)	292 (51.9)

TABLE 4. Mean weights of 422 field-dressed deer shot at Governor Dodge State Park during the 1977-79 gun seasons.*

Age	Males No. Deer	Weight (kg)	S.E.	Females No. Deer	Weight (kg)	S.E.
Fawn	82	30.7	± 0.50	70	29.9	± 0.50
1.5	101	53.5	± 0.50	39	45.5	± 0.90
2.5	18	65.9	± 1.70	41	50.4	± 0.60
3.5	8	67.4	± 3.20	32	49.3	± 0.80
4.5-5.5	3	62.4	± 3.70	18	51.3	± 1.30
6.5-8.5		-		9	51.8	± 2.30
9.5-12.5		-		1	51.3	-
Totals	212	46.4	± 0.97	210	42.6	± 0.70

*Weights not recorded on 29 additional deer shot inside park.

TABLE 5. Field-dressed deer weights from five areas of the eastern United States.

Area	Age	Weight (kg) Males (n)	Females (n)
Governor Dodge (Current Study)	Fawns	30.7 (82)	29.9 (70)
	Yearlings	53.5 (101)	45.5 (39)
Western New York (Severinghaus 1979)	Fawns	33.7 (129)	31.9 (124)
	Yearlings	54.0 (211)	49.1 (87)
Southern Indiana (Kirkpatrick 1976)	Fawns	30.9 (1,246)	29.1 (1,146)
	Yearlings	51.1 (647)	45.0 (656)
Lewiston Swamp (Wozencraft 1978)	Fawns	26.8 (31)	28.1 (36)
	Yearlings	44.0 (41)	42.1 (42)
Pennsylvania (Woolf and Harder 1979)	Fawns	24.2 (276)	23.4 (298)
	Yearlings	44.3 (360)	35.7 (268)

100 m of a road or trail and appeared to be shot in the vital areas such as the anterior rib cage or the neck, which would limit the distance traveled after being hit. The 6 fawns may have been shot and left by hunters who thought these deer were larger. Several may have been wounded deer that eluded hunters before dying. One archery season loss was discovered in the 1977 gun season; this possibly was an escape from an archer outside the park.

HUNTER BEHAVIOR

Selection of Deer

When composite daily harvest figures were compared during the 9-day season, 42% of all the deer registered were taken during the opening weekend (Fig. 5). However, the success rate (number of deer harvested/hunters afield) was greatest (50%) during the last 2 days of the season. The total daily kill dropped during midseason, but increased and remained relatively constant during the last 4 days. Some hunters probably chose to exercise their regular tag elsewhere on opening weekend and saved their "refuge" hunt for later in the season. Adult bucks were principally bagged during the first 2 days, while proportions of adult doe kills were highest on opening day (Fig. 5). Apparently hunters became less selective as the end of the season approached and were willing to settle for any deer.

Composite hunter data at GDSP from 1976-79 suggest that hunter numbers also affected total deer harvested. For example, an average of 138 hunters afield during opening weekend shot the most deer ($\bar{x}$ = 60) during any consecutive days of the season. Conversely, when fewer hunters were afield ($\bar{x}$ = 73) during days 3-5, the fewest average number of deer were shot ($\bar{x}$ = 22).

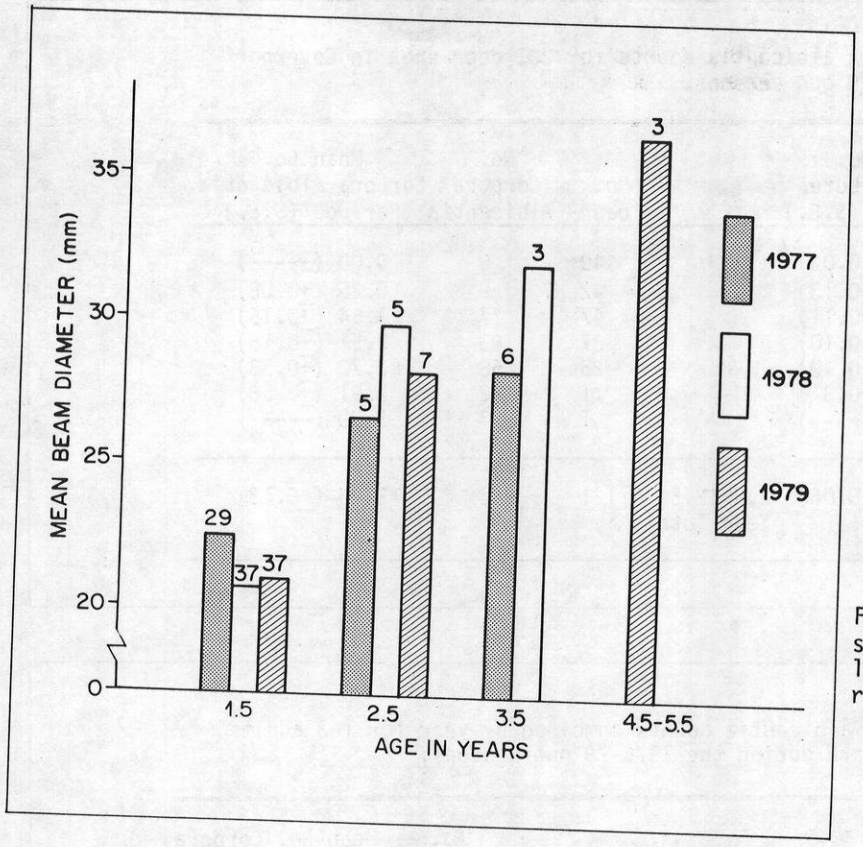

FIGURE 4. Mean beam diameters (mm) of 132 bucks shot in Governor Dodge State Park during the 1977-79 gun seasons. (The number above each bar represents sample size.)

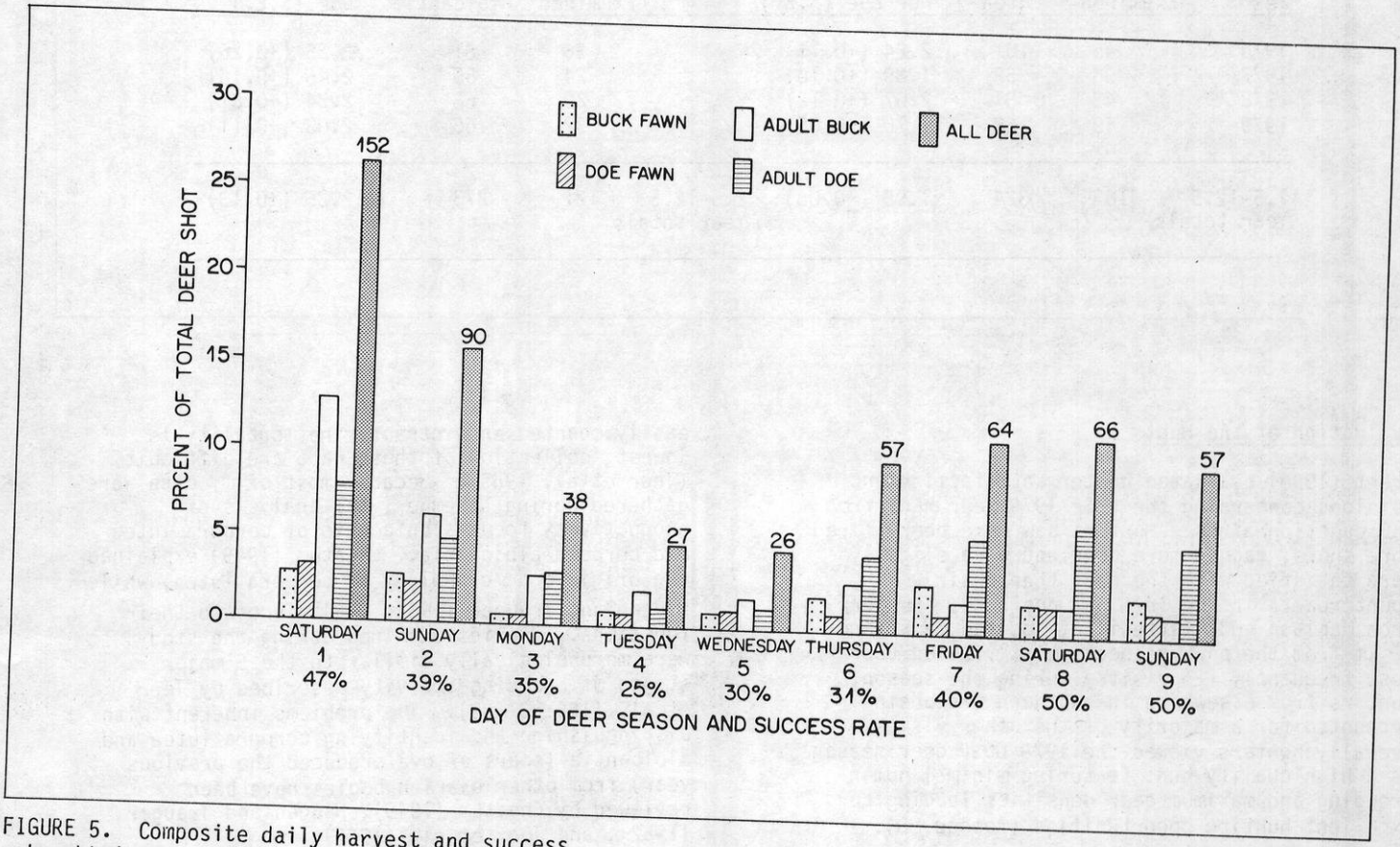

FIGURE 5. Composite daily harvest and success rate obtained from registration data during the 9-day deer gun seasons at Governor Dodge State Park, 1976-79. (The number above the last bar represents sample size, and the percentage figure below the day of season equals the success rate.)

TABLE 6. Corpora lutea and corpora albicantia counts for 203 deer shot in Governor Dodge State Park during the 1976-79 gun seasons.

Age	No. Deer	No. Corpora Lutea	Mean No. Corpora Lutea Per Doe (S.E.)	No. Deer	No. Corpora Albicantia	Mean No. Corpora Albicantia Per Doe (S.E.)
Fawn	40	10	0.25 (±0.09)	40	0	0.00 (-----)
1.5	42	72	1.69 (±0.13)	42	9	0.26 (±0.08)
2.5	47	96	2.04 (±0.11)	47	77	1.64 (±0.15)
3.5	37	78	2.11 (±0.10)	37	93	2.51 (±0.16)
4.5-5.5	25	58	2.32 (±0.10)	25	68	2.72 (±0.33)
6.5-8.5	11	18	1.64 (±0.31)	11	32	2.91 (±0.58)
9.5-12.5	1	2	2.00 (-----)	1	3	3.00 (-----)
1.5-12.5 Year totals	163	324	1.98 (±0.06)	2.5-12.5 Year totals	121	273	2.25 (±0.13)

TABLE 7. Corpora lutea and corpora albicantia counts combined by year for 163 adult deer shot in Governor Dodge State Park during the 1976-79 gun seasons.

Year	No. Ovary Pairs Examined	No. Corpora Lutea	Mean No. Corpora Lutea Per Doe (S.E.)	No. Ovary Pairs Examined	No. Corpora Albicantia	Mean No. Corpora Albicantia Per Doe (S.E.)
1976	45	101	2.24 (±0.11)	36	81	2.25 (±0.26)
1977	36	68	1.89 (±0.10)	24	59	2.46 (±0.16)
1978	42	87	2.07 (±0.12)	29	68	2.34 (±0.31)
1979	40	68	1.70 (±0.08)	32	65	2.03 (±0.11)
1.5-12.5 Year totals	163	324	1.98 (±0.06)	2.5-12.5 Year totals	121	273	2.25 (±0.13)

Evaluation of the Hunt

Trent (1980) evaluated hunter satisfaction and opinions concerning the GDSP 1979 deer hunt from 260 questionnaires. Hunters saw more deer, fired more shots, bagged more deer and were slightly more satisfied with the hunt than their counterparts in the 1979 SWA doe hunt. Hunters from Madison and Platteville, located 72 km and 50 km from the park respectively, visited GDSP most frequently (25 visits) during the season. Hunters from elsewhere in southern Wisconsin accounted for a majority of the other visits. Overall, hunters viewed the 1979 GDSP deer season as a high quality hunt featuring minimal human crowding and maximum deer densities leading to excellent hunting opportunities (Append. D).

PRODUCTIVITY

Although the best estimates of deer productivity are made during late gestation when fetuses are easily counted and intrauterine mortality is lowest, collection of these data are difficult (Teer et al. 1965). Because most of my data were gathered during November, the analysis of productivity focuses on counts of corpora lutea and corpora albicantia. Cheatum (1949) explained the origin and morphology of corpora lutea, while Haugen and Trauger (1962: 232) discussed their functions. Ovaries examined during the study were morphologically similar to the 5 major stages of breeding activity described by Teer et al. (165: 31-32). The problems inherent with distinguishing and identifying corpora lutea and albicantia (scars of ova produced the previous year) from other ovarian bodies have been reviewed by Cheatum (1949), Haugen and Trauger (1962), and Teer et al. (1965).

Limited comparisons have been made between years and age classes under the assumption of an essentially stable age composition for does in

the population and in the kill. More detailed comparisons have been avoided which might be unduly affected by the falsity of this assumption.

Counts of Corpora Lutea

Counts of corpora lutea from ovaries of 203 deer shot by hunters are compared by age class in Table 6. An average of 1.98 ova were shed per adult doe (1.5 years and older) during 1976-79. Rates for 4.5 - 5.5 year old does were the highest encountered. Yearling corpora lutea counts were significantly lower than all older age class counts combined (Table 6). Few GDSP fawns shed ova, based on their ovulation rate of 0.25. The 1979 ovulation rate, according to the corpora lutea counts, was significantly lower than a comparable rate for the 1976-78 counts combined (Table 7). This low rate suggests that the severe winter of 1978-79 negatively affected ova production.

Counts of Corpora Albicantia

Since ovaries were collected within 8 months of birth, I could also obtain frequency of ovulation from counts of corpora albicantia (Cheatum 1949). Ovulations determined from corpora albicantia were higher than those obtained from corpora lutea counts in the previous age class (Table 6), possibly because other similar tan or orange bodies such as blood clots, developing follicles or small lutenizing bodies (Haugen and Trauger 1962: 236) were counted as albicantia. However, an adequate statistical comparison could not be made between the 2 counts because of too few degrees of freedom. Corpora albicantia also increased with age. Counts in 2.5-year-old deer were significantly lower than counts for all older age classes combined (Table 6). Teer et al. (1965: 36) suggested that more than 1 generation of corpora albicantia persists into the collecting period. Corpora albicantia and lutea counts both indicate that the 4.5 - 5.5 age class exhibited the highest ovulation rates, and this was further evidenced by the higher corpora albicantia count in the 6.5 - 8.5 age class. The fawn ovulation rate (0.26) determined from counts of corpora albicantia, also suggested that a low percentage of fawns were bred in GDSP, as compared to other agricultural states such as Iowa (Haugen 1975) and Ohio (Nixon 1971) with fawn ovulation rates of 0.77.

Conception Rate Estimates

The conception rate or the percentage of the population that ultimately ovulated and conceived (Teer et al. 1965: 36-37) was used to calculate the productivity of each age class. Conception rate data from GDSP indicate that most adult does (1.5 years and older) were bred by the third week of November; 3% of the fawns ovulated after that period (Table 8). Governor Dodge fawns and yearlings were less productive than deer from most other more southerly midwestern states (Table 9). Wozencraft (1978) also found low numbers of corpora lutea per doe and a smaller percentage of pregnant does from Lewiston Marsh deer.

Woolf and Harder (1979: 29) hypothesized that herd density, disease and natural foods influenced reproductive performance. Although I did not examine the possible effects of disease and nutrition, some effects of natural foods on reproduction were suggested. Acorns provided the bulk of the fall diet during 1976, a year of heavy acorn mast (Table 12). Corpora lutea (1976) and albicantia (1977) counts implied that 1976 was the year of highest productivity (Table 7), suggesting relationships between acorn availability, utilization and high productivity.

TABLE 8. Estimates of conception rates and of the percentages of deer that ovulated after November, when the collection of ovaries was made at Governor Dodge State Park during 1976-79. (The average conception rate for adults was calculated from data for 2.5-8.5 year old deer.)

Age Class	(A) No. Deer Collected	(B) No. Deer With Corpora Lutea in Ovaries	(C) No. Deer With Corpora Albicantia in Ovaries	(B ÷ A) Percentage of Herd That Ovulated Before Collected (95% C.L.)	(C ÷ A) Conception Rate (95% C.L.)	(C ÷ A) - (B ÷ A) Percentage of Herd That Ovulated After Collections Were Made
Fawns	40	7	0	18 (7-33)	21 (10-37)	3
1.5	42	40	9	95 (84-99)	87 (74-95)	0
2.5	47	45	41	96 (85-99)	97 (87-100)	1
3.5	37	37	36	100 (86-100)	100 (80-100)	0
4.5-5.5	25	25	25	100 (80-100)	82 (48-98)	0
6.5-8.5	11	9	9	82 (48-98)	---------	-
Average 2.5-8.5				97 (92-99)	93 (86-97)	0

TABLE 9. Comparative productivity of Governor Dodge State Park deer with those from 4 other midwestern states.

Area	Age	Percent Ovulated	Corpora Lutea Per Doe	Percent Pregnant
Southern Illinois (Roseberry and Klimstra 1970)	Fawns	41	1.19	41
	1.5	97	1.94	97
Iowa (Haugen 1975)	Fawns	77	1.39	65
	1.5	87	2.36	55
GDSP (Current Study)	Fawns	18	0.25	21
	1.5	95	1.69	87
Lewiston Swamp (Wozencraft 1978)	Fawns	--	0.17	17
	1.5	--	1.64	91
Ohio (Nixon 1971)	Fawns	77	1.65	--
	1.5	97	2.04	--
Crane Depot, Indiana (C. White pers. comm.)	Fawns	5.1	0.05	13
	1.5	90.3	1.46	100

TABLE 10. Results of spotlight counts conducted at Governor Dodge State Park, October-November 1976-79.

	No. Individuals Seen					
Year	Bucks	Lone Does	Lone Fawn	Doe + 1 Fawn	Doe + 2 Fawns	Doe + 3 Fawns
1976	1	18	1	1	6	1
1977	7	15	9	11	11	0
1978	0	5	12	2	5	0
1979	6	11	3	12	0	0
Totals	14	49	25	26	22	1

Total 1976-79 $\frac{\text{Fawns}}{\text{Doe}} = \frac{98}{98} = 1.00$

$\frac{\text{Does with multiple fawns}}{\text{Does with one fawn}} = \frac{23}{26} = 0.88$

Verme (1969) concluded that four general classes of reproduction were present for Michigan whitetails, depending upon variations in range nutritive quality and winter weather severity. Class I features year-round optimum nutrition, mild winters, and productive adult does in a farmland-brush type environment. A sizeable proportion of doe fawns breed and frequently produce twins; because of the excellent habitat, natal mortality is slight (Verme 1969: 884-85).

The types of habitat and nutrition described in Class I are very similar to those found at Governor Dodge; however, the level of fawn productivity does not correspond. Gross examination of deer shot during this study indicated a general high body fat content and rapid growth of antlers in yearling bucks, suggesting good physical condition. Why then did so few fawns conceive and produce at such low rates? Hesselton and Sauer (1973: 102) stated

TABLE 11. Calculation of gross productivity from analysis of reproductive tracts from 203 does shot at Governor Dodge State Park, 1976-79.

Age Class (n)	Conception Rate		Fawns Per Pregnant Doe		Proportion of Population		Estimated Gross Productivity
Fawns (40)	0.21	x	0.23	x	0.38	=	0.02
Yearlings (42)	0.87	x	1.54	x	0.25	=	0.34
Adults (121)	0.93	x	1.87	x	0.37	=	0.64
TOTAL							1.00

TABLE 12. Food items found in rumens of 75 Governor Dodge State Park deer shot during November, 1976.

Taxa	Percent Frequency	Percent Volume
Fruits or seeds		
Oak acorns	97	64
Corn	5	1
Mushrooms	3	1
American filbert	3	Tr
Sumac	3	Tr
Grape	1	Tr
Hawthorn	1	Tr
Sweet cicely	1	Tr
Woody plants		
Unknown twig	28	2
Eastern juniper	8	Tr
Eastern arborvitae	1	Tr
Herbaceous plants		
Unknown forb	72	8
Grass or sedge	61	8
Aster	15	1
Canada thistle	9	1
Woodfern	9	Tr
Herbaceous plants (cont.)		
Wild carrot	8	Tr
Alfalfa	4	Tr
Plantain	4	Tr
American maidenhair fern	1	Tr
Black-eyed susan	1	Tr
Cinquefoil	1	Tr
Forb root	1	Tr
Dandelion	4	Tr
Unknown fern	4	Tr
Leaves		
Unknown tree	79	10
Oak	36	4
Elm	5	Tr
Honeysuckle	3	Tr
Gooseberry	3	Tr
Buckthorn	1	Tr
Dogwood	1	Tr
Hawthorn	1	Tr
TOTAL		100

that field dressed fawns weighing less than 30-32 kg do not breed. Wozencraft (1978) speculated that increased social pressure could partially be responsible for a lower reproductive potential in the crowded areas of Lewiston Marsh. Woolf and Harder (1979) also documented the severe negative effects of overcrowding on fawn reproduction. High herd densities at GDSP and/or mating preferences may have lowered fecundity of the fawns. However, the specific reasons for the low productivity of fawns at GDSP remain unknown.

Spotlight Counts

Fall spotlight counts were also used to measure productivity at GDSP. Overall, 210 deer were observed and categorized as either bucks, does or fawns; additional deer were seen but could not be positively identified due to distance or obstruction by vegetation. When does were seen with fawns, they were usually accompanied by 1 or 2 fawns (Table 10). Does with multiple fawns were seen every year except 1979. The unusually severe 1978-79 winter may have been partially responsible for the reduced incidence and/or

survival of multiple births. Separation of fawn and adult deer, even under ideal viewing conditions can be difficult, especially if single deer are scattered throughout a field. Therefore, spotlighting count results must be viewed with caution.

When comparisons were made between July-September daytime observations of deer in Management Unit Group N (Fig. 1) during 1976-79 (average of 0.93 fawns/doe - Rusch (1976, 1977, 1978, 1979) and GDSP spotlight counts, no significant differences in fawn/doe ratios were noted. Pils (1979b) also was unable to demonstrate any meaningful difference between fawn/doe ratios obtained from the two observational techniques throughout a large portion of the Wisconsin deer range.

Gross Productivity

Gross productivity is defined as the approximate numbers of fawns carried to birth by all age classes of does. The factors used to calculate gross productivity are: (1) corpora lutea produced/doe (Table 6); (2) conception rates (Table 8); (3) age proportions within the population (Table 3); and (4) fawns produced/pregnant doe. The number of fawns produced/pregnant doe was estimated by incorporating a 10% ovum loss for all GDSP corpora lutea counts, based on the approximate mean losses noted by Haugen (1975) in Iowa, Roseberry and Klimstra (1970) in Illinois and Nixon (1971) in Ohio. The 10% loss was assumed to represent all intrauterine mortality and was incorporated into the data concerning numbers of fawns/pregnant doe (Table 11). The proportions of fawns, yearlings, and adults in the GDSP population were calculated from the sex-age-kill data by backdating all deer alive in those three age classes during 1976. Numbers of fawns, yearlings and adults alive in 1976 were totaled, and the proportions in each group calculated. When these data were multiplied together and added by age classes, 1.00 fawns/doe were produced in the park during 1976-79. By comparison, Pils (unpubl. data) found an average of 1.41 fetuses in 27 vehicle-killed does (all age classes combined) elsewhere in southern Wisconsin during 1977-79. In this sample, does which were one year or older (n = 18) averaged 1.9 fetuses per doe.

FALL FOODS

Oak acorns, tree leaves, forbs and grasses/sedges were the principal foods found in 75 rumina of deer shot at GDSP during November 1976 (Table 12). Corn and alfalfa, principal crops found in and adjacent to GDSP, were not commonly found in the fall samples. However, lesser quantities of a wide variety of herbaceous plants were noted. The many kinds of plants eaten indicates the varied diet available at GDSP.

Woolf and Harder (1979) suspected that enterotoxemia or the overeating disease associated with the ingestion of acorns caused sporadic mortality. However, supportive evidence concerning this relationship was lacking. The high population density and poor range conditions, which may have precipitated the disease at Rachelwood (Woolf and Harder 1979: 40) did not exist at GDSP. No traces of enterotoxemia were noted during my investigation, although acorns were consumed in large quantities.

MANAGEMENT AND RESEARCH CONSIDERATIONS

Two changes in future Wisconsin deer hunting regulations will affect deer management at GDSP. First, a "hunter's choice" permit system was implemented during the November 1980 season. This system differs from the variable quota system in two basic ways: (1) one person can apply for and obtain a hunter's choice permit, while 4 persons were required previously; (2) a hunter's choice permit will not represent a bonus deer, which was the case with deer taken on the variable quota permits. For the 1980 season, 201 permits were issued for the park, resulting in a harvest of 137 deer. This 69% success rate was far below the 95% rate from 1972-79.

A second major regulation change will be the inauguration of a muzzle-loading firearms only season at GDSP in 1981. A comparison of the hunter success rate for the 1978 Sandhill muzzle-loader season (16.4%, Kubisiak 1979) and the 1979 GDSP hunt showed a GDSP success rate of 36.4% which is more than double. This indicates that additional permits may again have to be issued to maintain 1976-79 harvest levels. The increase in number of muzzle-loader permits to be issued during 1981 will have to be predicted from the initial success rate of the 1980 hunter's choice season. Harvest data gathered by Kubisiak (1979) suggest that SWA muzzle-loader hunters selected a higher percentage of adult bucks (59.3%) than GDSP hunters (30%) (Append. C) did from 1976-79. However at Sandhill, the deer hunt preceded the regular season, giving hunters a larger latitude of preference. The SWA hunt also occurred during the rut, when bucks were more active. This will not be the case at GDSP. What effect potential changes in hunter selectivity will have on the park herd is unknown. Hunter numbers and/or efficiency could be further reduced by the use of muzzle-loaders because of the greater difficulties in loading and firing these weapons.

Although annual population reconstructions were not made during our investigation, reproductive data and prehunt estimates indicated that a high density deer herd currently populates GDSP and adjacent areas. Carrying capacity, or the maximum number of animals an environment will support (Dasmann 1964), is difficult to determine in agricultural areas where timber provides cover and crops supply in an abundant food source (Gladfelter 1980).

The carrying capacity of GDSP was not determined. The data do, however, suggest that GDSP held more deer than the adjacent management unit (at least in fall and winter) and has remained high despite a relatively sustained annual harvest of about 140 animals and one severe winter. The actual ability of the park's habitat to sustain these levels of deer is

completely obscured by the "sanctuary" effect which concentrates deer in the park, and the unknown level of ingress and egress. Also, since deer move in and out of the park on a daily basis to feed on surrounding croplands, etc. GDSP does not provide all the food required to maintain a herd of this size.

This study has provided an initial step towards the reconstruction of annual populations of agricultural deer by assessing productivity both in terms of ovarian analysis and spotlight counts. Additional collections and studies of ovaries along with more intense fawn/doe observations at GDSP could improve estimates of productivity. The radio-tagging of GDSP deer could estimate the level of ingress and egress at GDSP, and identify relative proportions of the various population segments (e.g., year-round inhabitants, winter inhabitants, and transients) using the park during different seasons.

SUMMARY AND CONCLUSIONS

I investigated prehunt densities, mortality, reproductive performance and foods of white-tailed deer in the 2,034 ha Governor Dodge State Park (GDSP) located in Iowa County, Wisconsin from 1976 to 1979. A 1979 hunter attitude survey was conducted by the University of Wisconsin-Madison Department of Rural Sociology in 1979.

Mean 1976-79 prehunt herd estimates at GDSP were calculated by: (1) employing sex-age-kill data to estimate the buck populations and total deer populations which were 446 (23.2/km^2) deer; and (2) utilizing 0.4 km trail count transects to determine a density of 486 (25.2 km^2) deer. The combined prehunt estimate, employing the two techniques, yielded an average figure of 466 (24.2/km^2) deer. Annual population reconstructions were not attempted because of heavy dependence on biased sex-age-kill data and small sample sizes for individual years.

Dead deer surveys indicated that crippling and waste losses and the severe winter of 1978-79 may have accounted for the deaths of 177±77 ($P < 0.05$) deer throughout the park. Most (68%) of the deer found apparently died from starvation, while 32% perished from suspected gunshot wounds or unknown causes.

Fawns (30.4%) and yearling bucks (25.1%), made up the largest proportion of the 1976-79 harvest. Only 6.1% of the bucks aged were 2.5 years or older.

Dressed weights of bucks taken at GDSP increased through 2.5 years of age, while doe weights plateaued after 2.5 years. Male weights were significantly heavier than female weights in all classes except fawns. Weights in GDSP were heavier than those from other more crowded areas in Pennsylvania and Wisconsin, including SWA, suggesting an inverse relationship between weight and density. Antler development was excellent at Governor Dodge, with only 5% of the yearling males carrying spike antlers.

Sixteen deer (6 fawns, 8 adult does and 2 adult males) were known to have been killed and left or lost by hunters during 1976-79.

Hunting success rate was greatest (50%) during the last 2 days of the season. Most hunters selected for large antlered deer early in the season, but became less selective as the season progressed. GDSP hunters saw and shot at numerous deer, experienced little crowding, enjoyed a high success rate, and greatly relished their overall hunting experience.

Corpora lutea counts were highest during 1976 (2.24±0.11), a year of high acorn production, and were lowest during 1979 (1.70±0.08), following the severe winter of 1978-79. Adult does shed an average of 1.98 ova. Three-and-one-half-year old does appeared to be most fertile in terms of ovulation and conception rates. Only 21% of the fawns examined conceived, possibly due to small size associated with high herd density.

Fall spotlight counts conducted during 1976-79 yielded a ratio of 1 fawn seen/doe, which was not significantly different from the 0.93 fawns seen/doe during the summers by DNR personnel in Management Unit Group N during the same years. Gross productivity -- incorporating ova production, intrauterine mortality (10%), and the proportion of the herd conceiving -- also yielded approximately the same ratio of 1.00 fawn/doe.

The most commonly eaten fall foods, based on analysis of stomach contents from 75 rumens collected during 1976 were acorns, tree leaves, forbs and grasses/sedges.

Deer hunting at Governor Dodge will be affected by two regulation changes: (1) the switch in 1980 to a hunter's choice permit system, and (2) initiation of a muzzle-loader only season during 1981. Based on the 1980 harvest of 137 deer (201 permits issued), more permits will have to be supplied in order to maintain the average 1976-79 kill of 142 deer. A more crowded hunting situation may develop in GDSP as a result. A switch to muzzle-loaders might lower hunter effectiveness, based on previous muzzle-loader hunts at Sandhill.

Governor Dodge deer research conducted from 1976-79 strongly suggests that population levels remained high despite a mean annual harvest of 142 deer (30% of the prehunt population estimate) and the depressing effects of one extremely severe winter. Results of this investigation have added information on agricultural deer characteristics by providing additional sex-age-kill data and better estimates of productivity rates for southwestern Wisconsin. This research also established a data base for comparisons with future harvest and productivity information. Additional collections of age and reproductive data, supported by marking and/or radio-tagging studies to estimate ingress and egress at GDSP, would refine the population information presented here, which would lead to better recommendations for managing the park's deer herd.

APPENDIX A

Scientific Names of Plants and Mammals Used in the Text

Scientific Names of Plants from Scott and Wasser (1980) and Mammals, Jackson (1961)

PLANTS

Alfalfa, *Medicago sativa*
American filbert, *Corylus americana*
American maidenhair fern, *Adiantum pedatum*
Aster, *Aster* sp.
Black-eyed susan, *Rudbeckia hirta*
Black oak, *Quercus velutina*
Buckthorn, *Rhamnus cathartica*
Bur oak, *Quercus macrocarpa*
Bluegrass, *Poa* sp.
Canada thistle, *Cirsium arvense*
Cinquefoil, *Potentilla* sp.
Corn, *Zea mays*
Dandelion, *Taraxacum* sp.
Dogwood, *Cornus* sp.
Eastern arborvitae, *Thuja occidentalis*
Eastern juniper, *Juniperus virginiana*
Elm, *Ulmus* sp.
Ferns, Polypodiaceae
Gooseberry, *Ribes* sp.
Grape, *Vitis* sp.
Grass, Poaceae
Hawthorn, *Crataegus* sp.
Hepatica, *Hepatica* sp.
Honeysuckle, *Lonicera* sp.
Jack pine, *Pinus banksiana*
Mushrooms, Agaricaceae
Oaks, *Quercus* sp.
Plantain, *Plantago* sp.
Quackgrass, *Agropyron repens*
Red Pine, *Pinus resinosa*
Sedge, *Carex* sp.
Smooth brome, *Bromus inermis*
Sumac, *Rhus* sp.
Sweet cicely, *Osmorhiza* sp.
White oak, *Quercus alba*
White pine, *Pinus strobus*
Wild carrot, *Daucus carota*
Woodfern, *Dryopteris* sp.

MAMMALS

Coyote, *Canis latrans*
Cottontail, *Sylvilagus floridanus*
Domestic dog, *Canis familiaris*
White-tailed deer, *Odocoileus virginianus*

APPENDIX B. Numbers of deer shot at Governor Dodge State Park from 1972-79.

Year	No. Permits Issued	No. Registered Deer				
		Adults		Fawns		Total
		Males	Females	Males	Females	Deer
1972	100	46	38	10	2	96
1973	150	51	71	8	12	142
1974	150	45	74	14	15	148
1975	150	49	61	17	15	142
1976	150	42	69	11	15	137
1977	150	46	48	24	21	139
1978	150	45	49	31	24	149
1979	150	47	50	29	16	142
Totals	1,150	371	460	144	120	1,095

APPENDIX C. Mean beam diameter (mm)* and number of points (>7.6 cm) of bucks shot in Governor Dodge State Park during the 1977-79 gun seasons.

	1977		1978		1979	
Age	Points (n) S.E.	Beam Diameter (n) S.E.	Points (n) S.E.	Beam Diameter (n) S.E.	Points (n) S.E.	Beam Diameter (n) S.E.
1.5	5.3(28)±0.29	22.4(29)±0.43	4.9(34)±0.31	20.8(37)±0.78	4.8(31)±0.26	21.0(37)±0.04
2.5	7.0(6)±0.52	26.7(5)±1.35	8.2(5)±1.02	29.9(5)±2.47	7.9(7)±0.59	28.1(7)±0.09
3.5	8.2(6)±0.54	28.2(6)±0.91	8.0(3)±0.00	32.0(3)±2.10	-----	
4.5-5.5	9.7(3)±1.20	36.5(3)±3.30	-----		-----	
All Ages						
Mean	6.3(±0.28)	24.7(±0.59)	5.5(±0.34)	23.0(±0.88)	5.3(±0.35)	22.0(±0.05)
Range	3-12	14.3 - 49.2	3-11	12.2 - 39.4	2-10	15.2 - 31.0
Number	43	43	42	45	38	44

* For beam diameter, the individual antlers were measured and analyzed, but adjustment was made in the S.E. calculation to treat the data set as though the sample included only the number of pairs as a sample size.

Appendix D. Summary of the 1979 Governor Dodge State Park hunter attitude questionnaire.

NAME _____
ADDRESS _____

N = 260 Visits by Hunters

UNIVERSITY OF WISCONSIN
1979 GOVERNOR DODGE DEER HUNTER SURVEY

WE ARE INTERESTED IN HOW THE NUMBER OF HUNTERS YOU SEE IN THE FIELD AFFECTS YOUR HUNT TODAY. PLEASE TAKE NOTICE OF THE NUMBER OF HUNTERS OUTSIDE YOUR OWN GROUP THAT YOU SEE WHILE HUNTING IN THE FIELD. (Don't count hunters seen only in the parking lot or checking in this morning)

x I saw 6 hunters in the field this morning
x I saw 5 hunters in the field afternoon
71% saw 10 or less

Overall, how satisfied were you with your deer hunt here today?

	%		
12	poor	14	very good, but some things could have been better
21	fair, the day didn't work out very well	19	excellent, only minor problems
22	good, but a number of things could have been better	12	perfect

How crowded did you feel in the field here today? (CIRCLE ONE NUMBER)

1	2	3	4	5	6	7	8	9
84		10		6			1	
not at all crowded		slightly crowded		moderately crowded			extremely crowded	

What would be the maximum number of hunters you could see in the field before it would be too crowded for good deer hunting?

	%		
3	none	13	16 - 20
4	1 -2	4	21 - 25
20	3 - 5	5	26 - 30
23	6 - 10	2	31 - 40
13	11 - 15	15	more than 40

Suppose that on some day you hunted this same area and saw 35 other hunters in the field. How would you feel about seeing this number of hunters? (CIRCLE ONE NUMBER)

1	2	3	4	5
very unpleasant	un-pleasant	neutral	pleasant	very pleasant

How many hunters other than those in your own party would you prefer to see while hunting in the field?
$\bar{x}$=12 other hunters
41% prefer to see 10 or more

Did you personally put your tag on a deer today?

	%		
51	no	49	yes % of 260 visits

How many deer did you see within shooting range?

	%		
12	none	10	3
9	1	8	4
10	2	51	5 or more

How many shells did you use here today?

36	none		12	4
19	1	%	3	5
16	2		3	6
8	3		5	7 or more

Overall, how would you rate the quality of your deer hunt here today? (CIRCLE ONE NUMBER)

1	2	%	3	4	5
very low	fairly low		about average	fairly high	very high
13	17		34	18	18

Other hunters may have affected your deer hunting here today. For each statement below please circle the response which best describes your hunt today

Y = Definitely Yes
y = yes, somewhat
n = no, not much
N = No, not at all

There were too many other hunters for me to enjoy being in the field Y y (n) N 92%

Other hunters occasionally kept me from hunting where I wanted to Y y (n) N 84%

Where I hunted there was the chance of 2 or more hunters claiming the same deer Y y (n) N 90%

The number of other hunters where I hunted made stalking a deer impossible Y y (n) N 89%

There was too much competition from other hunters where I hunted Y y (n) N 92%

Where I hunted there were not enough hunters to keep the deer moving Y y (n) N 34%

How many hunters including yourself were in your hunting party?

$\bar{x}$=2 hunters

What are the three most important things that added to the quality of your hunt here today?

1.	Seeing Game	74
2.	Good Weather	70
3.	Nature, Outdoors	56

What are the three most important things that decreased the quality of your hunt here today?

1.	Poor Weather	131
2.	Not Enough Hunters	57
3.		

How did you first learn about the Governor Dodge deer hunt? (CHECK ONE)

- 53 from other hunters
- 2 friends who are not hunters
- 5 newspaper
- 0 TV
- 0 radio
- 32 DNR hunting regulations pamphlet
- 1 hunting license salesmen
- 8 other _____

When you came to Governor Dodge this morning, how many hunters other than those in your own party did you expect to see while hunting in the field?

I expected to see 42% other hunters in the field Give a number of 10 or less
29% I didn't have any idea how many other hunters I would see in the field
Of all responding

If you wanted to learn more about deer habits, where would you go for information? (CHECK THREE)

#1	78	go out and observe deer	
#3	42	talk to another hunter	
	8	talk to a friend	%
	32	read a book about deer	
	40	read sportsman's magazines (Outdoor Life or Field and Stream)	
#2	45	talk to DNR personnel	
	4	other _____	

If you wanted to learn more about good places to hunt deer, would you: (CHECK THREE)

#1	79	go out and observe	
#2	60	talk to another hunter	
	22	talk to a friend	%
	18	read a book about deer	
	19	look through sportsman's magazines	
#3	53	talk to DNR personnel	
	4	other _____	

In the last year, have you made suggestions or voiced concerns about the DNR to: (CHECK ALL THAT APPLY)

#2	41	family	
#1	57	friends who hunt	
	17	friends who do not hunt	%
	9	sporting goods store employee	
#3	24	DNR personnel	
	4	a legislator	
	2	editorial page of a newspaper	
	7	deer checker at a registration station	
	11	hunting license salesperson	
	12	Conservation Congress Meetings	

METRIC CONVERSION TABLE

Meters (m) x 3.3 = Feet (ft)
Kilometers (km) x 0.6 = Miles
Square Kilometers (km^2) x 0.4 = Square Miles (mi^2)
Hectares (ha) x 2.5 = Acres
Centimeters (cm) x 0.4 = Inches
Celsius Temperature (°C), 9/5(°C) + 32 = Fahrenheit Temperature (°F)
Kilograms (kg) x 2.2 = pounds (lb)
Liter (l) x 1.057 = quarts (qt)

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