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Effect of simulated hunting during the rut on reproduction and movement of Coues white-tailed deer

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EFFECT OF SIMULATED HUNTING DURING THE RUT ON REPRODUCTION AND MOVEMENT OF COUES WHITE-TAILED DEER

by

Kirby Bristow

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ABSTRACT

I examined the influence of human disturbance on Coues white-tailed deer (Odocoileus virginianus couesi) by subjecting deer within separate but similar areas to different levels of disturbance during breeding seasons, 1990-91 and 1991-92. Marked does (n = 7) were seldom found outside their harmonic mean core areas (χ^2 = 7.140, 6 df), or harmonic mean home ranges (χ^2 = 1.030, 6 df). In summer 1992, I collected reproductive information from 10 adult females within each area. Fetal rates within the control and treatment areas were 1.3 fetuses/female and 1.1 fetuses/female, respectively. The corpora albicantia counts, reflecting the 1991 fetal rate, were 0.9 for the control, and 1.1 for the treatment areas. Calculated conception dates within both areas showed a peak in early January and their distributions were not significantly different (P = 0.32). There was no difference in reproduction or movement in response to increased disturbance of 60 hunter-days/15km^2.

INTRODUCTION

I am the sole author of my thesis, which is prepared for submission to the Wildlife Society Bulletin. My thesis follows the guidelines of Guthery et al. (1988, Guidelines for authors and reviewers of wildlife society bulletin manuscripts, Supplement to Wildlife Society Bulletin 16: 23 pp.).

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EFFECT OF SIMULATED HUNTING DURING THE RUT ON REPRODUCTION AND MOVEMENT OF COUES WHITE-TAILED DEER

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Key words: disturbance, fetus, home range, movement, ovary, reproduction.

Many animal species alter their behavior in response to increased human activity (Anderson et al. 1990, Freddy et al. 1986). Changes in behavior and movement patterns have been documented in elk (*Cervus elaphus*) and mule deer (*Odocoileus hemionus*) (Edge et al. 1985, Ward 1985). Nest success of raptors has been reduced in response to increased human disturbance (Wiley 1975, White and Thurow 1985). However, the effect of human disturbance on reproductive rates of large ungulates has received little attention. Wildlife managers in Southern Arizona have expressed concern that disturbance resulting from the late season deer hunt is interfering with breeding, and reducing herd productivity of Coues white-tailed deer (Odocoileus virginianus couesi).

White-tailed deer increased their daily movement and activity in response to human disturbance (Marshall and Whittington 1968, Pilcher and Wampler 1982). Some female white-tailed deer shifted their activities to areas of their home range where human disturbance was reduced (Kammermeyer and Marchinton 1976, Root et al. 1988). Welch (1960) found that concentrated hunting pressure caused Coues white-tailed deer to shift their feeding periods and bedding areas.

Deer typically restrict their movements within their home range to a "center of activity" (Robinette 1966). These activity centers can change in response to seasonally available foods (Marchinton and Jeter 1966, Byford 1969), and other variables (Rongstad and Tester 1969). Ivey and Causey (1984) showed that during the rut female white-tailed deer increased their activity but restricted their movement. By restricting movement to small areas of their home range, females could advertise their readiness to breed. Holzenbein and Schwede (1989) observed similar behavior and hypothesized that females restricted their movements to these "intensive search areas" (ISA) to facilitate their location by rutting males.

If human disturbance causes female white-tailed deer to shift their seasonal center of activity to areas outside the ISA, rutting males may not locate receptive females as easily. Human disturbance could further hinder the search for receptive females by affecting the behavior of rutting males. This situation could delay or prevent reproductive opportunities.

Female white-tailed deer have a 24 hour estrous period. If a female is not bred during that 24 hour period then she may come into estrus again, approximately 28 days later (Cheatum and Morton 1942). Lost breeding opportunities during a female's first estrus could prevent reproduction, or delay breeding and parturition by 28 days. The fawns of Coues white-tailed deer populations are born during the summer rains, when more forage is available for the lactating does (McCabe and Leopold 1951). Females may become malnourished and fail to lactate sufficiently, if fawning is delayed by a month, when forage may be less available (Butts et al. 1978). Fawns may starve, or become malnourished and more vulnerable to other sources of mortality (Verme and Ullrey 1984).

The evolution of synchronous fawning has been hypothesized as a result of high neonatal predation (Sadlier 1969). Opportunistic predators such as coyotes (<u>Canis</u>

latrans), will attempt to prey upon white-tailed deer fawns whenever they are encountered (Smith 1984). When all the fawns are born, and are vulnerable, during a shorter period, the probability of a chance encounter with a potential predator is reduced. If breeding opportunities are delayed such that the fawning period becomes less synchronous then more fawns may be lost to predation. Predation also could have a greater impact if many fawns are born later, because ground cover may be less available (Marburger and Thomas 1965).

White-tailed deer populations in Texas are subjected to firearms hunts during the rut with no apparent effect on reproduction (Teer et al. 1965). However, Texas populations have higher densities than those of the Coues white-tailed deer of Southern Arizona. Location of mates would be more difficult, and human disturbance might have a greater effect, in populations with lower densities.

I designed this study to assess the effects of human disturbance on reproduction and movement on a population of Coues white-tailed deer. My objectives of this study were to detect a measurable influence of simulated hunting on conception dates, intrauterine loss, and fetal rate on a sub-population of white-tailed deer; and to measure the influence of simulated hunting during the rut on movements of marked deer.

STUDY AREA

I conducted this study in the foothills of the Santa Rita Mountains north of Patagonia, Arizona. The area is composed of semi-desert grassland in the lower elevations (1,300-1,550 m) with encinal and oak-pine communities dominating the middle (1,350-1,700 m) and upper (1,600-2,100 m) elevations respectively (Brown 1984).

I selected a control and a treatment area. The treatment area was located between Little Casa Blanca Canyon and U.S. Forest Service road No. 72, running southeast from Anaconda Spring to the Coronado National Forest boundary. In the past, this area had been hunted heavily during October, November, and December rifle hunts (Ockenfels et al. 1991).

The control area was located between Big Casa Blanca and Wood Canyons, running southeast from their confluence to the Coronado National Forest boundary. Because of restricted access, this area had historically received less hunting pressure (Ockenfels et al. 1991). A high ridge between Big and Little Casa Blanca Canyons separates these 2 areas. This ridge is wider than the average home range of female white-tailed deer; thus, I assumed that marked deer and most unmarked deer would not move between the 2 areas. In the past, the marked deer had not moved between the 2 areas (Ockenfels et al. 1991).

I compared habitat between the 2 areas using vegetation association maps from Ockenfels et al. (1991). Each area was dominated by; mixed oak (Quercus spp)/mesquite (Prosopis spp), mixed oak, and mixed oak/juniper (Juniperus spp) associations. The control area had a higher occurrence of the mixed oak/mesquite vegetation association, while mixed oak was more common in the treatment area.

METHODS

Disturbance

I measured background and experimental disturbance during this study. I measured background disturbance, exerted by the public, in both areas, throughout the field seasons (Oct-Mar). I counted people, vehicles, and camps, and recorded the type of activity (e.g., hiking, quail hunting, deer hunting). I placed hunter survey boxes at the main entrances to each area during the general deer hunting seasons (Oct, Nov, Dec; Fig. 1). A sign directed each hunter to take a survey card and record the number of days hunted in that particular area. I multiplied the average number of days hunted within each area by the number of cards taken to determine the hunter-days for each area. Casa Blanca Canyon road, Wood Canyon road, and USFS road 72 represented boundaries of the control and treatment areas. Hunters using these roads may have hunted on either side of the road and thus had a 50% chance of hunting outside the study areas. Therefore, I used only half of the cards taken from these survey boxes to calculate hunter-days.

I exposed deer within the treatment area to increased disturbance, through simulated hunts, during the second and third weekends of January of each field season. Groups of 2-3 people hiked along designated routes searching for white-tailed deer. When we found deer we fired blank, large caliber rifles to simulate hunting. We pursued and disturbed all deer that we found until they left the area or could no longer be located. I designed the routes so that 10-20 individuals could survey the entire treatment area in a weekend. I based the total number of people upon the maximum number of hunters seen within the treatment area during the general white-tailed deer hunts. Each person recorded the number of marked and unmarked deer seen, and the number of shots fired. We disturbed deer within the treatment area throughout January, firing blanks whenever deer were encountered. Fewer people participated during the week, and on weekends after 21 January, during these times we concentrated our disturbance on the marked animals.

Movement

Each area contained several female white-tailed deer that had been fitted with radio collars containing pulsing type, mortality sensing transmitters (Ockenfels et al. 1991; Fig. 2). I used a variable channel radio receiver (Telonics

Inc., Mesa, Ariz.) and a hand held yagi antenna to locate each animal. I scheduled observations so that an equal number of locations were obtained at dawn, mid-day and dusk to produce independent samples of feeding and bed sites. I obtained all locations from vehicles, or on foot, and recorded whether I had disturbed the animal. During the disturbance period, (Dec-Jan), I intentionally disturbed instrumented animals within the experimental area while radio tracking. I continued to disturb the animal until it could no longer be relocated due to loss of radio signal or time constraints. During the pre and post disturbance periods (Sep-Dec, Feb-Mar) in the treatment area, and throughout the field seasons in the control area, I attempted to avoid disturbing the instrumented animals.

I plotted all locations on topographic maps and recorded other pertinent information such as date, time, location, group size, and animal identification. I divided each field season into 4, 53 day periods based upon hunting seasons and breeding seasons (Smith 1984). I compared relocations of marked deer during these periods to their home ranges as calculated by Ockenfels et al. (1991). I recorded relocations as within the 68% harmonic mean core area (HMCA), within the 90% HM home range (HMHR), or outside the HMHR. I used Chi-square goodness of fit tests to assess whether the deer altered their movement patterns in response to increased disturbance.

Reproduction

In 1992, from 10 June to 21 July, personnel from the Arizona Game and Fish Department, and the University of Arizona collected 10 females from each area. We attempted to collect all instrumented females, with the remaining does being collected as encountered from the population of each area. I based the sample size on population densities estimated within the treatment area, using a Lincoln index of survey data collected during the simulated hunts. We tried to collect only females ≥ 2 years old. Female white-tailed deer are faithful to their home ranges (Hood and Inglis 1974, Ockenfels et al. 1991). Thus, I assumed that animals collected from each area represented those individuals that were present under the experimental conditions.

I recorded standard weights and measurements for each female, fetus, uterus and conceptus, and collected ovaries, and lower jaws. I examined ovaries for presence, number, and size of corpora lutea (CL), accessory CL (ACL) and corpora albicantia (CA) according to Cheatum (1949). I used 2-sample-*t* tests to compare the numbers of ovarian structures (CL, ACL, and CA), between the study groups.

I estimated the age of the females from tooth eruption and wear and compared ages between the study groups using a

Mann-Whitney-Wilcoxon rank sum test. I estimated the age of fetuses as outlined in Hugget and Widdas (1951) using weight$^{1/3}$ and a birth weight of 2.48 kg (Smith 1984). I estimated birth and conception dates by assuming a gestation period of 200 days and projecting forward and back from the age of the fetus. I compared the projected birth and conception dates using a one tailed 2-sample-*t* test.

I calculated kidney fat indexes (Riney 1955), qualitatively estimated subcutaneous fat, and used live weight minus conceptus weight, as measures of condition of the does collected. I compared the condition estimates between study groups using Mann-Whitney-Wilcoxon rank sum tests.

RESULTS

Disturbance

There were 3 white-tailed deer hunts within the study area each year: the early season 26-29 October, the middle season 9-18 November, and the late season 13-31 December. In 1990 the Arizona Game and Fish Department collected the data from the survey boxes, and I was not able to get an accurate measure of the hunter-days for December, in my study areas. The hunter-days in the control area for October and November were 64 and 120, respectively. The hunter-days in the treatment area were 125 and 148 for October and

November, respectively.

In the control area in 1991 there were 60, 64, and 24 hunter-days in October, November, and December, respectively. In the treatment area in 1991 there were 157, 201, and 69 hunter-days in October, November, and December respectively (Fig. 3). Surveys of hunters, vehicles, and campsites each year reflected the hunter-days within each area. The treatment area received greater use each year during all seasons.

The average numbers of people participating in the simulated hunts were 15/day in 1990 and 17/day in 1992. We disturbed a mean of 28 deer/day, an average of 2 of which were marked animals. We fired an average of 18 shots/day, and ≥5 deer were disturbed several times. During the remainder of January there were 2-3 people available for disturbance on weekends. We calculated a mean of 60 hunter-days for January each year, including the simulated hunts (Fig. 3).

Movement

In the fall of 1990 when this study began there were 5 marked deer (2 M, 3 F) within the control area, and 7 marked deer (1 M, 6 F) within the treatment area. In December of 1991 the AG&FD captured, and radio-collared, 3 additional females in the control area and 2 females in the treatment area.

During the study mountain lions (Felis concolor) killed 2 marked females within the control area, and 1 marked female in the treatment area died of unknown causes. Hunters killed 1 marked male within each area, and 7 collars failed at various stages throughout the study. We relocated the marked animals 160 times over both field seasons ($\bar{X}$ = 4 locations/animal/period).

The number of relocations of marked females that were within their 70% HMCAs and 90% HMHRs was not different between periods (χ^2 = 3.591, and 0.600, respectively, 6 df; Table 1). Twice the observed relocations of a particular female within her 70% HMCA and 90% HMHR did not meet or exceed the expected values for that period, once was during a pre-disturbance period and the other was during a post-disturbance period. I found does outside their 90% HMHR 4 times, once during a disturbance period. Female 34 was the only marked animal in the control area that we could relocate throughout the field season. The numbers of relocations within the 70% HMCA and 90% HMHR of female 34 were not significantly different from that of females within the treatment area during all periods (χ^2 = 7.140 and 1.030, respectively, 6 df).

Reproduction

I estimated the deer population in the treatment area to be 128-145 animals. Ockenfels et al. (1992) estimated the herd composition within the study area to be 26 males:100 females and 43 fawns:100 females, resulting in a total female population of 77-87 animals. Survey data within the control area produced similar results. Therefore the collection of 10 females/area represents ≥10% portion of the female population.

We collected 2 marked females from the control area and 4 marked females from the treatment area, the rest of the does were taken as encountered from the population of each area (Fig. 4). There were no differences ($\underline{P}$ < 0.05) among ages, kidney fat indices, subcutaneous fat estimates, and body weights for the females collected from both areas (Table 2).

We collected 11 fetuses from each area. We collected 2 females (≤2 yr.) within the treatment area that were not pregnant. The CL rate, indicating the 1992 fetal rate, was 1.3 in the control area and 1.1 in the treatment area. The CA rate, indicating the 1991 fetal rates, for the control and treatment areas were 0.9 and 1.1, respectively. The numbers of ACL were not significantly different between sample groups (Table 3). The sex ratios of fetuses in both groups were 4 males/7 females.

I calculated the week of birth and conception for both study groups. The mean and median birth dates for both groups were in the fourth week of July, and the mean and median conception dates were in the first week of January (Fig. 4). Female 34, collected 22 June in the control area, had already given birth. When I examined her ovaries I found 2 CL, and several cotyledons were present in both horns of the uterus. She was lactating when I collected her, and I saw 2 fawns in the area.

I calculated the fetus age at 1 July for both groups and compared them. The mean fetus ages at 1 July for the control and treatment groups were 178 days and 176 days, respectively. The range of fetus ages was larger in the control area but their distributions were not significantly different ($\underline{P}$ = 0.32, Fig. 5). I compared the estimated date of conception for marked does within the treatment area to known dates of disturbance for these deer in 1992. Females 38 and 45 had been disturbed within the same week as their estimated conception dates.

DISCUSSION

Disturbance

The results of this study indicate that our level of disturbance did not affect reproduction or movement patterns of Coues white-tailed deer. We disturbed deer to a greater extent (>60 hunter-days/15 km^2) than that of the normal hunting seasons. During our simulated hunts we fired at every animal regardless of age or sex, and some individuals were pursued and disturbed several times/day. The concentration of hunters during the simulated hunts was greater than that for the same area during the regular hunting seasons. On the opening weekend of the 1991 October hunting season the density of hunters in the treatment area was <35 hunter-days/15 km^2.

I scheduled the simulated hunts to coincide with the peak of the breeding season. This would have produced the greatest impact upon reproduction, by disturbing deer and possibly preventing or delaying reproduction. However, fetal rates for both years, and fawning dates for 1992 were not affected.

Movement

Increased disturbance, through simulated hunts, did not affect the movement patterns of marked females. Reproduction could have been prevented or delayed, if disturbance would have caused females to abandon their ISAs. Marked females that were disturbed during the simulated hunts were always relocated within their 70% HMCA the next morning. While disturbance might have caused females to leave their ISA, they may have returned within their 24 hour estrous period.

If the male:female ratios are high enough, does may breed despite being chased out of their HMCA during estrus. Twice in 1992 I located, and disturbed, a marked female that was with a male during her calculated week of conception. Whether I had actually prevented the observed male from breeding the marked female on that day is unclear. However, if I had prevented a breeding event, clearly the female was still able to breed during her estrous period.

Reproduction

Conception rates for each year were not significantly different between the study groups. Reproduction in white-tailed deer can be affected by several factors such as age and physical condition of the doe. Condition estimates and age structures of the sample groups were not significantly different, therefore we can rule out any mitigating influences of nutrition or age specific fertility. Thus, I assume that there was no measurable effect of our level of disturbance upon breeding. The only does collected in 1992 that were not pregnant were from the treatment area, both were younger animals with low KFI's and body weights. Conception rates represent a true measure of the practical effects of disturbance. A difference in conception rates would indicate a loss of reproductive opportunities.

Another potential effect of disturbance during the rut would be a delay in breeding and consequently in fawning periods. If does are bred during their second estrus, then fawning would be delayed by 28 days (Cheatum and Morton 1942). If the level of disturbance caused a delay in breeding opportunities then I would expect a distinct difference in calculated birth dates between sample groups. There was no difference between calculated birth dates of the 2 sample groups.

Management Implications

Disturbance during the peak of the rut did not effect reproduction of coues white-tailed deer. Hunting prior to the peak of the rut would probably be inconsequential relative to the effect of hunting on reproduction.

Special trophy hunts, in areas with adequate male:female ratios, could be designed offering extended hunting seasons during the peak of the rut, when bucks are more active. If hunter numbers, areas open, and season dates are designed so that potential disturbance is <60 hunter-days/15 km^2, managers could be confident that disturbance would not effect herd productivity. These trophy hunts would provide opportunities for hunters seeking to avoid the crowds often associated with early season hunts.

SUMMARY

I examined the influence of human disturbance on Coues white-tailed deer by subjecting deer within separate but similar areas to different levels of disturbance during the breeding seasons of 1990-91 and 1991-92. Marked does ($\underline{n}$ = 7) were seldom found outside their harmonic mean core areas (χ^2 = 7.140, 6 df), or harmonic mean home ranges (χ^2 = 1.030, 6 df) even during the disturbance periods. In 1992, between 10 June and 21 July I collected reproductive information from 10 adult females within each area. Fetal rates within the control (low disturbance) and treatment (high disturbance) areas were 1.3 fetuses/female and 1.1 fetuses/female respectively. The corpora albicantia counts, reflecting the 1991 fetal rate, were 0.9 for the control, and 1.1 for the treatment areas. Calculated conception dates within both areas showed a peak in early January (during the disturbance period) and their distributions were not significantly different ($\underline{P}$ = 0.32). We found no significant difference in reproduction, or change in movement patterns in response to our level of disturbance (60 hunter days/15 km^2) during the peak of the rut. Therefore, late season firearms hunts, which now occur before the peak of the rut, probably do not effect herd productivity significantly.

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Table 1. Relocations of marked female white-tailed deer, by period, within their 70% harmonic mean core areas (HMCA), and 90% harmonic mean home ranges (HMHR) from the Santa Rita Mountains, 1992.

	No. Locations					
	Disturbance periods			Non-disturbance periods		
Deer no.	n	HMCA	HMHR	n	HMCA	HMHR
11	7	7	7	9	9	9
13	8	7	8	11	11	11
14	7	6	7	7	4	5
24	5	5	5	1	0	0
34[a]	10	10	10	9	9	9
36	10	9	10	11	9	11
38	14	11	14	15	11	14
$\bar{X}$	8.7	7.9	8.7	9.0	7.6	8.4

[a] Deer 34 was within the control area.

Table 2. Age, kidney fat indices (KFI), body weight (BW), and subcutaneous fat (SF) estimates, of female white-tailed deer collected in the Santa Rita Mountains, Arizona, 1992.

	Age		KFI		BW(kg)		SF	
Area	$\bar{X}$	Range	$\bar{X}$	Range	$\bar{X}$	Range	$\bar{X}$	Range
Ctrl.	3.7	2-5	34.5	16-45	32.5	26.6-35.8	2.9	1-4
Trmt.	4.2	1-8	35.2	11-46	31.5	23.0-39.1	3.5	1-5
P[a]	0.50		0.91		0.85		0.15	

[a] Mann-Whitney-Wilcoxon rank sum tests.

Table 3. Corpora lutea (CL), corpora albicantia (CA), accessory corpora lutea (ACL), and fetuses taken from female white-tailed deer collected in the control and treatment areas in the Santa Rita Mountains, Arizona, 1992.

	CL		CA		ACL		Fetuses	
Area	$\bar{X}$	Range	$\bar{X}$	Range	$\bar{X}$	Range	$\bar{X}$	Range
Ctrl.	1.3	1-2	0.9	0-2	0.3	0-2	1.1	0-2
Trmt.	1.1	0-2	1.1	0-3	0.2	0-1	1.1	0-2
P[a]	0.34		0.73		0.74			

[a] 2-sample-t tests.

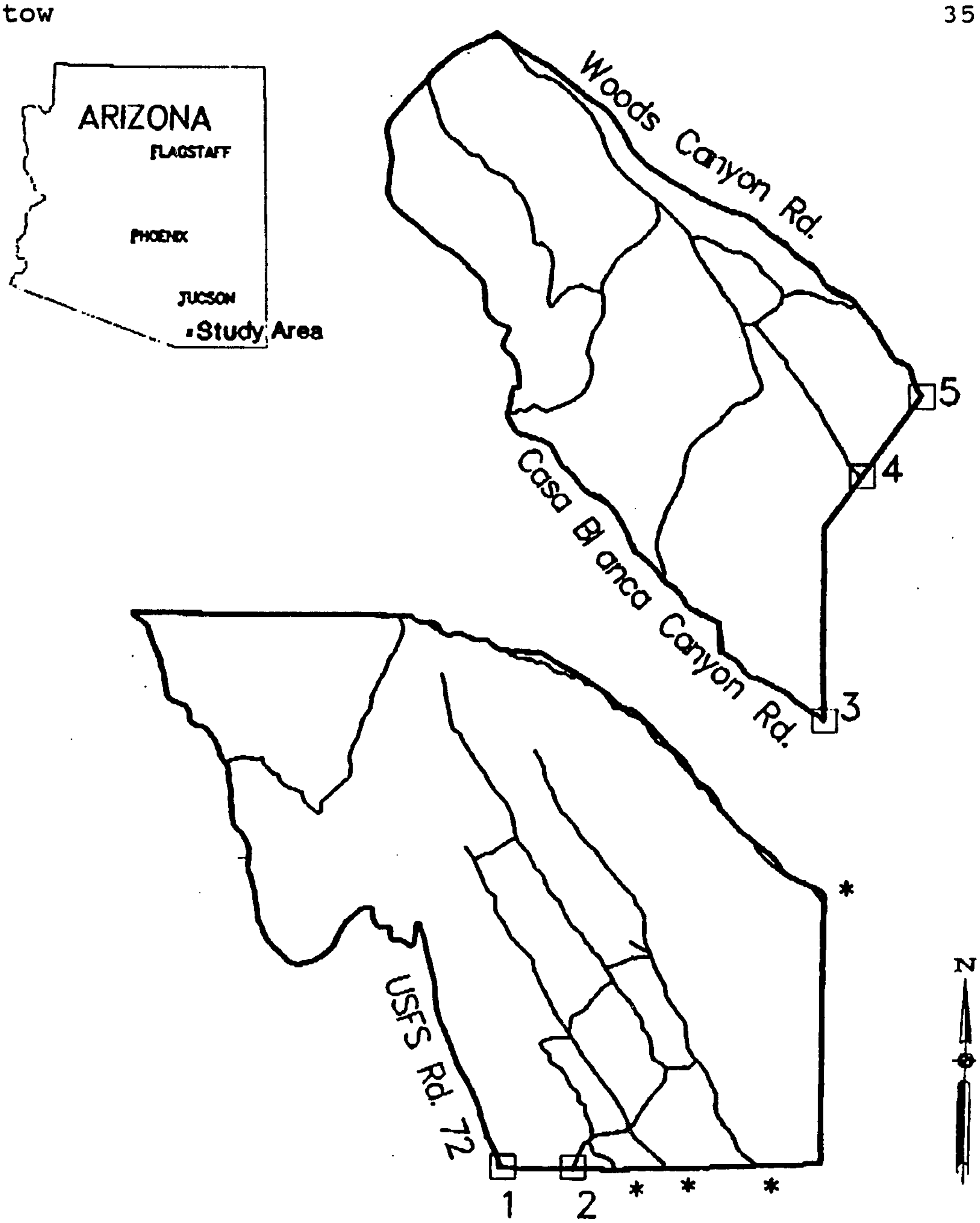

Fig. 1. Map of study areas showing road access, and hunter survey box locations (1-5) in the Santa Rita Mountains, Arizona, 1991.

* Locked gate, access denied by landowner.

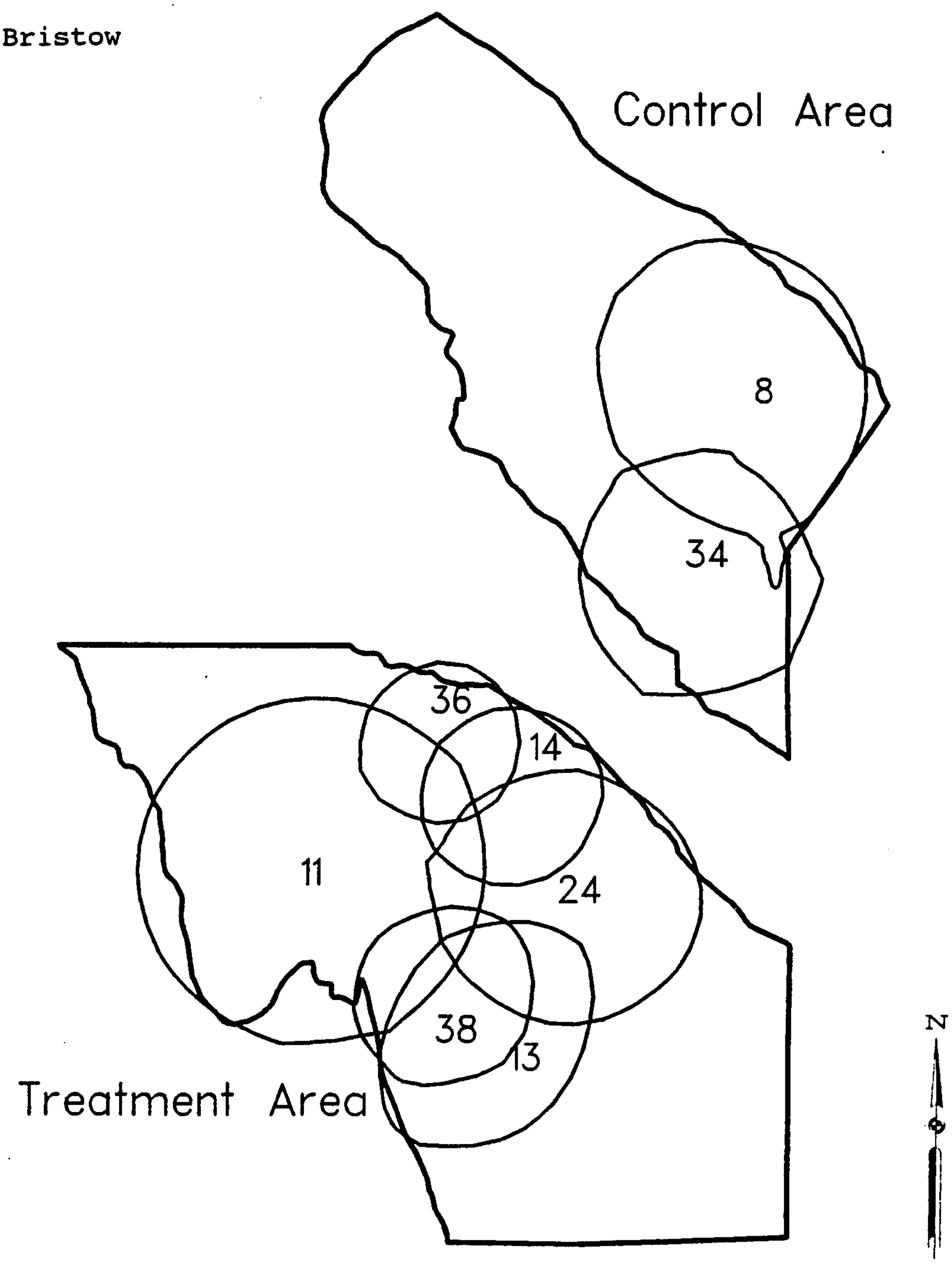

Fig. 2. Home ranges (68% harmonic mean core areas) of marked female white-tailed deer in the control and treatment areas of the Santa Rita Mountains, Arizona, 1990.

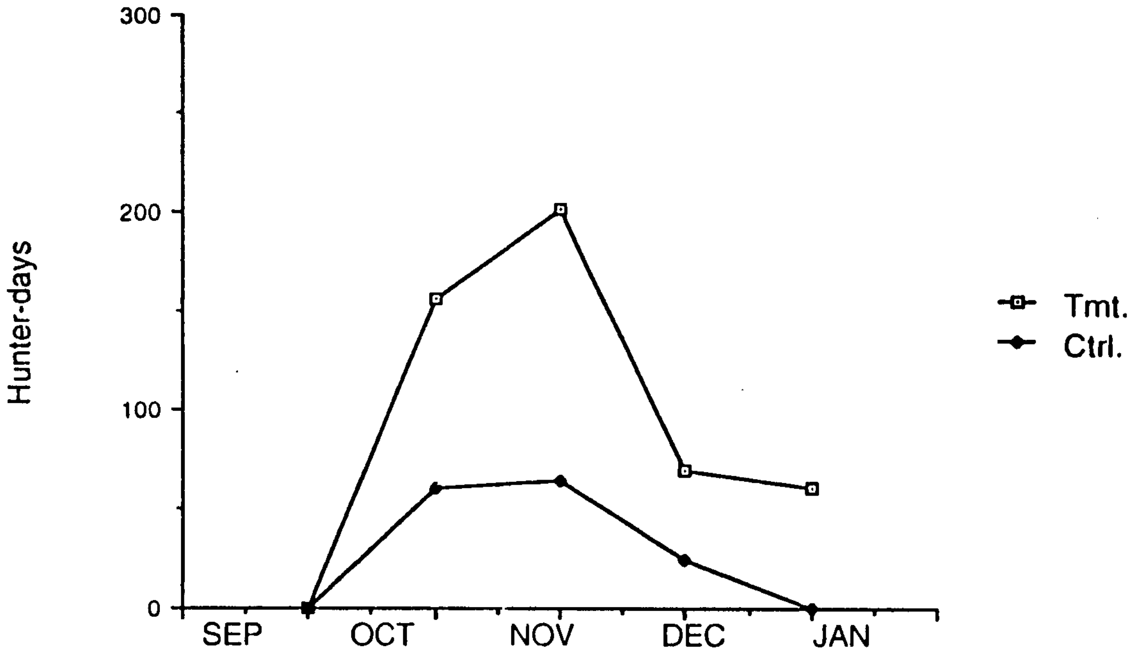

Fig. 3. Hunter disturbance levels for the control and treatment areas in the Santa Rita Mountains, Arizona, 1992.

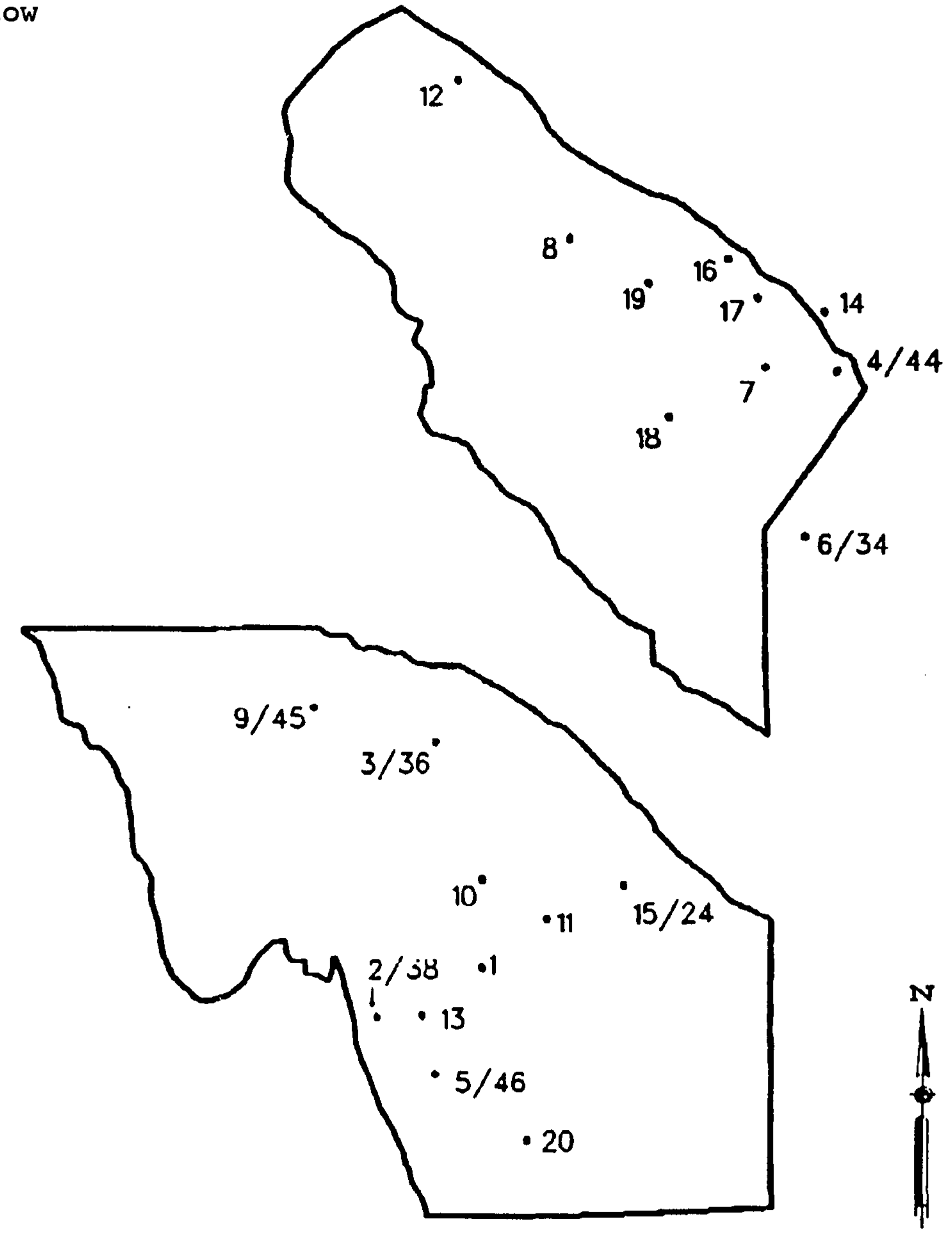

Fig. 4. Collection Locations of marked, (2/38, 3/36, 4/44, 5/46, 6/34, 9/45, and 15/24) and unmarked, female white-tailed deer in the control and treatment areas of the Santa Rita Mountains, Arizona, 1992.

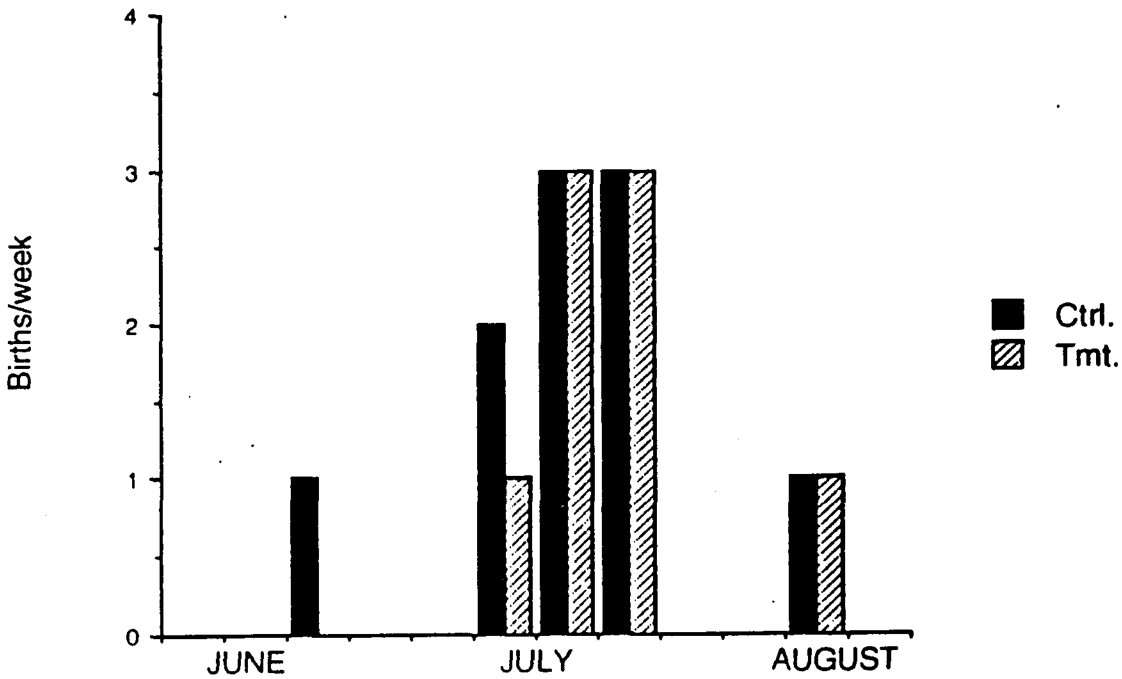

Fig. 5. Projected birth dates of fetuses in utero from the control and treatment areas in the Santa Rita Mts., Arizona, 1992.