A Track Plot System to Monitor Habitat Use

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Abstract: Difficulty in capturing a sufficient sample of white-tailed deer (*Odocoileus virginianus*) for a biotelemetry habitat use study led to the development of an alternative method using track plots. One-hundred 1 × 3 m plots/site were proportionately allocated by percentage area of distinct cover types, prior to random location in the 3 study areas. Results from 13 months of use indicated that the method was acceptable for monitoring habitat use patterns. Potential uses and problems are discussed. Comparisons with biotelemetry and direct observation data are made.

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The assessment of habitat use patterns by wildlife during recent years has been accomplished mainly by biotelemetry location. With state-of-the-art equipment, one can obtain consistent and continuous monitoring of a wide variety of animals. Although not free from biases, data collected in this manner are considered the best available today. The system requires capturing a sufficient number of animals, not always an easy task, and fitting them with transmitters. Biotelemetry monitoring is initially expensive and if animals are often located, costs in time and in dollars are high. To counteract these problems (sample size, time, cost), an alternative monitoring method was developed using track counts to evaluate habitat use patterns. This paper describes the method and suggests potential uses and problems. In addition, the method was compared to available biotelemetry and direct observation data.

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Study Area

The Cross Timbers region (Dyksterhuis 1948) extends from Kansas through central Oklahoma, to Texas, and is comprised of dense stands of post oak (*Quercus stellata*) and blackjack oak (*Q. marilandica*) growing on rolling to hilly sandstone uplands (Dwyer and Santelman 1964), with areas of grassland dispersed throughout. Riparian areas dissect the stands, while bushy species continue to invade the grasslands. Dyksterhuis (1948), Rice and Penfound (1959), and Risser and Rice (1971) described the vegetation and its distribution.

Three sites in north-central Oklahoma were chosen for this study: 1 located 10 km west of Okmulgee (259 ha), while the remaining 2, Hunt Creek (373 ha) and South Hiway (97 ha), were 13 km west of Stillwater.

Methods

Field

Aerial photographs (1:11,500, May 1978) were used to delineate distinct cover types (Ockenfels 1980) within the 3 sites. Cover types were based on species composition and vegetative community structure. Ground reconnaissance was used to verify boundary lines before transfer to base maps. Percentage area of each cover type was calculated with an electronic digitizer.

One-hundred plots/site were allocated proportionally, based on percentage area of each cover type. Plot locations were determined by overlaying a grid on aerial photographs and selecting random locations. A rear-bladed rototiller and shovel were used to prepare 1 × 3 m plots. Each plot was cut to a depth of 10 cm, raked smooth, and flagged to facilitate relocation. Data collected every 4 to 8 days by plot included total number of deer tracks counted. A single hoof impression was considered as 1 track. All plots (100) at each site were "read" during a single sampling period. Following data collection, each plot was raked clear of tracks, initiating a new time interval. Heavy rain or snow were also used to start new periods.

Biotelemetry study animals were captured with Stephenson box traps during the 1978–1979 winter. A variety of other methods (e.g., drug immobilization, drives, snares) were used during the rest of the year. Deer were collared with color-coded activity-mode transmitters and ear streamers were attached for identification.

The biotelemetry monitoring system consisted of known-point stations and a reference beacon, coupled with a roof-mounted, null-peak antenna boom for mobile tracking (Hegdal and Gatz 1978). Station number, beacon angle, and angle to animal were recorded in the field. Locations were determined by plotting angles on acetate overlays of the base map. Cover type and the appropriate coordinates were recorded. Handheld Yagi antennas were also used to locate animals. "Burst" sampling was used for the relocations. Relocations were at 2-hour intervals during tracking sessions. Sessions were dictated by priority (first, track plot data; second, telemetry) and personnel available. Generally, a session would start at any hour of the 24-hour cycle, and run for 4 to 8 hours. Three to 5 relocations/animal were possible in any session.

Location and cover type were recorded for every direct observation during the study. Locations and observations were recorded during capture efforts, telemetry location work, and during sampling periods for the track plots. Data from a previous study period (1977–1978) on the site were combined with the data for this study to increase sample size to more than 100 observations.

Analysis

Deer use was estimated by 2 track indices. One index was based on number of plots with tracks (USE_p), while the other (USE_t) was based on the number of tracks counted within plots.

USE_p can best be illustrated by the following example: if 30 of 100 plots at Hunt Creek had deer tracks during an 8-day period in May 1978, and 10 were in the bottomland forest (riparian) cover type, USE_p for the type would be 0.333 (10/30). USE_t is more involved, being the percentage of total tracks counted on a site located in a particular cover type. The basic calculation is as follows:

1) Number of tracks are counted and recorded for each numbered plot;

2) Number of tracks in each plot is divided by the number of days the plot was available. Number of days varied by plot due to the large number plots/site, plot spacing (random), weather conditions, and available personnel.

3) Results (tracks/day/plot) were summed by cover type;

4) USE_t values were then calculated by dividing cover type totals by the total of all types on a site.

Ockenfels (1980) showed the calculation in tabulation form for USE_t (defined as TPD in previous publication). For the example above, USE_t was 0.385.

Indices (USE_p, USE_t) were compared by paired *t* tests (Snedecor and

Cochran 1967), as were comparisons between USE_t and biotelemetry data. Habitat use values from telemetry location were calculated as number of relocations within a cover type divided by total number of relocations within a period, all animals summed. Relocations were restricted to only those taken during the sample periods and located within the area monitored by the track plot system. This insured *t*-test validity of the hypothesis: Percent use of a type did not vary by method for time and area.

Seasonal cover type use estimates were calculated for USE_t, biotelemetry data, and direct observation data as general trend indicators, then compared subjectively. All data from the 3 methods were restricted to Hunt Creek.

Results

Habitat use patterns were evaluated by comparing track plot indices with expected use from November 1978 to December 1979. Sixty-six readings were completed during the study. Hunt Creek, Okmulgee, and South Hiway were monitored for 11, 8, and 6 months, respectively. Summary results from 2 sites (Hunt Creek, Okmulgee) were similar (Table 1), while South Hiway estimates were lower in all categories, i.e., estimated intensity of use. Sixty-five of the 66 readings (USE_t) differed ($P < 0.05$) from expected habitat use. Combining for monthly summaries resulted in 23 of 25 comparisons differing ($P < 0.05$) from expected (Table 2). The combining of July 1979 individual readings for South Hiway negated the individual differences.

Paired *t* tests indicated that USE_p and USE_t differed significantly ($P < 0.05$) in only 5 of 30 comparisons for 3 sites. On Hunt Creek, with the largest sample size, only 1 of 12 types differed. Two of 9 were different at both Okmulgee and South Hiway.

Characteristics of the telemetry monitoring effort (Fig. 1) show biases in the resultant data. Few relocations were taken before 0600 hours during the winter (also reflected in the temperature graph), and for only a few deer. Of 2,257 telemetry locations, 838 (37%) met the criteria necessary for the

Table 1. Number of sampling periods, $\bar{x}$ number of plots with tracks, and $\bar{x}$ number of deer tracks/plot per day for 3 sites in Oklahoma during 1978 and 1979. Data based on 100 1 × 3 m plots/site.

Study site	Hunt Creek	Okmulgee	South Hiway	Totals
Number of sampling periods	33	17	16	66
$\bar{x}$ number of plots with tracks	24.6	27.9	13.3	22.7
Range[a]	7–52	9–54	7–23	7–54
$\bar{x}$ tracks/day per period	42.9	43.6	18.0	37.0
Range	7.0–77.4	11.6–80.3	3.1–37.5	3.1–80.3

[a] Range of preceding value during study.

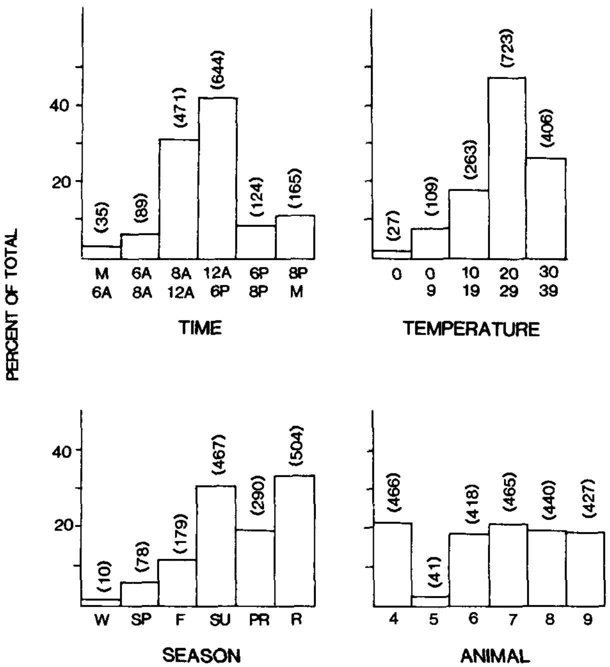

Figure 1. Characteristics of telemetry monitoring of white-tailed deer during 1978 and 1979. Y axis is percent of locations for each X variable. Seasonal dates are listed on figure 2.

habitat comparison (see analysis). Three deer dominated the habitat analysis, accounting for 831 of the 838 on-site relocations. USE_t and telemetry data were compared in 23 (of 33) sampling periods by paired t tests. The 2 indices differed significantly ($P < 0.05$) in only 3 of 8 possible habitat comparisons.

Table 2. Distribution of sampling periods for track plot Chi-square analyses.

Site	N78	D78	J	F	M	A	M	Month J	J	A	S	O	N	D
Hunt Creek	2[ab]	4[b]	4[b]			3[b]	4[b]	4[b]	3[b]	3[b]	2[b]	2[b]		
South Hiway		4[b]	1[b]					3[b]	4	3	1[b]			
Okmulgee							1[b]	1[b]	4[b]	2[b]	2[b]	1	3[b]	3[b]

[a] Two sample periods, $P < 0.05$ indicated for November 1978.

[b] Habitat use as indicated by data collected during all sample periods in the month was significantly different ($P < 0.05$) from that which would be expected based on relative areas of habitat types.

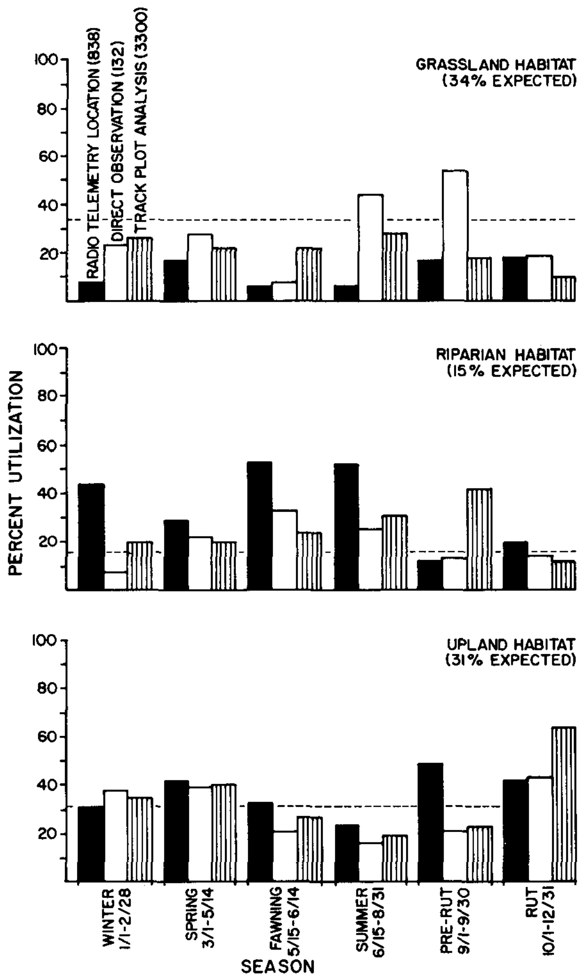

Figure 2. Comparison of 3 methods (USE_t, biotelemetry, and direct observation) used to monitor seasonal habitat use patterns of white-tailed deer in Oklahoma during 1979. Seasons are based on current literature and field observations. Sample size in parentheses. Expected values based on percentage area of that cover type within the particular site.

USE_t and telemetry data, in general, yielded similar conclusions in terms of seasonal use (Fig 2). However, the degree of selection varied considerably. The telemetry data were highly variable, with noticeable changes between seasons. Direct observations also provided a pattern of seasonal use, with a large increase in grassland use from May to November, the period in which spotlighting was concentrated for capture.

Discussion

The "reading" distribution (Table 2) throughout the study influenced mean values of use (Table 1), due in part to seasonal changes in deer activity levels (Ockenfels and Bissonette 1982). Summer readings predominated at South Hiway, when deer were moving less and making fewer impressions, which reduced mean values substantially. In addition, higher human-related activities, coupled with the area's small size, probably reduced deer use year-round. Hunt Creek and Okmulgee, sites with different habitat percentages (Hunt Creek interspersed, Okmulgee mainly upland forest) and similar human activities had mean values that were comparable in magnitude.

Paired *t* tests indicated that either USE_t or USE_p could be used for habitat use-monitoring. One point to consider is that USE_t has an added value since within as well as between-cover type use can be compared. The ability to document differential use patterns over a shorter or seasonal time period within a single cover type has high management value, as does assessment of comparative use of different cover types. For example, distance to edge, water, roads, or other environmental factors can be correlated to relative deer use (USE_t or USE_p) of a plot (Ockenfels, unpubl. data). On the other hand, USE_p is easier and faster to collect and less likely to be influenced by observer bias. The choice of index used should be based on the principle objective of the study as well as time and fiscal considerations.

Results indicated that track plot data, as was described, can be used to test if deer are or are not using the habitat randomly. However, telemetry and direct observations also provided the same conclusion. Which method, if any, is correct?

All 3 methods are suspect, if sample size and design are inadequate. As stated in the introduction, telemetry data are the accepted standard today. Is our method also acceptable? Comparisons with other methods show inconsistencies, more a result of inadequate telemetry and observation data, we believe, than problems with the track method. In our case, the small sample size (6) of telemetered deer and their social interrelations biased the telemetry data. In reality, only 3 deer were monitored on-site, as the others moved off-site after capture. This is a small sample on which to base a decision. Large changes in seasonal use of habitat components were due to single animal responses. Track indices monitored an "open" population (i.e., ingress-egress possible); thus, single animal responses were dampened.

A different factor affects the track plot data. Sample distribution was uneven, as rain and snow prevented us from following our original study design of 1 reading/week on each site. Even with track plot data the priority, 3 sites (300 plots) and a telemetry study (1 site) placed a burden on field personnel. For all practical purposes, telemetry and USE_t or USE_p would help managers make decisions supported by data collected in a sound experimental design. Biases with direct observation, e.g. visibility differences due to seasonal vegetational changes, reduces its usefulness for management decisions as a reliable tool. However, aside from a few inconsistencies, direct observation data did provide useful information. For those management decisions requiring data on seasonal use patterns, biotelemetry and track indices should provide an equivalent data base, if adequate sample sizes are obtained. Direct observations would likely be too low for seasonal comparisons, unless years are combined.

We used 1 × 3 m plots to sample deer use (USE_t) and activity; however, the rectangular shape samples lengthwise movement greater than widthwise movements. Lumping of several readings or lengthening time intervals (4 to 8 days) would reduce this bias, while circular or square plots would eliminate it. However, circular plots are difficult to establish with a rototiller and would increase the time necessary to establish a set of 100 plots. We expect, under our experimental design, that square plots (2 × 2 m) would be better to document seasonal or monthly habitat use patterns than either rectangular or circular designs.

Methods noted in recent literature (Kohn and Mooty 1971, Bloom 1978) illustrate the difficulties in sampling proportionately within a mosaic habitat structure. The ability to sample effectively is a major asset of our method. Additional uses include: (1) documenting fawning dates by backdating from the time when the first fawn tracks appear, (2) estimating seasonal levels of activity (Ockenfels and Bissonette 1982), and (3) evaluating comparative habitat use by more than one species.

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