THE DISTRIBUTION OF WINTER MULE DEER USE AROUND HOMESITES

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Abstract: Distribution of mule deer (*Odocoileus hemionus*) use of winter range habitat around a residential subdivision in northeastern California was estimated by the pellet-group count technique. Our objective was to determine whether homesites influenced deer use, and if so, to determine the distance from homes that deer use was affected. Estimates of deer use at 25 and 50 yard distances from homesites were lower ($P < 0.05$) than deer use estimates beyond 75 yds distance, and lower than overall deer use. At these distances, pellet-group densities were 12 and 53% of the overall mean density, respectively. Linear regression of pellet-group densities on distance from homes indicated that deer use was influenced by homes to about 90 yds distance. The estimated circular area about homesites where reduced deer use could be expected was over 5 ac (90 yds radius). Within this radius, deer use was 61% of overall mean deer use.

Residential development has been encroaching on seasonal ranges of mule deer throughout the western states for several decades. Housing developments were not considered a serious factor contributing to the deer decline addressed in 1976, but were thought significant enough to eliminate deer from localized areas (Wallmo et al. 1976). Of greatest concern in California is the development occurring on deer winter ranges. Studies have indicated that residential development and associated human activity can adversely affect deer (*Odocoileus* sp.) populations (Reed 1981). For example, cottage development reduced the quality of winter habitat for white-tailed deer (*Odocoileus virginianus*) in Ontario (Armstrong et al. 1983). The effects are probably greatest during winter because deer are concentrated at high densities on the winter range. Roads and associated human traffic have also been shown to reduce the value of habitat to big game species (Leege 1976, Thiessen 1976, Perry and Overly 1977, Rost and Bailey 1979). Bormann (1976) reported that human activities such as residential or recreational development, impacts the environment beyond the actual boundary of the development. Dorrance et al. (1975) reported that white-tailed deer were displaced from areas immediately adjacent to snowmobile trails even when traffic levels were low. Cornett et al. (1979) reported that deer use of a meadow near cabins received only 40% of the use in a similar undisturbed meadow area. They also reported a 70% decline in deer use within a 30-50 yard distance from hiking trails. Reed (1981) reported that residential and recreational development may eliminate deer from localized areas.

We evaluated the effects of residential development on use of winter range by mule deer, emphasizing the distribution of deer use adjacent to homes. We tested the null hypothesis that deer use as represented by pellet-groups, was similarly distributed at varying distances from homes. Such information can assist land-use planners and policy makers understand the effects of subdivision and home development on wintering deer populations.

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STUDY AREA

The Day Bench winter range is on a 3 x 17 mi lava bench located in northeastern Shasta County, California. The deer population in April during the study was estimated at 3,300 deer (Calif. Dep. Fish and Game files, Redding). Most of the deer in this herd migrate to summer ranges in spring and return by late November.

Day Bench is bordered by the slopes of Big Valley Mountain on the east and agricultural lands of Fall River Valley on the west. Vegetatively, the area is transitional between the Cascade Mountains and the Great Basin. Big sagebrush (*Artemisia tridentata*)/ juniper (*Juniperus osteosperma*) and oak (*Quercus* sp.) woodland are the dominant vegetation communities. Shrubfields dominated by birchleaf mountain mahogany (*Cercocarpus betuloides*) and wedgeleaf ceanothus (*Ceanothus cuneatus*) occur on Big Valley Mountain. Areas of level topography support mixed woodlands of Oregon white oak (*Quercus garryana*), California black oak (*Q. kelloggii*), ponderosa pine (*Pinus ponderosa*) and incense cedar (*Libocedrus decurrens*). Understory vegetation is primarily scattered stands of bitterbrush (*Purshia tridentata*), manzanita (*Arctostaphylos* sp.) and birchleaf mountain mahogany.

METHODS

Recent studies (Leopold et al. 1984, Loft and Kie 1988) suggest that pellet-group counts are a satisfactory method for estimating deer use. We counted fecal pellet-groups (Neff 1968) within 6 x 50 ft sample plots established perpendicular to transects leading out from homesites lived in on a year-around basis. Plots were established and sampled at 25 yd intervals from 0-500 yds distance. The plots (belts) were centered at 3 ft on either side of each distance class. For example, at 25 yds distance from homesites, pellet-groups were counted for 60 ft along the arc between 22-28 yd distances from homes.

Homesite and transect locations were subjectively selected to minimize the influences of other variables that could affect deer use. Large-scale aerial photographs and ground observations were used to locate transects that did not intersect changes in vegetation, roads, or zones of influence from other homes. In this way, changes in pellet-group density along transects were attributed to distance from homes rather than other human-caused or environmental factors. No effort was made to categorize the kinds or amount of disturbances that occurred at homesites.

Data were collected from 19 July to 7 October 1983 to represent the previous winter's deer use. Transects were established at 15 different homes. The first six homes had transects (n = 60) that were 500 yds in length. Preliminary analysis indicated that beyond 200 yds there was no affect ($P > 0.10$) of homesites on deer use, so transects sampled (n = 54) at the nine remaining homes were 200 yds in length. In sum, 114 transects and 1,637 pellet-group plots were established. ANOVA (SAS) was used to test for differences among the different distance classes. Student-Neuman-Kuels mean comparison test (controlled for Type I experimentwise error rate) was used to determine if means were different at $P \leq 0.10$.

Simple linear regression between the pellet-group densities and distance from homes was calculated for means significantly lower than the overall mean. The point at which the regression line intersects the overall mean use was used to estimate how far from a home its presence would affect deer use.

The regression line was used to generate expected percent changes in deer use for 10 yd distance classes, 0-100 yds from homes. The expected mean pellet-groups per plot at 10 yard distance classes <100 yds from homes were compared to mean pellet-groups/plot ≥100 yds distant. The percentage change in deer use by distance class was multiplied by the cumulative acreage that would be included within each successive distance class (concentric circles about the home) to estimate the equivalent acres of deer habitat affected.

RESULTS AND DISCUSSION

Mean number of pellet-groups/plot at 25 and 50 yd distances from homes were different from each other ($P < 0.05$) and were lower ($P < 0.05$) than the overall mean density of 2.1 pellet-groups/plot (Table 1). Hence, deer use at these distances was 12 and 53% of the overall mean, respectively. Deer use at the 50 and 75 yd distance classes were not different from each other at $P < 0.10$. From 75 to 500 yds, deer use did not significantly ($P > 0.10$) differ among 25 yd classes.

Linear regression of deer use at distance classes ≤100 yds intercepted the overall mean at 105 yards (Fig. 1). Estimated reduction in deer use ranged from 8.3% less than the mean at 85 yds to 100% less at 5 yds. Overall, the area affected as represented by reduced deer use was estimated to be 5.3 ac. The equivalent acres lost (total deer use in the 5.3 acres around homes equated to acres at the overall mean level of deer use) in areas beyond 105 yds was estimated at 2.2 ac lost for each existing home (Table 2).

This study was conducted during a year when weather and forage conditions were near-normal. Although lower deer use was observed at close dis-

Table 1. Deer use as estimated from pellet-group densities and percentage of overall mean use at transect distances from homesites.

Dist. (yds)	n	Mean pellet[1] groups per plot	SE	% of overall mean use
25	114	0.3a	0.1	12
50	114	1.1b	0.2	53
75	114	1.6bc	0.2	76
100	114	2.0c	0.3	102
125	114	1.9c	0.2	89
150	114	2.0c	0.2	96
175	114	2.1c	0.2	102
200	114	2.3c	0.3	112
225	60	2.9c	0.5	141
250	60	2.4c	0.3	117
275	60	2.9c	0.4	141
300	60	2.3c	0.3	112
325	60	3.0c	0.4	146
350	60	2.4c	0.3	117
375	60	2.5c	0.4	121
400	60	2.4c	0.3	117
425	60	2.6c	0.4	126
450	60	2.2c	0.4	107
475	60	3.2c	0.5	155
500	60	2.1c	0.3	102

[1]Values in the column of the same letter are not different from each other ($P > 0.10$).

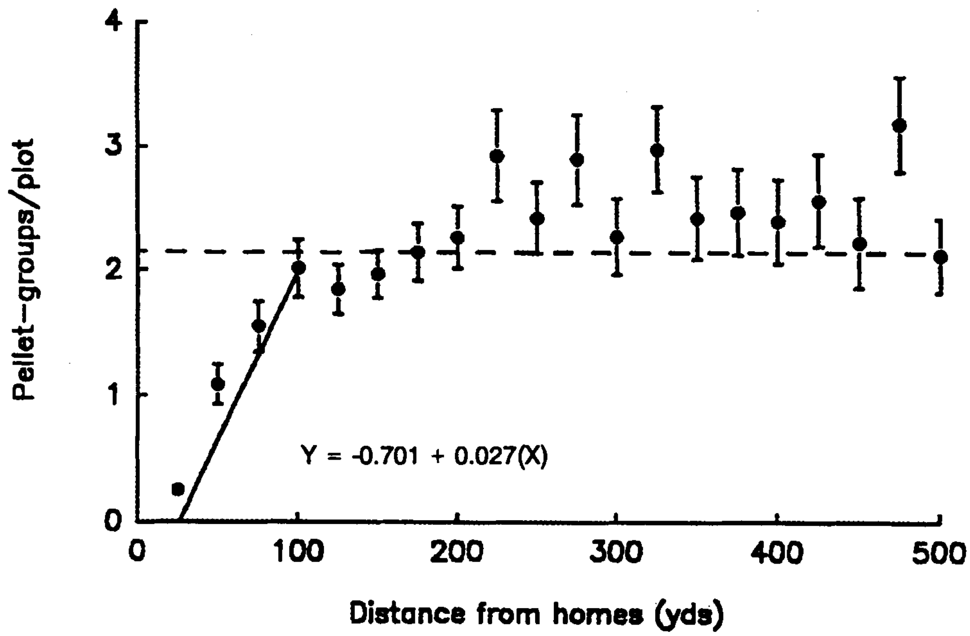

Figure 1. Mean number of pellet-groups per plot (± 1 S.E.), overall mean pellet-groups per plot (dashed line), and regression line of pellet-groups per plot in relation to distance (25-100 yd classes) from homesites. Sample size for distance classes 25-200 yds, n = 114, for 225-500 yds, n = 54.

tances to homes, this pattern of use could vary under different environmental conditions. For example, during periods of mild weather and low snowfall, forage availability may be high enough that deer stay away from homes. Avoidance would be expected more during time of forage abundance because deer would not "need" to approach homesites for feeding. Conversely, when conditions are severe, nutritional demands might cause deer to abandon avoidance behavior and use available forage near homesites. Deer may feed on ornamental plants around homesites during severe weather when native forage is unavailable because of deep snow (D.L. Neal pers. commun.) or during mild weather if a plant is particularly relished and disturbances are not of a threatening manner. Rost and Bailey (1979) indicated that cervids generally avoided roadsides until a food shortage occurs and those areas became the best source of food available.

Table 2. Average reduction in deer use as a percentage of overall mean deer use, acres of land within a distance class, and equivalent acres lost.

Distance class (yds)	Reduction in use	Affected acres	Equivalent acres lost
0-10	1.00	0.1	0.1
10-20	0.98	0.2	0.2
20-30	0.85	0.3	0.3
30-40	0.72	0.5	0.3
40-50	0.59	0.6	0.4
50-60	0.47	0.7	0.3
60-70	0.34	0.8	0.3
70-80	0.21	1.0	0.2
80-90	0.08	1.1	0.1
		5.3[a]	2.2[b]

[a] Average acres affected around each home.
[b] Equivalent acres lost per home. Calculated by multiplying the percent reduction in deer use in each distance class by the area in that distance class.

Several factors contribute to variation in the level of deer avoidance at different homes. Some of these factors are the presence of free roaming dogs, distribution of native forage and cover, species of landscape plants, gardens, fences and levels of human activity. We did not separate these factors specifically, however there appeared a tendency for deer to avoid homes with dogs. Also, deer were generally closer to homes where cover was more abundant. Although this study was not intended to evaluate the effects of all factors contributing to variability in the distribution of deer use, they each may have implications for management when making mitigative recommendations to land use planners and are important items for future investigation.

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