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Responses of black tailed deer to off-highway vehicles

Robert M. Ferris
San Jose State University

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Ferris, Robert Morris, M.A.

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U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

RESPONSES OF BLACK TAILED DEER TO OFF-HIGHWAY VEHICLES

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Robert M. Ferris

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APPROVED FOR THE DEPARTMENT OF BIOLOGICAL SCIENCES

Dr. Michael Kutilek

Dr. Howard Shellhammer

Dr. William Bros

APPROVED FOR THE UNIVERSITY

ABSTRACT

RESPONSES OF BLACK TAILED DEER TO OFF-HIGHWAY VEHICLES

by Robert M. Ferris

The responses of 14 radio-collared, female black-tailed deer (*Odocoileus hemionus columbianus*) to off-highway vehicles were studied at Hollister Hills State Vehicular Recreation Area in central California. Movements, habitat use, and activity levels were recorded for one year and compared with OHV use levels. Home range sizes for deer living within the riding area were similar to those of previously studied deer populations living in similar habitats but not exposed to riding. There was no significant correlation between OHV activity levels and deer activity levels. Deer exhibited diurnal activity patterns similar to patterns observed in other populations. Adult females, fawns and yearlings preferentially used riparian habitats and avoided north slope woodlands. Deer avoided OHV riding areas during peak use but returned to their established home ranges after traffic levels subsided.

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INTRODUCTION

While off-highway vehicle (OHV) use on public lands has increased dramatically in the last 10-15 years, knowledge of the effects of this activity on large ungulates is lacking. Most research has concentrated in desert environments on rodents, birds and reptiles, with little research in other habitats or on larger animals (Jones and Kutilek 1988).

The objective of this study was to assess the responses of black-tailed deer (Odocoileus hemionus columbianus) to off-highway vehicle (OHV) use in Hollister Hills State Vehicular Recreation Area (HHSVRA). While it has been reported that deer adapt to some types of motor vehicle traffic (Ward et al. 1976, Schultz and Bailey 1978, Adams 1981), I felt that intermittent, high levels of OHV activity may cause significant changes in deer biology. Exposure to OHV traffic may cause deer to move further distances than usual, remain active longer during the day, use their habitat differently, and move away from sources of disturbance. Therefore, I hypothesized that female deer exposed to OHV traffic: (1) have larger home ranges than those reported in the literature that have not been exposed to OHV traffic, (2) vary their normal activity patterns, (3) have unusual habitat preferences and, (4) retreat from the area when vehicles are in operation.

STUDY AREA

Hollister Hills State Vehicular Recreation Area (HHSVRA) is a 1356 ha unit of the State Park System located in San Benito County, California. The study was conducted on a combination of public and private lands subjected to differing land uses. The majority of the study area was located in the riparian corridors of the 1000 ha Lower Ranch of HHSVRA which is open to OHV traffic. The remainder of the study area was composed of the parks 275 ha Nature Area which is closed to OHV traffic and portions of two adjacent cattle ranches.

The dominant vegetation types in the study area were chaparral consisting of chamise (Adenostoma fasciculatum) and toyon (Heteromeles arbutifolia) and north slope woodland consisting of toyon, wedgeleaf ceanothus (Ceanothus cuneatus), manzanita (Arctostaphylos sp.), scrub oak (Quercus dumosa), interior live oak (Quercus wislizenii), and mountain Mahogany (Cercocarpus betuloides). Other vegetation types included grassland, riparian-oak woodland, oak woodland, and coastal scrub (California State Department of Parks and Recreation 1978).

Elevation within the study area ranges from 245-830 m. The climate is Mediterranean. Precipitation averages 33 cm/yr consisting mostly of rain with occasional snow during the winter.

OHV use began in this area as early as 1956. The State of California purchased the ranch in October of 1975 and now operates it (California State Department of Parks and Recreation 1978). Deer populations at HHSVRA have not been subjected to hunting for at least 20 years.

METHODS

I used modified Clover traps (Clover 1956) or tranquilizer darts to capture a total of 14 female deer (7 adults, 6 yearlings, and 1 fawn). In the later case, drugs were delivered using Pneu-darts (Pneu-Dart, Inc., Williamsport, PA) containing a 2cc dose (approximately 1 ml/22 kg) of a ketamine hydrochloride and xylazine mixture (200 mg:40 mg/ml respectively), propelled by either CO2 or black powder dart rifles. Ear tags and Telonics MOD-600 radio collars equipped with S6B mortality/motion sensors (Telonics, Inc., Mesa, AZ) were attached to the deer.

Movements of the radio-collared deer were monitored an average of two days per week for a period of one year using a Telonics TR2 receiver and a 2-element yagi-type antenna. I made visual confirmations of relocations when possible and otherwise used triangulation (Mech 1983). Relocation data were compiled and converted to UTM co-ordinates.

Home range sizes were computed using Program Home Range (Samuel *et al*. 1985). The data were non-independent which limited their analysis to the use of minimum convex polygon home ranges (MCP) (Hayne 1949). The 95% MCP's were used to estimate actual home range size because they included almost all relocations except outliers that were beyond the normal use areas. Fifty percent MCP's were also calculated to indicate each animal's core use area. ANOVA was used to analyze differences in the 95% and 50% MCP's due to seasons, ages of deer, traffic levels, and differences between animals living in the riding and non-riding areas.

The year was divided into four seasons for analysis: the dry season (summer) from 1 June 1988 to 30 September 1988; the rutting season (fall) from 1 October 1988 to 31 December 1988; the wet season (winter) from 1 January 1989 to 30 March 1989; and the fawning season (spring) from 1 April 1989 to 1 June 1989.

I recorded radio-collar pulse rates with each relocation along with information about time, temperature, and traffic levels. The faster pulse rates indicated that the deer had moved within the previous three minutes. Activity levels were recorded as active or inactive. To detect unusual activity patterns, I compared my results with previous studies examining the relationships between activity and time of day and temperature. I also examined the relationship between traffic levels and activity by comparing mean activity/day with mean OHV traffic levels/day. OHV traffic levels were determined from gate receipts.

Habitat utilization was analyzed by using a G-test to compare habitat use with habitat availability in a method similar to Neu et al. (1974) and Alldredge and Ratti (1986).

With each relocation, I assigned a location category (LC) number to approximate the probability of the deer's exposure to OHV traffic. An LC of 1 indicated that the animal was in a relatively open spot < 30 m from a primary road open to all types of traffic. An LC of 2 was assigned to an animal in the open but > 30 m from a primary road, behind a fence or in cover < 30 m of a primary road, or in open areas within 30 meters of a secondary road. An LC of 3 was assigned to an animal in more remote parts of the riding area and a 4 was given to an animal in park areas closed to riding. An LC of 5 indicated that the animal was outside the park and that its chance of being exposed to vehicular traffic was negligeable.

I recorded a detection category (DC) value with each relocation which measured how difficult it was to locate animals visually or with the radio-telemetry receiver. Animals located visually received a DC of 1. Animals not seen but close enough to have their signal received without an antenna or the antenna lead were given DC's of 2 and 3 respectively. Animals in heavy cover located with the short, flexible antenna received a DC of 4. Animals outside the park boundaries, located using a two-element yagi antenna and triangulation, received a detection yagi antenna and triangulation, received a detection category of 5.

The LC and DC values were analyzed in several ways. Mean daily LC's and DC's were correlated (Pearson Product Moment Correlation Coefficient) with mean daily OHV traffic levels to establish if deer reacted to OHV traffic. After testing that the assumptions were met, the LC's and DC's were then analyzed seasonally using ANCOVA. This analysis factors out the effects due to traffic levels to determine whether deer were more sensitive to OHV traffic at certain times of the year.

RESULTS

A total of 1773 relocations were recorded for all radio-collared and visibly identified animals between 17 June 1988 and 20 May 1989. There were 210 visual sightings and 1563 via triangulation. There were 153 visual sightings during summer and fall (dry season) and 57 during winter and spring (wet season). Muddy conditions hampered access to certain areas and fewer daylight observation hours caused a decrease in visual sightings during the wet season.

Home range sizes varied greatly between individuals and seasons (Table 1). ANOVA showed that seasonal differences were highly significant for the 95% home range sizes ($p= 0.001$) but not significant for the 50% home ranges ($p= 0.052$). Several factors contributed to differences between seasonal home range sizes. Two of the most impor-

Table 1. Convex polygon home range sizes (ha) of black-tailed deer at Hollister Hills State Vehicular Recreation Area, Hollister, CA June 1988-June 1989.

DEER	Summer 1988		Fall 1988		Winter 1989		Spring 1989		Year Round	
No.	95%	50%	95%	50%	95%	50%	95%	50%	95%	50%
11YC	63.3	5.3	100.0	5.0	18.0	3.5	10.5	0.5	92.5	9.0
1YaC	---	---	17.0	5.0	20.5	2.5	---	---	26.0	7.5
4AC	64.3	10.5	25.5	3.0	30.5	2.0	---	---	73.3	9.0
8YaC	153.0	19.0	58.0	14.0	35.0	8.0	15.0	0.5	202.5	28.5
10AC	204.7	4.0	37.0	3.5	32.5	17.0	26.5	4.0	204.9	13.5
3YC	23.8	0.8	42.0	2.6	26.0	6.5	3.3	0.5	42.3	6.1
1YbC	---	---	41.0	3.5	22.5	2.8	26.0	6.5	69.0	17.5
5AC	35.0	9.1	---	---	---	---	---	---	35.0	9.1
3AC	16.3	4.3	38.5	1.4	27.3	3.8	27.5	0.1	37.3	3.3
2AC	---	---	40.5	3.0	22.5	7.5	10.5	3.0	64.0	19.0
9AC	185.1	56.0	33.0	4.0	24.5	1.0	5.5	1.0	178.2	17.0
2FaC	---	---	40.5	3.0	26.5	3.3	---	---	60.5	19.0
13YC	---	---	65.0	1.5	---	---	---	---	65.0	1.5
12AC	---	---	6.0	0.1	---	---	---	---	6.0	0.1
Mean=	93.2	13.6	41.9	3.8	26.0	5.3	15.6	2.0	82.6	11.4
S.D.=	75.9	18.0	23.2	3.4	5.2	4.5	9.8	2.3	65.1	8.0

tant factors were water availability and seasonal activity (e.g., seasonal food preferences, fawning, rutting). One family group spent all summer in a stand of coastal scrub above a pond; their 95% home range was 16.5 ha. Their water supply during that time came from a leaking pipe. When the pipe was repaired and the water supply was no longer available, their 95% home range expanded to 38.5 ha. Another family group spent most of the rutting season near a pond close to the main park road. When the rains came, they moved to another pond in a more isolated part of the park. Two other family groups also moved their centers of activity as water resources changed.

The smallest average home range sizes occurred during the fawning season when the fawns are hidden by females (Jackson et al. 1972, Riley and Dood 1984). Summer home ranges were the largest and the fawns were fully capable of extended travel at age 1 month. Increased travel by fawns during summer was probably linked to diet (Riley and Dood 1984), that is, as their dependency on browse increased so did their home range sizes.

ANCVA showed that home range sizes for females adults and yearlings were not significantly different (p= 0.784 for 95% home range, p= 0.688 for 50% home range). There was no significant correlation between traffic level and home range sizes using Pearson's Correlation Coefficient. ANOVA yielded no statistically significant differences in size of

95% home ranges (p= 0.280) or 50% home ranges (p= 0.695) for animals with home range centers in the riding area, non-riding area or adjacent ranch lands.

The daily patterns of activity were similar to those found in other studies (Kammermeyer and Marchinton 1977). Deer showed normal crepuscular activity peaks throughout most of the year (Figure 1) except during the winter when the peaks were not as pronounced and activity levels were steady most of the day. There was a negative correlation (r= -0.663 p= 0.013) between temperature and activity which was consistent with Lindsdale and Tomich (1953). OHV traffic levels and the amount of activity of deer were not significantly correlated (r= -0.020 p= 0.10).

A G-test comparing available habitat with habitat used indicated that adult females, yearlings and fawns had a strong preference for riparian oak woodland and avoided the north slope woodland and grassland areas (G=16.75 df=5, p= 0.005) (Table 2). Their use of coastal scrub and chaparral did not appear to differ from their availability.

Deer avoided riding areas when OHV use increased. The mean daily DC's rose near the weekend with greater OHV use and declined during mid-week and were highly correlated with traffic levels (r= 0.685 p= 0.010) (Figure 2). ANCOVA showed that when the effects attributable to traffic were factored out, the DC levels were not affected by the various

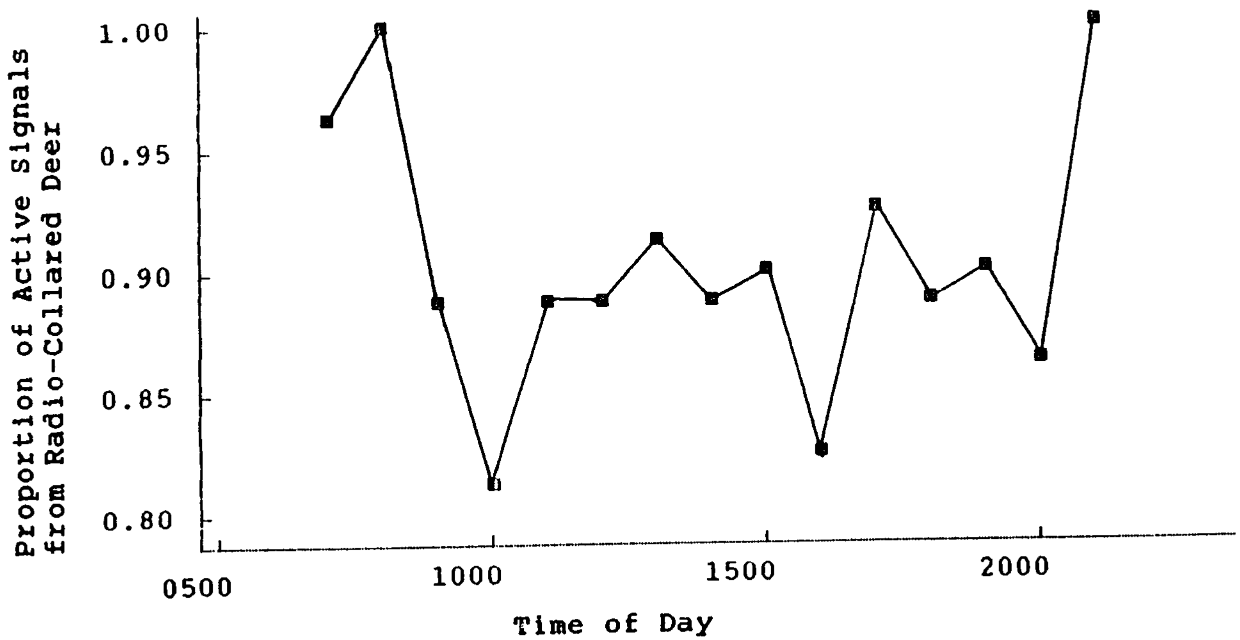

Figure 1. Diurnal activity patterns of collared black-tailed deer at Hollister Hills State Vehicular Recreation Area, Hollister, California, June 1988-May 1989.

Table 2. Habitat Use and Habitat Availability at Hollister Hills State Vehicular Recreation Area, Hollister, California, June, 1988-May, 1989

Habitat Type	Percent Available	Percent Used				
		Summer	Fall	Winter	Spring	Year
Grassland	18%	4%	5%	1%	1%	3%
Chaparral	12%	20%	12%	15%	17%	16%
North Slope Woodland	28%	7%	2%	3%	4%	4%
Oak Woodlands:	22%	64%	67%	51%	56%	59%
Riparian	17%	58%	55%	43%	44%	50%
Savannah	5%	6%	12%	8%	12%	9%
Coastal Scrub	20%	6%	15%	29%	21%	19%

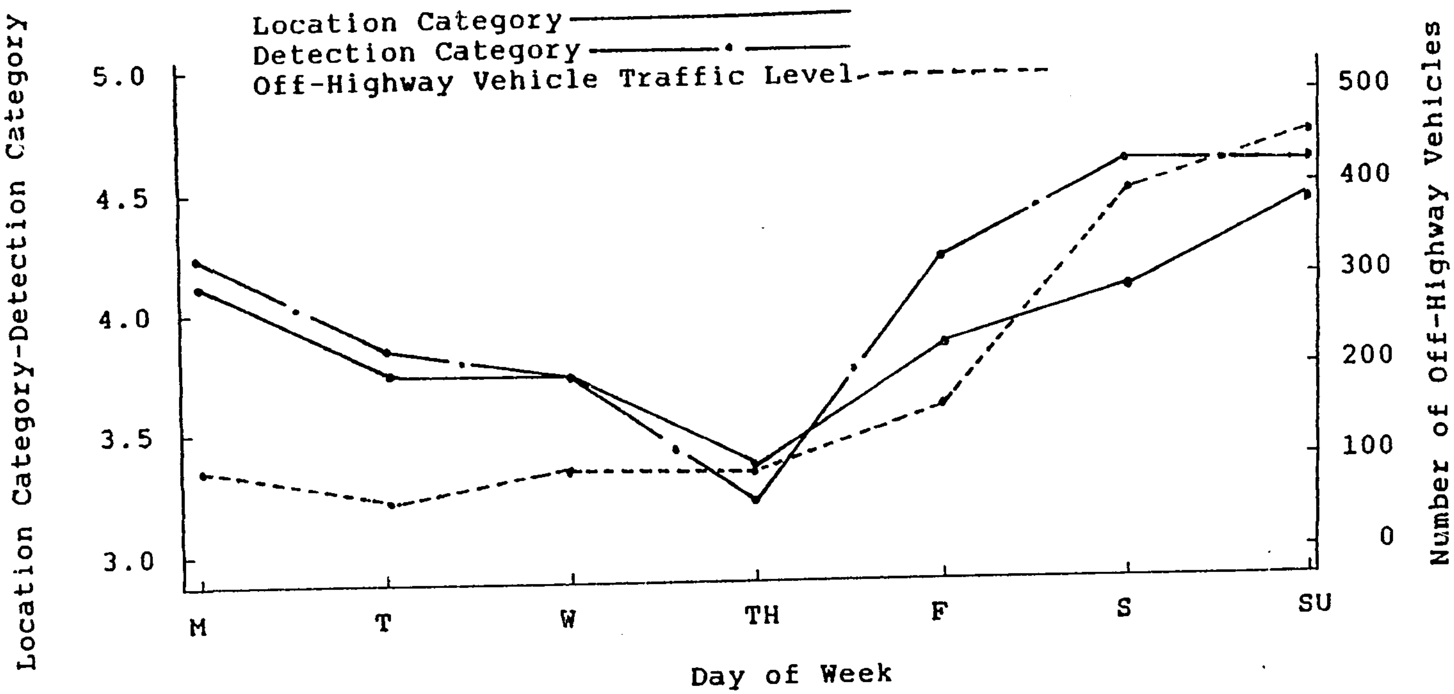

Figure 2. Mean detection category, mean location category, and mean off-highway vehicle levels per day of week for all collared deer at Hollister Hills State Vehicular Recreation Area, Hollister, California, June 1988-May 1989.

seasons; deer were not more sensitive to traffic during fawning season or less sensitive during the rut.

The relationship between LC and the days of the week was similar but weaker than for the DC (Figure 2). Traffic levels were correlated with LC ($r = 0.478$ $p = 0.010$). A high incidence of LC 5's on weekends indicated a tendency for deer to leave the park during traffic peaks.

The pattern for both DC's and LC's recurred on a weekly basis. Reaction to increased traffic was immediate with most of the deer leaving the park. Once traffic subsided, the deer took 2-3 days to return (Figure 2).

DISCUSSION

In this study, estimates of home range sizes of deer at HHSVRA using the MCP method were of the same magnitude as other studies using similar methods. The mean home range size of 93.2 ha was well below the values measured by Dasmann and Taber (1956) (130 ha), Longhurst et al. (1979) (207 ha), and within the range of values found by Miller (1970) (34-130 ha). The values were larger than those found by Jennings (1985) (49.6 ha), but she used the more conservative modified minimum area method (Harvey and Barbour 1965); a concave polygon analysis which eliminates all outliers and whose size calculations do not seem to be as strongly correlated with number of relocations as are the MCP's (Eberhardt et al. 1984). Therefore, I found no evidence that home range size was related to OHV use.

Female deer did not appear to change their activity patterns in relation to OHV activity. Deer at HHSVRA continued to have the same crepuscular activity patterns observed by Kammermeyer and Marchinton (1976) and Eberhardt et al. (1984) for deer not exposed to OHV traffic. There was also no evidence that deer were active at unusual temperatures. Activity levels were independent of OHV traffic levels.

I found no evidence that deer changed their habitat utilization because of traffic levels. Deer at HHSVRA exhibited habitat preferences that were similar to those previously observed for black-tailed deer (Jennings 1985, Klinger et al. 1989). Deer continued to use oak woodlands preferentially during times of high traffic and avoided both north slope woodland and chaparral habitats, even though these habitats were denser and constituted better cover.

Deer at HHSVRA did retreat from high levels of OHV traffic. However, because home range size, activity patterns, and habitat preferences did not change, deer within HHSVRA appeared to have acclimated to periodic high levels of OHV activity.

MANAGEMENT IMPLICATIONS

The distribution and activity patterns of deer in vehicular recreation areas result from a complex interaction between park design, the distribution of water and forage, land management practices such as cattle grazing on surrounding lands, and the availability of proximal escape areas. Water resources are of paramount importance to adult females, yearlings, and fawns (Bowyer 1984, Hervert and Krausman 1986). In HHSVRA, the development and maintenance of sediment ponds enhanced deer habitat. Further protection of the basins from vehicles during the drying period in late summer and early fall would allow water resources to last longer.

Another proposed habitat protection measure is to direct traffic away from important deer habitat by seasonal closure of some roads and trails. For OHV parks in California, fewer trails should be located in the riparian and oak woodland habitats. If more trails are needed, they should be placed in north slope woodland and chaparral.

OHV users should be encouraged to stay on established trails in riparian and wooded areas. Studies have shown that animals reacted minimally to disturbances on established trails and roads but there were increased responses to disturbance where none had occurred before (MacArthur et al. 1982, Schultz and Bailey 1978). Campsites and picnic areas should be moved out of riparian areas when possible.

This study demonstrated that deer tolerate OHV traffic and suggests, by the fact that deer kept returning after disturbance, that OHV areas may actually provide resources that typical overgrazed ranges do not. It is important to determine in the future whether there are positive aspects for deer from OHV land use by comparing populations exposed to different land management schemes, including OHV use.

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