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DIFFERENTIAL HABITAT UTILIZATION BY THE SEXES OF MULE DEER

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Abstract.— Habitat segregation trends have been observed and published for the sexes of mule deer (*Odocoileus hemionus*) based on elevation and slope exposure. Despite these brief descriptions, quantitative studies on habitat segregation by the sexes of mule deer are lacking. Results of research conducted in central Utah indicated no significant difference in elevation positions used by males, but did show significant difference in utilization of study sites based on slope exposure, relative percentage forb cover, and relative percentage hiding cover. Males were most common at sites characterized by low forb abundance and hiding cover, and on south-facing exposures. Females were most common at sites characterized by high forb abundance and hiding cover, and on north-facing exposures. Possible advantages of habitat separation to both sexes and management implications are discussed.

Mule deer (*Odocoileus hemionus*), like many other ungulates, seem to exhibit habitat partitioning between sexes (Darling 1937, Estes 1974, Geist 1974, 1977, Gest and Petocz 1977, Hirth 1977, Leuthold 1978). DeVos et al. (1967) indicated that male and female mule deer are separated throughout the year with the exception of the breeding season. Dasmann and Taber (1956) found that males occupied more open south-facing slopes and females occupied densely vegetated north-facing slopes. Several workers have suggested that males prefer higher altitudes and ridge tops more than do females (Cowan 1956, Miller 1970). The same trend was observed in a Nevada mule deer herd by Robinette et al. (1977) where subalpine and alpine conditions were prevalent. Males were found predominantly above 3000 m elevation, whereas females were more often below 2500 m elevation. Although habitat separation by male and female mule deer has been reported, little attempt has been made to quantify differential habitat use or to describe site differences other than to suggest slope exposure and elevational differences.

The objectives of this study were: (1) to determine quantitatively if male and female mule deer differentially utilize habitat, (2) to suggest possible advantages to habitat separation by sexes of mule deer, and (3) to identify critical management problems related to differential resource utilization between male and female mule deer.

Study Area

The study was conducted on the Bighorn Ranch, a privately owned ranch in the Nebo Range of the Wasatch Mountains, Utah. The study area was approximately 1130 ha in size, ranging from 2200 to 2500 m elevation. Human access is restricted, thus providing a relatively undisturbed area for observation of mule deer behavior, distribution, and habitat utilization. Ridge tops, south-facing slopes, and other well-drained areas were dominated by Gambel oak (*Quercus gambelii*) and big sagebrush (*Artemisia tridentata*) communities with little herbaceous growth. Drainage bottoms, north-facing slopes, and well-watered areas were dominated by quaking aspen (*Populus tremuloides*), Rocky Mountain maple (*Acer glabrum*), and chokecherry (*Prunus virginiana*) communities, with numerous forb species in the understory.

Methods

Preliminary observations made in September 1977 to determine deer distribution in the various watersheds of the ranch indicated habitat segregation between male and female mule deer. Based on that survey, the following spring nine study sites (Fig. 1) were selected where deer numbers were relatively high. Other areas had equally as many deer, but excessive area or distance from access roads made observation unrealistic.

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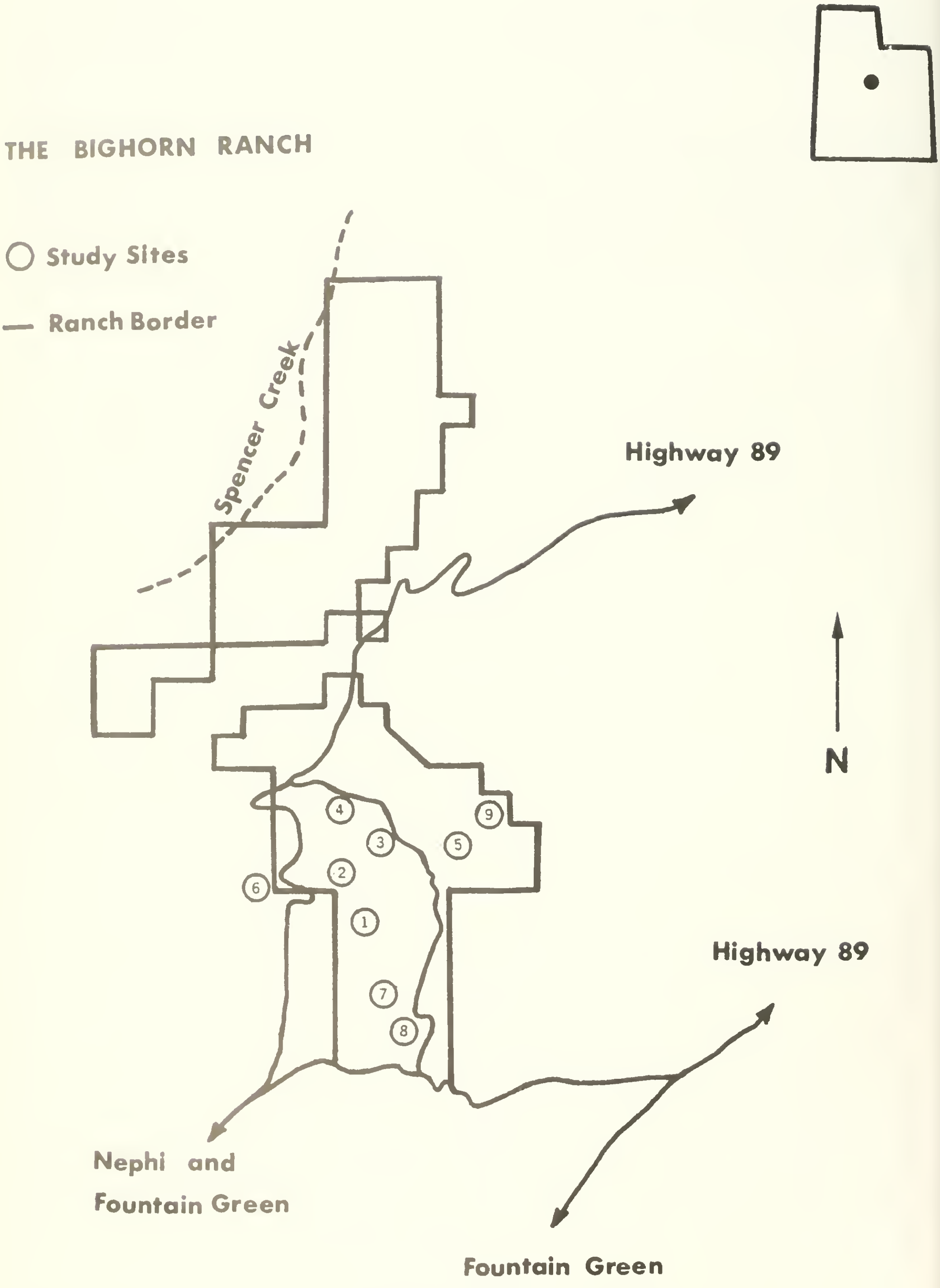

Fig. 1. Map of the Bighorn Ranch showing the approximate location of study sites.

Each study site was observed weekly from 1 June 1978 to 1 September 1978. Observations were made from established observation points or by vehicle from sunrise until late morning or from early afternoon until dark. Observation time for each site was alternated weekly between morning and evening so approximately equal observation time was spent at each site during each time period. A variable 15-45X spotting scope and 12X binoculars were used for daytime observation, and a 200,000 candlepower spotlight operated through the electrical system of the vehicle, along with spotting scope and binoculars, was used for observation at night. Total observation time for the study exceeded 900 hours.

Observed deer were recorded according to sex, slope position (Fig. 2), and slope exposure. A 2X4 contingency analysis (Zar 1974) was performed to determine significant differences in utilization of slope positions by males and females. Total numbers of males and females recorded at north- and south-facing exposures were also subjected to contingency analysis to determine slope exposure usage differences. To characterize study sites two critical parameters, relative abundance of forb and hiding cover, were examined at each site. Forbs were defined as succulent, low-growing, nonwoody vegetation, and hiding cover as vegetation more than 2 m in height. Both estimates were determined by a line-point transect method for determining relative abundance of vegetation (Kershaw 1973).

Simple correlation procedures relating relative abundance of forb and hiding cover with the corresponding male/female ratio for each site were used to determine if utilization of sites by males and females differed significantly based on forb abundance and hiding cover (Zar 1974). The maximum probability accepted for statistical significance was 0.05; probabilities less than 0.01 were considered highly significant.

Results and Discussion

Analysis of slope positions used by males and females (Table 1, Fig. 3) showed no significant difference in slope position utilization by sex ($P = 0.06$). The data, though not significant at the 0.05 level, approach signifi-

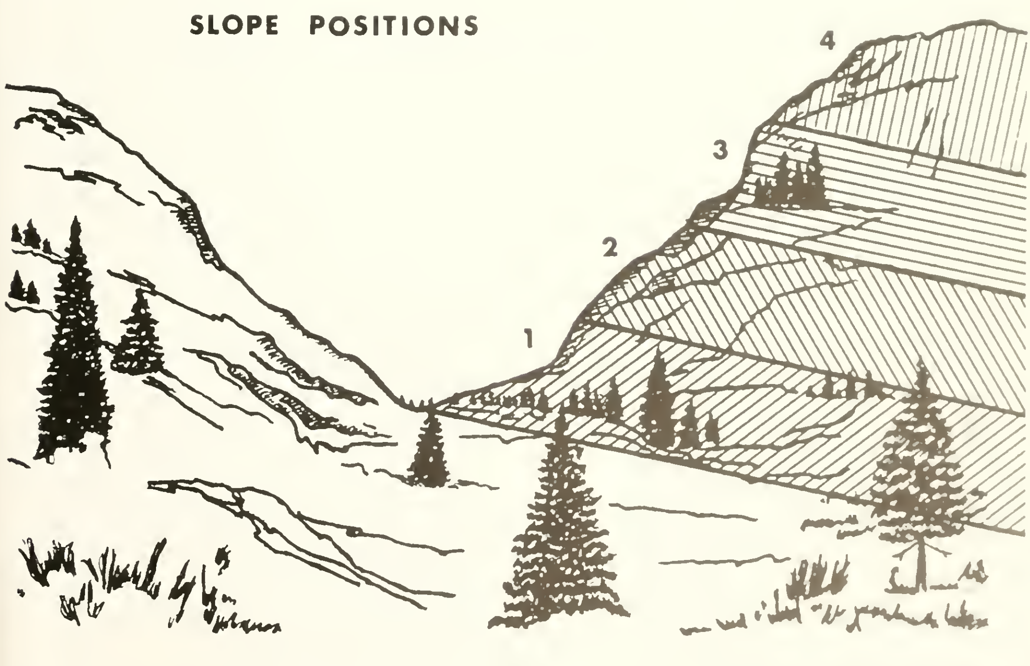

Fig. 2. Diagram of the four slope positions at each site; slope position 1 = canyon bottom to ¼ slope, slope position 2 = ¼ slope to ½ slope, slope position 3 = ½ slope to ¾ slope, and slope position 4 = ¾ slope to ridgetop.

TABLE 1. Total number of male and female mule deer at each slope position for all study sites. 2 X 4 contingency analysis indicates a nonsignificant difference in utilization of slope position by male and female mule deer ($X^2 = 7.42$, df = 3, P = 0.06). Numbers in parentheses are expected values.

	Slope position				
Sex	1	2	3	4	Total
Males	74 (86.9)	63 (56.4)	42 (39.9)	14 (9.8)	193
Females	157 (144.1)	87 (93.4)	64 (66.1)	12 (16.2)	320
Total	231	150	106	26	513

cance and indicate support for elevational segregation observed in other areas. Further categorical analysis to determine usage of individual slope positions by males and females shows that considerable differences exist in utilization of slope positions 1 and 4 by males and females (Fienberg 1977), with more females than males at slope position 1, and more males than females at slope position 4 (position 1 male = –.208, position 1 females = +.208; position 4 males = +.245, position 4 females = –.245; positive values indicate most usage at slope position). Analysis of slope exposure use by males and females

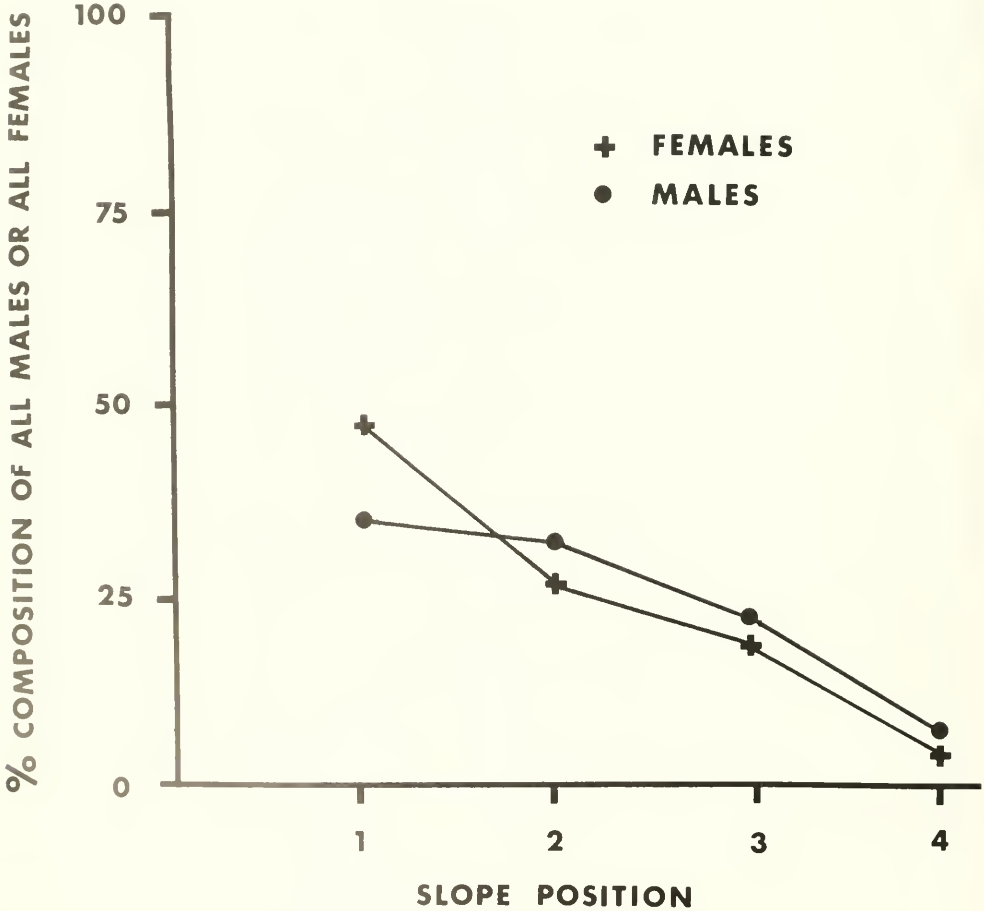

Fig. 3. Percentage of total males and total females observed at each slope position.

showed a significant difference (P<0.005), with males most often at south-facing slopes and females most often at north-facing slopes (Table 2, Fig. 4).

Calculated male/female ratios for each site correlated with corresponding relative percentages of forb and hiding cover (Table 3, Fig. 5) showed a highly significant negative correlation between forb abundance and male/female ratios (r = −.89, df=7, P<0.005) and a significant negative correlation between male/female ratios and hiding cover (r= −.69, df=7, P<0.05). Therefore, as forb and hiding cover increased, the male/female ratios decreased, indicating that females select areas characterized by relatively high forb and hiding cover densities, but males select areas characterized by low forb and hiding cover densites.

Table 2. Total number of male and female mule deer at each slope exposure for all study sites. 2 X 2 contingency analysis indicates a significant difference in utilization of slope exposure by male and female mule deer ($X^2 = 29.3$, df = 1, P<0.005). Numbers in parentheses are expected values.

	Slope exposure		
Sex	North-facing	South-facing	Total
Males	64 (93.7)	129 (99.3)	193
Females	185 (155.3)	135 (164.7)	320
Total	249	264	513

To comprehend implications of this pattern of spatial separation, possible advantages accrued by males and females in their spring-summer habitats should be examined. During the spring-summer season perhaps the most critical events to females are production and

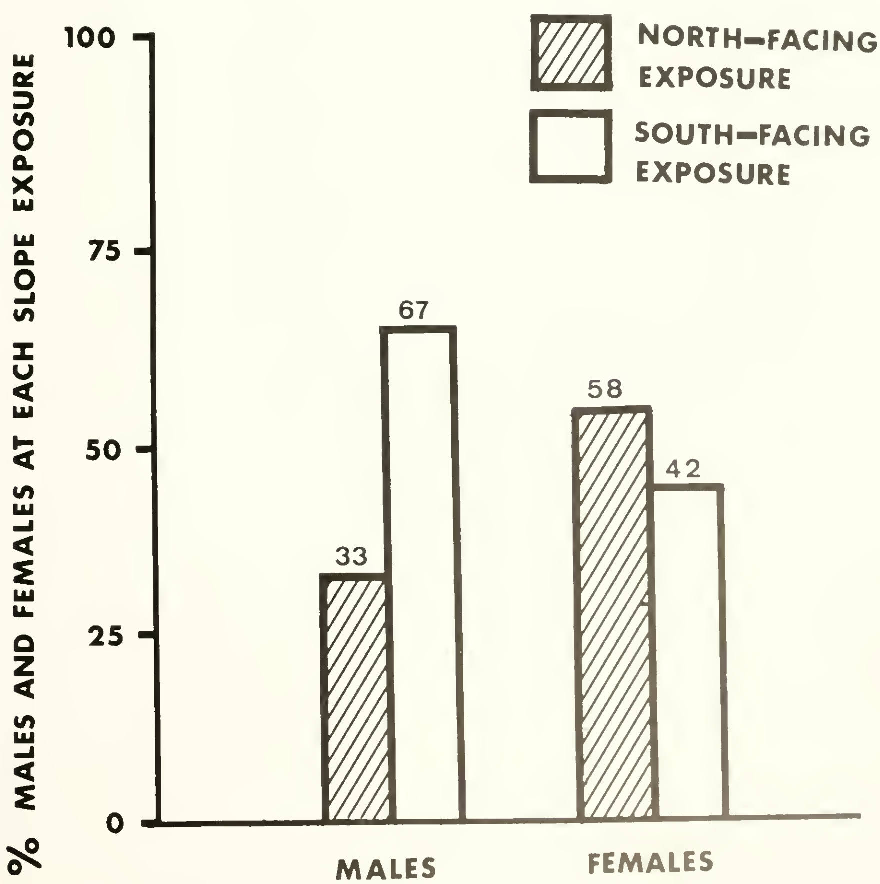

Fig. 4. Percentage of total males and total females observed at each slope exposure.

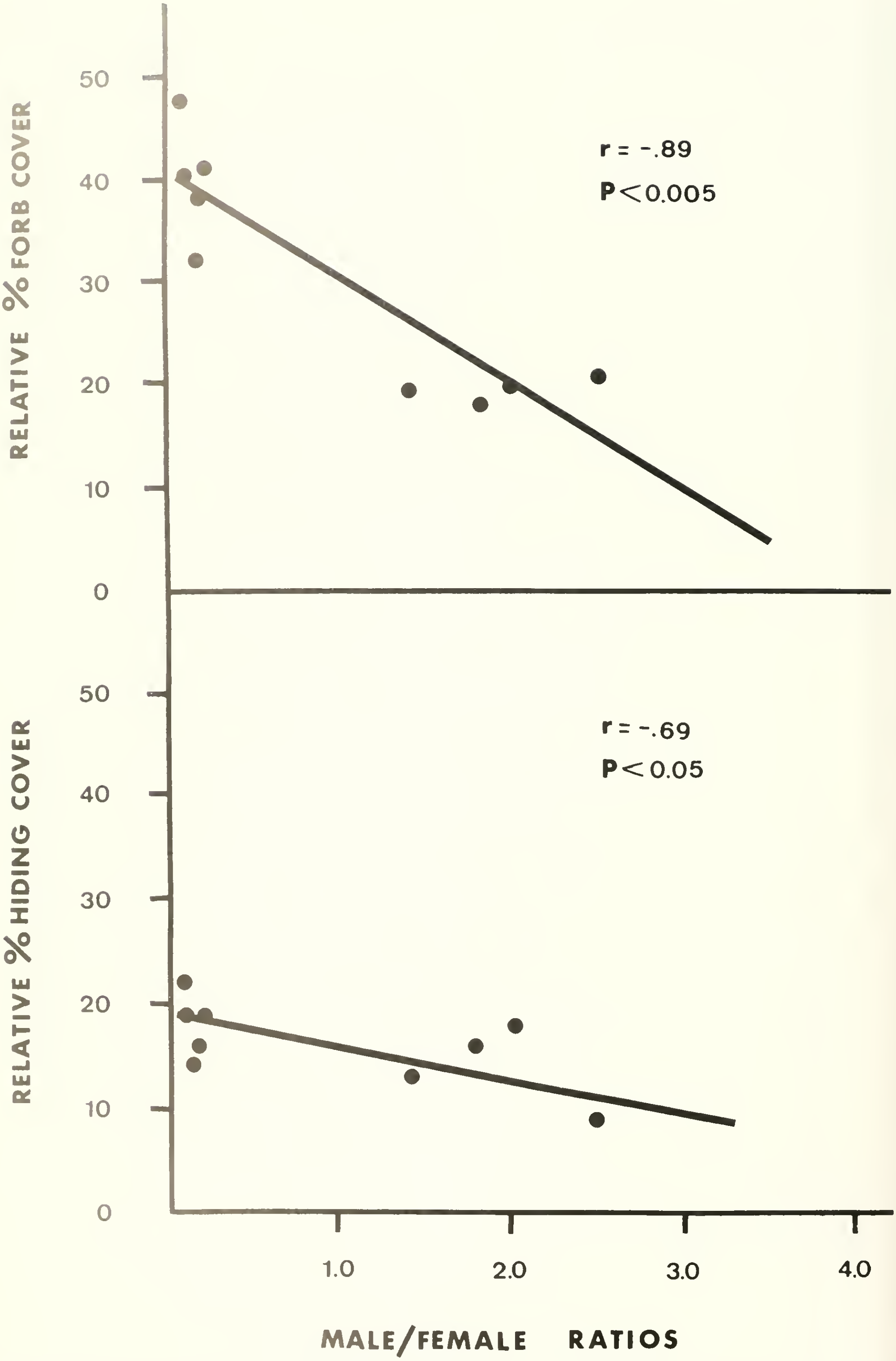

Fig. 5. Correlation of relative percentage forb cover and relative percentage hiding cover with corresponding male/female ratio for each study site.

Table 3. Relative percentage forb cover, relative percentage hiding cover, total number of male and female mule deer, and male/female ratios for each study site.

Site No.	Relative % forb cover	Relative % hiding cover	Males	Females	M/F ratios
1	40.50	19.00	7	63	0.11
2	32.25	14.00	6	39	0.15
3	41.25	19.00	12	61	0.20
4	46.50	22.00	2	25	0.08
5	37.75	16.00	7	46	0.16
6	16.50	15.00	52	29	1.80
7	19.00	13.00	32	23	1.40
8	20.75	8.00	38	15	2.53
9	19.75	17.00	37	19	1.95

rearing of offspring. This implies that considerable energy is apportioned to gestation, parturition, and lactation beyond normal body maintenance requirements (Nelson 1975, Stebbins 1977). If these requirements are not met through diet resources, body reserves are utilized, thus reducing offspring vigor and survival. Since energy demands for offspring production exceed normal energy requirements, it is important that females occupy areas where nutritious, high-quality forage is readily available. Adequate nutrition insures successful offspring production and facilitates proper lactation. Research indicates that, during the time period critical to fawn production, high moisture content, ease of digestion, and increased nutrition content (Smith 1952, Short 1966, Short and Reagor 1970, Boeker et al. 1972) make the forbs preferred diet items of mule deer (Smith 1952, Morris and Schwartz 1957, Lovass 1958, Anderson et al. 1965, Crouch 1966, Dasmann et al. 1967, Nelson 1975). It has also been shown that deer herds having a variety of succulent forage in their diets have greater herd productivity and vigor than those that utilize a greater percentage of woody vegetation (Biswell 1961, Julander et al. 1961, Boeker et al. 1972, Nelson 1975, Pederson and Harper 1978). We assume, therefore, that forb abundance is related to site quality and that areas of high forb abundance are considered high quality, whereas areas of low forb abundance are low quality. Deer that select forb-rich areas would have survival advantages because of availability of choice forage. It follows that females should select high-quality sites to assure adequate nutrition and energy for fawn production and survival. However, it seems strange that males would occupy areas of low forb abundance when selection of high-forb areas would more readily insure adequate energy for increasing body size, accumulating fat reserves, and developing antlers. We suggest as a partial explanation that it is more advantageous for the sexes to be separated to reduce chances of energy-expensive agonistic expression between males and females (Geist and Petocz 1977, McCullough 1979). This allows energy allocation to gestation, parturition, and lactation rather than to stresses of harassment. Females on ranges uncontested by males should leave more offspring, and those behavioral traits responsible for habitat partitioning should be selected to increase the population. Males that did not compete for resources necessary for fawn production, though occupying lower-quality sites, should likewise leave more offspring to succeeding generations than males whose behavior bring them into competition with their offspring (Wilson 1975, Geist and Petocz 1977, McCullough 1979).

Differential habitat use patterns could also confer advantages to males and females by increasing odds for predator avoidance. Ecologists working on ungulates have suggested a theory of predator avoidance based on the relative degree of habitat openness and group size. Ungulates that inhabit densely vegetated areas usually occur as solitary animals or in small groups that use hiding as a mechanism for predator avoidance, whereas ungulates that occupy open areas are primarily herding animals that rely on the use of collective senses and high mobility for predator escape

(Dasmann and Taber 1956, Kitchen 1974, Hirth 1977).

Life history studies of mule deer (Linsdale and Tomich 1953, Robinette et al. 1977), along with personal observations, give supportive evidence to this hypothesis. Males and females form different-sized groups in their preferred habitats. During spring and summer months females seek isolation in areas where hiding cover is relatively abundant (Fig. 5) and tolerate few deer other than their offspring of the year. This partial solitary existence has advantages from a predator avoidance standpoint in that females can secret themselves and their offspring in dense vegetation during periods of high vulnerability to potential danger. After the young are born, maternal duties restrict the mobility and escape efficiency of females. It would, therefore, be advantageous for females with fawns to avoid open habitats where predators can detect and capture them or their fawns more easily.

In contrast, males on the Bighorn Ranch during the same time period were often observed to form fraternal groups in areas with relatively low abundance of hiding cover (Fig. 5). Male groups that inhabit open areas of high visibility can collectively monitor their surroundings and take advantage of rapid flight when escape is necessary. This is better than hiding in dense cover, where effectiveness of concealment would be reduced by large groups and would increase chances of detection by predators.

Further supportive evidence for the predator avoidance theory is provided by the differential use of slope positions 1 and 4 by males and females. More females than males occupied slope position 1, the lower position of the slope where the greatest abundance of hiding cover was located. This suggests the importance of cover to females. More males than females used slope position 4, the open ridges, suggesting preference by males for the areas of high visibility.

In this study habitat separation by males and females is primarily based on slope exposure, forb abundance, and hiding cover, with some evidence, though not significant, for elevational segregation. We do not detract from the importance of elevational segregation as it has been observed frequently in other areas, but suggest to wildlife managers that there are several habitat separation possibilities, depending on characteristics of mule deer range in a given area. We encourage that further research delineating segregation characteristics, advantages, and mechanisms be initiated so that management implications can be evaluated.

Knowledge of habitat separation between the sexes of mule deer will have considerable influence on several critical management problems. Three important problems as we view them are now discussed. First, as deer populations are being censused in various areas and habitats, a prime concern is the determination of an accurate sex ratio. If managers are not aware of site-specific habitat separation by male and female deer, biases favoring one sex over the other will arise in calculated ratios depending on the area sampled. Failure to determine accurate sex ratios will allow faulty plans to be devised and implemented. Second, through recognition of specific habitat requirements of the sexes, it is possible that habitat can be manipulated through appropriate techniques to create conditions favorable to either sex. This will allow sex ratio manipulation depending on management needs. Third, critical areas to females and offspring as well as males must be protected from detrimental commercial, industrial, and recreational development. Destruction of important fawning areas through development will force females to occupy suboptimal habitats and result in reduced fawn production and survival. Development in areas occupied predominantly by males will restrict fall hunting and ultimately reduce herd productivity if adequate male/female ratios are not maintained.

An understanding of how male and female mule deer partition the habitat and how habitats preferred by females differ from those most frequented by males will undoubtedly improve abilities to effectively manage mule deer habitat. Proper use of knowledge regarding differential habitat and resource utilization by the sexes of mule deer can increase the efficiency with which agencies manage the deer resource.

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