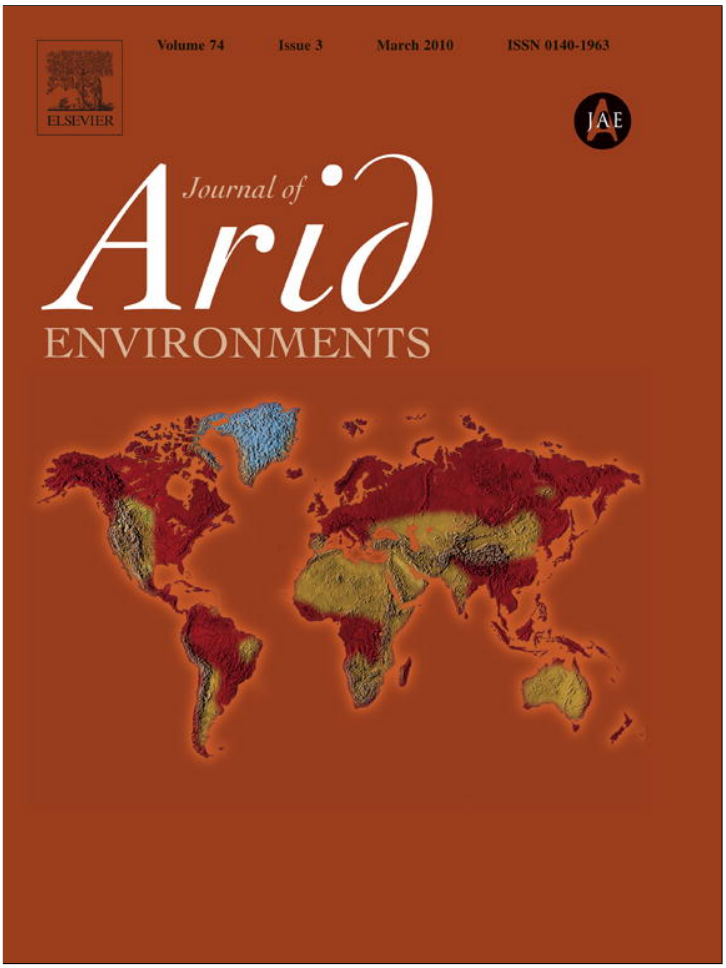

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Daytime bedsite selection by the texan white-tailed deer in xerophyllous brushland, North-eastern Mexico

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ABSTRACT

The importance of the characteristics of the diurnal bedsites used by male and female deer (*Odocoileus virginianus texanus*) in hot (> 40 °C), dry (< 400 mm rainfall per year) semiarid zones with xerophyllous brushland was analyzed. From December 1997 to October 1998, on six occasions, seven-km-long random transects were surveyed on horseback on different periods and days during three different days to locate resting deer at the San Francisco Ranch (1000 ha) in north-eastern Mexico. The habitat variables measured at 50 bedsites and 50 random sites were shrub species, height, volume, thermal cover and protection cover, as well as herb and grass cover. Males selected bedsites with greater total cover, volume and shrub height than females did, with a preference for mesquite and sweet acacia shrubs. There were seasonal differences in site selection, and shrub height and volume were greater during the post-reproductive season (dry season), although the number of species was lower in the bedsites. During the fawning season, females chose bedsites with greater concealment cover (0–50 and 50–100 cm). Conservation strategies should take into account that deer select bedsites with specific characteristics, and shrubs are important elements in their habitat.

RESUMEN

Se analizaron las características de los echaderos diurnos usados por machos y hembras de venado (*O. virginianus texanus*) en una zona semiárida con matorral xerófilo (temperaturas > 40 °C y precipitación anual < 400 mm). En el rancho San Francisco (1000 ha) en el noreste de México, de diciembre de 1997 a octubre de 1998, durante 6 salidas de campo se hicieron muestreos a caballo en transectos al azar de siete kilómetros de largo en diferentes días para localizar venados echados. Se midieron variables de habitat en 50 echaderos y en 50 sitios al azar (para detectar alguna preferencia) como: especies de arbustos, altura, volumen, cobertura térmica y contra depredadores, cobertura de herbáceas y pastos. Los machos seleccionan echaderos con más cobertura térmica, volumen y altura de arbustos que las hembras, prefiriendo mezquites y huizaches. Existen diferencias estacionales en la selección de sitios, durante la época posreproductiva (época seca), la altura y volumen de los arbustos fue la mayor, pero tuvieron el menor número de especies. Durante la época de crianza, las hembras escogieron sitios con mayor cobertura de protección contra depredadores (0–50 y 50–100 cm). Las estrategias de conservación deben de tomar en cuenta que los venados seleccionan echaderos con características específicas, y los arbustos son elementos importantes en su habitat.

1. Introduction

Sufficient quantities of good quality food, water and cover are fundamental to the survival of cervid populations (Davis, 1990; Ockenfels et al., 1991; Soriguer et al., 1994). Deer select specific sites to lie down and ruminate, to rest and to protect their offspring.

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These places need to offer protection from predators (Gerlach and Vaughan, 1991; Germaine et al., 2004; Huegel et al., 1986), as well as thermal cover that allows the deer to minimize both the absorption of heat from exposure to the sun and the loss of water from evaporate cooling (Lang and Gates, 1985; Ockenfels and Brooks, 1994; Olson, 1992; Tull et al., 2001). Cover is of greater importance in arid and semiarid zones where it is important to prevent the loss of water in the high temperatures (more than 40 °C) and limited availability of water that prevail for at least five months of the year (February–June). Thus, the importance of cover varies with weather conditions between months (Huegel et al., 1986; Pollock et al., 1994).

Concealment cover is important for females because of their need to protect fawns. Gerlach and Vaughan (1991) stated that increased plant cover could reduce the ability of predators to locate and kill fawns, especially during the first few weeks when fawns spend approximately 90% of their time bedded. They found that concealment cover at the 0.0–0.5 m height interval made the largest contribution. Dense bedsite cover was found to be critical to fawn survival in Montana (Riley and Dood, 1984), Arizona (Smith and LeCount, 1979) and Iowa (Huegel et al., 1986). Germaine et al. (2004) found that site temperature and canopy closure were the most influential attributes in bedsite selection by deer.

Many studies include comparisons between bedsites and random sites, but there is no information about whether bedsites vary in their characteristics when used by males or females, or between seasons. The characteristics of the bedsites that deer select (shrub species, cover, height, etc.) offer valuable information that can be incorporated into management programs for arid and semiarid areas, and prevent drastic changes to the habitat, such as the elimination of shrubs or plant species. Owing to cattle ranching activities in the brushland of north-eastern Mexico, vast areas of woody vegetation have been cleared to establish pastures, and so there has been a notable decrease in the quality of the habitat used by the white-tailed deer (Shea and Osborne, 1995; Villarreal, 1999). Therefore, proper deer management makes it necessary to describe the characteristics of bedsites since these are a key part of the habitat and have a notable impact on the carrying capacity of the area (Mysterud and Ostbye, 1999).

The objectives of this study were to determine whether deer select diurnal bedsites based on microhabitat characteristics, whether there are differences in the sites selected by males and females, and whether selection is influenced by season and reflects the changing requirements of deer throughout the year.

2. Methods

2.1. Study area

This research was carried out on the San Francisco Ranch (27°20′N-100°36′W), formerly owned by Ducks Unlimited of Mexico, A.C. and located in north-eastern Mexico. The ranch covers 1000 ha enclosed by a deer fence (2.4 m high). There is an intensive water management program (3 dams and 32 water troughs). The area is flat and slope is less than 8°. Average elevation is 430 m a.s.l., and mean annual temperature is 21 °C. Annual rainfall averages less than 400 mm (197 mm in 1998), with notable monthly and annual variations (Bello et al., 2004). Generally, the rainy season is from May to September, but in 1998 it started in August and ended in November (Fig. 1). Vegetation is xerophyllous brushland with seven associations: *Hilaria* grassland (3%), *Opuntia* brushland (1.1%), *Flourensia cernua* brushland (5.9%), *Leucophyllum-Acacia* brushland (11.6%), *Acacia-Castela* brushland (54%), *Prosopis* brushland (14.7%) and *Acacia-Celtis* brushland (9.7%) (Bello et al., 2001a).

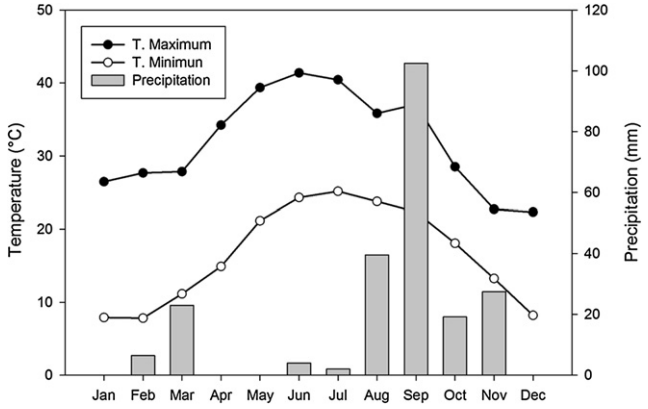

Fig. 1. Climograph of the San Francisco Ranch in Mexico, showing maximum and mean temperature and precipitation during 1998 (T = temperature).

2.2. Field methods

Field work was carried out from December 1997 to October 1998. Two people surveyed seven-kilometre-long routes on horseback, and the direction of the route was chosen by random compass bearing from random points with the objective of surveying the entire area. Surveys were done during the morning (0700–1000 h), at midday (1100–1400 h) and in the afternoon (1500–1800 h) over three different days to search for resting deer in each of six months (December 1997, January, March, May, August and October 1998). A Garmin 45XL global positioning system was used to determine bedsite coordinates. The time, the sex of the animal and the main shrub species providing cover were recorded. Each bedsite was described at the end of each survey (Ockenfels and Brooks, 1994). For each bedsite, we established and described a random site (the compass direction was obtained with random numbers) 10–100 m (chose also with random numbers) away from the bedsite in order to determine which microhabitat variables bedsite selection.

Data were grouped by deer physiological season: 1) reproductive season or rut (November–February), 2) postreproductive or gestation period (March to June), and 3) fawning season (July to October).

2.3. Description of the bedsite and the random site

To describe bedsites and random sites, a radius of 3.6 m (area: 40 m^2) centred on the bedsite or the random site was sampled. Canfield lines were used for each compass direction to estimate herb and grass cover (Ockenfels and Brooks, 1994; Tull et al., 2001). Within the circle the following were measured: mean herb and grass cover, total cover (the horizontal area of plant foliage as an estimate of thermal or weather protection cover, according to Mysterud and Ostbye, 1999), total shrub volume and mean shrub height, the main shrub height and cover, total cactus cover at each site, the number of shrub species, total concealment cover, concealment cover in each of the four directions of the compass and on the four sections of the pole (see below), in addition to the distance to the closest dam (Barrett, 1981; Fox and Krausman, 1994; Ockenfels and Brooks, 1994).

To estimate concealment cover—a measure of the protection offered by a site against predators—a cover pole was used. The pole was two meters high and divided into four 50 cm sections. The pole was placed in the centre of the bedsite and the reading was taken from a distance of 15 m, at eye level for a coyote or predator (eye level of a kneeling human). Total cover was calculated for each section and for each compass point (Griffith and Youtie, 1988; Nudds, 1977).

2.4. Data analysis

Principal Component Analysis was applied to reveal which variables are important to bedsite selection compared to random sites, and analyzed using the Infostat/Professional Program (InfoStat, 2002). The variables used in this analysis were mean herb and grass cover, total cover, total volume and mean shrub height, the main shrub height and cover, total cactus cover at each site, the number of shrub species, total concealment cover, concealment cover in each of the four directions of the compass and on the four sections of the pole. Differences for bedsite characteristics between sexes and among seasons were analyzed with a 2-way ANOVA and a G-Likelihood test was applied for the species shrub used by sexes for bedding. Multiple comparisons were done using the Student-Newman-Keuls test (Zar, 1996) in the program SigmaStat (Jandel, 1995).

3. Results

Fifty bedsites (30 with females and 20 with males) and their corresponding random sites were described. No bedsites were recorded for fawns during the surveys, almost all of the individual observations were independent, and on the rare occasion when a group was observed, only one observation was used. Of these, 17 were recorded during the reproductive season (seven with males and 10 with females), 15 in the postreproductive season (five with males and 10 with females), and 18 in the fawning season (eight with males and 10 with females). We recorded 30.3% of the bedsites between 0700 and 1000 h, 42.4% between 1100 and 1400 h, and 27.3% between 1500 and 1800 h.

The highly correlated variables on the matrix were excluded from the PCA (cactus volume and concealment cover in each of the four directions of the compass). The PCA separated the bedsites from the random sites (Fig. 2); the first two principal components accounted for 60% of the variance (PC1: 39%, PC2: 21%). The first component was significantly correlated ($P< 0.05$) with the concealment cover of different strata and number of shrub species; the second was significantly correlated ($P< 0.05$) with shrub height and total cover.

Table 1
Two-way ANOVA for habitat variables by sex and season for white-tailed deer on the San Francisco Ranch (F = Fisher's values for a two-way ANOVA, P = probability).

Variable	factor	DF	F	P
Total cover (m^2)	Sex	1,44	4.800	0.034
Shrub height (m)	Sex	1,44	6.308	0.016
	Season	2,44	13.300	< 0.001
No. of shrub species	Season	2,44	11.010	< 0.001
	Sex and Season	2,44	4.080	0.024
Total volume m^3	Sex	1,44	5.008	0.030
	Season	2,44	7.023	0.002
Mean grass cover (%)	Season	2,44	7.707	0.001
Concealment cover 0–50 (%)	Season	2,44	6.606	0.003
Concealment cover 50–100 (%)	Season	2,44	4.114	0.023
West concealment cover (%)	Sex and Season	2,44	3.224	0.049

Significant differences between the bedsites occupied by males and females were only detected for thermal cover, volume and shrub height with the higher values always recorded for the bedsites occupied by males (Table 1).

Shrub height was greater in male bedsites (Table 2), and the highest shrubs were found during the postreproductive season (Table 2). The number of species was lower (2) during the postreproductive season (the dry season) (Table 2), and there were differences between sex and season with fewer species in male bedsites except during the reproductive season when there were more (Fig. 3a).The total volume of plants was two times greater in male bedsites, and three times greater during the postreproductive season (Table 2).

There was less grass cover during the postreproductive season (Table 2). Males look for shrubs with higher cover (Table 2). Concealment (predator) cover from 0–50 cm (Table 2) and 50–100 cm was greater during the fawning season, and during the postreproductive season this type of cover was lower in the bedsites for females but higher for males (Fig. 3a).

The shrub species used most for bedding by the deer were mesquite (*Prosopis glandulosa*, 32.7%), sweet Acacia (*Acacia farnesiana,* known locally as huizache, 20.4%), and black-brush Acacia (*Acacia rigidula*, 18.4%). Males chose bedsites beneath mesquite 40% of the time that they were observed and used sweet Acacia 30% of

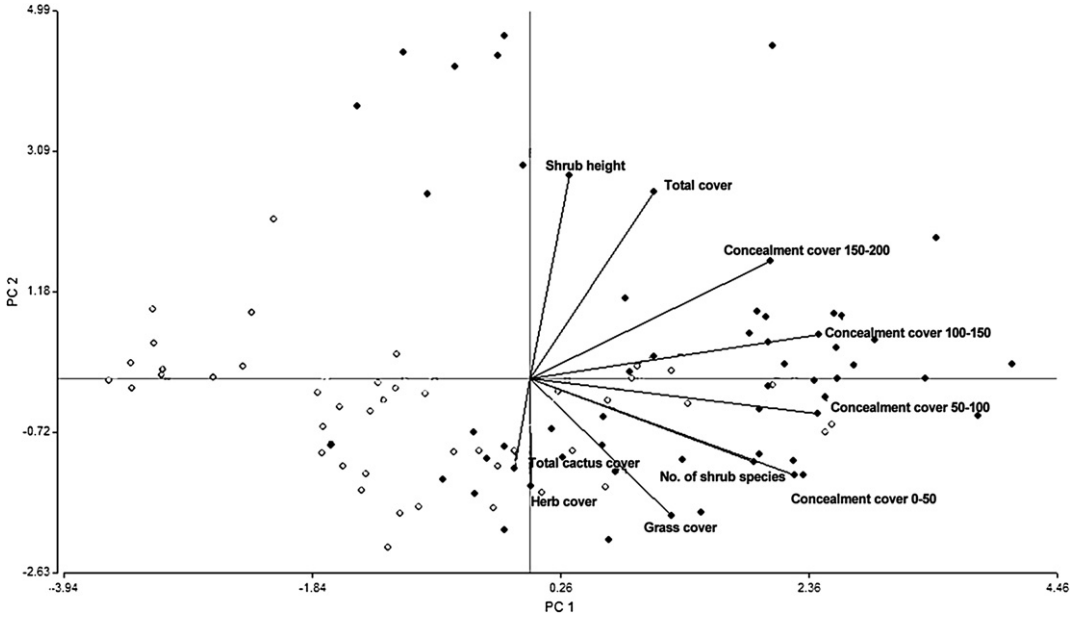

Fig. 2. Principal Components Analysis for habitat variables of white-tailed deer on the San Francisco Ranch, Mexico. Circles with lines are environmental variables, black squares are bedsites and white squares are random sites.

Table 2
Mean ± standard error of significant habitat variables between sexes and seasons for white-tailed deer on the San Francisco Ranch. (Different letters indicate significant differences).

Variable	Female	Male	Reproductive	Postreproductive	Fawning
Total cover (m^2)	32.80 ± 6.2[a]	54.49 ± 7.7b	36.66 ± 8.3a	54.99 ± 9.3a	39.28 ± 8a
Shrub height (m)	1.62 ± 0.2[a]	2.42 ± 0.249b	1.31 ± 0.27a	3.23 ± 0.3b	1.53 ± 0.3a
No. of shrub species	4.23±0.4[a]	4.14 ± 0.5a	5.56 ± 0.5a	2.10 ± 0.6b	4.90 ± 0.5a
Total volume m^3	29.71 ± 8.5a	60.13 ± 10.6b	24.68 ± 11.5a	82.45 ± 12.7b	27.62 ± 11a
Mean grass cover (%)	1.22 ± 0.2[a]	1.05 ± 0.2a	1.49 ± 0.2a	0.38 ± 0.2b	1.54 ± 0.2a
Concealment cover 0–50 (%)	79.67 ± 4.6a	72.19 ± 5.7a	78.46 ± 6.1a	58.25 ± 6.8b	91.06 ± 5.9a
Concealment cover 50–100 (%)	65.00 ± 5[a]	59.74 ± 6.2a	60.36 ± 6.7a	49.50 ± 7.5b	77.25 ± 6.5a

the time, while females used mesquite 27.6%, black-brush Acacia in 27.6% and sweet Acacia in 13.8% of the observations. The G-likelihood test revealed a significant difference between sexes ($G = 25.4$, d.f. = 2, $P < <0.001$).

Deer bedsites were found closer to the dams in the post-reproductive season than in the fawning or reproductive seasons ($F = 3.78$, d. f. = 2,44 $P = 0.031$), and there were no significant differences between sexes for distance to dams ($P < 0.05$).

4. Discussion

Deer select bedsites by searching for shrubs with more thermal cover and greater concealment cover as compared with random sites. The majority of deer bedsites were found occupied between 1100 and 1400 h, when the sun is highest and temperatures are generally higher. This is not surprising, considering that on this flat terrain there are no other landscape features, such as slopes, that could affect site selection, as might occur in other locations. This tendency has also been observed using radiotelemetry (Bello et al., 2001a; Gallina et al., 1998, 2004). In other arid sites, such as the Arizona Mountains (Ockenfels et al., 1991; Tull et al. 2001) deer used bedsites with thermal cover mostly during the hottest, sunniest hours to avoid losing water by evaporative cooling. Our study demonstrates the importance of thermal cover, because deer sought this cover when temperatures were high in this area, and even when water was available for drinking all year round owing to intensive water management in the study area.

Males and females differ in their selection of bedsites: males select sites with the tallest shrubs and shrub volume that offers more cover. The main shrubs offering these characteristics are mesquite and sweet Acacia, which were selected by males. This preference by males for sites with dense cover for protection has been observed in other studies (Pollock et al., 1994). Only few males are hunted on the San Francisco Ranch each year and, on occasion, they prefer open habitats for other activities (Bello et al., 2001a). In addition to seeking protection from the weather, this preference could be attributed to sexual dimorphism. Males are almost two times larger than females and thus experience greater heat gain from direct solar radiation; this in turn, influences their water balance (Ockenfels and Brooks, 1994).

We found that the use of bedsites with different characteristics varied by season. During the postreproductive season, which coincides with the driest, hottest time of the year (March–June), deer bedded under taller shrubs that offered the greatest thermal protection. For arid zones, the importance of variation in climate factors such as precipitation has been well documented (Marshal et al., 2002) and is directly related to deer behaviour, movement and activity patterns (Bello et al., 2004; Gallina et al., 1998). Solar radiation is the main factor causing heat stress and water loss in deer at the southern limit of their range in the USA (Ockenfels and Bissonette, 1984). Therefore, in arid and semiarid areas, even where surface water is readily available such as the San Francisco Ranch, in north-eastern Mexico bedsite selection is important to deer for thermal regulation (Bello et al., 2001a).

During the postreproductive and fawning seasons of 1998 the mean maximum temperature was 35.7 °C and 35.4 °C, respectively, but during June and July the maximum temperature exceeded 40 °C, while for the same months in 1995 and 1996 the maximum temperature was lower than 40 °C (Bello et al., 2001b). Furthermore, although these seasons tended to have the lowest rainfall of the study period, in 1998 they were markedly lower during these seasons (see Fig. 1; Bello et al., 2004) and under these conditions, deer could have reduced their activity level (Ockenfels and Bissonette, 1984) or selected sites that provided higher cover, as observed in this study.

During the fawning season, deer bedsites offered greater concealment (0–50 and 50–100 cm strata). Protection from predators is especially important for females trying to ensure the successful development of their offspring (Bowyer et al., 1998; Fox and Krausman, 1994; Gerlach and Vaughan, 1991; Germaine et al., 2004; Huegel et al., 1986; Kroll, 1992;). They search for bedsites with dense cover that is mostly located between the soil and one meter above the ground (Fox and Krausman, 1994; Germaine et al., 2004). Dams are very important sites for the deer given that, in addition to providing water, the riparian vegetation offers dense cover (thermal and concealment), and these are the only places

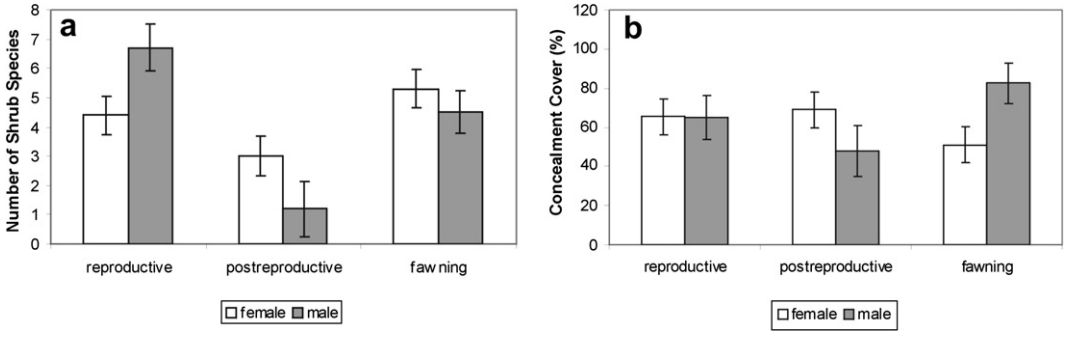

Fig. 3. Habitat variables significant to bedsite selection by white-tailed deer on the San Francisco Ranch, Mexico, by sex and season interaction: a) number of shrub species by season, and b) concealment cover.

Table 3
Characteristics for the bedding sites of white-tailed deer in a xerophyllous brushland, North-eastern Mexico.

Variable	Values
Total shrub cover	30–55 m^2
Shrub height	1.5–3.5 m
Species Number	2.0–7.0
Total volumen	30–85 m^3
Concealment cover 0–50	60–90%
Concealment cover 50–100	50–80%

where tree species such as *A. farnesiana* are found (Bello et al., 2001a). As such, bedsites near dams are very important to both sexes, particularly when temperatures are high, and can influence the behaviour of both sexes. This was supported by radiotracking studies in the same area (Bello et al., 2001b) and population dynamics studies, which confirmed that proximity to dams and riparian vegetation increases the probability of survival. Compton et al. (1988) found a direct relationship between the amount of riparian cover and mean number of deer estimated/section of river bottom for pooled data. Riparian cover was the most important factor affecting deer density distribution.

The selection of bedsites by deer depends on sex and season in arid zones even in areas with water management programs. Any habitat management strategy, particularly for males, must therefore take into account the need to maintain tall shrubs or trees (especially mesquite and sweet Acacia) with specific characteristics to provide adequate thermal and protective cover (see Table 3). It is important to leave shrubs for deer, mainly during the post-reproductive and fawning seasons. By allowing these plants to remain in their pastures cattle ranchers can also conserve and harvest deer populations.

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References

Barrett, M.W., 1981. Environmental characteristics and functional significance of pronghorn fawn bedding sites in Alberta. Journal of Wildlife Management 45, 120–131.
Bello, J., Gallina, S., Equihua, M., 2001a. Characterization and habitat preferences by white-tailed deer (*Odocoileus virginianus*) in Mexico. Journal of Range Management 54, 537–545.
Bello, J., Gallina, S., Equihua, M., Mandujano, S., Delfin, C., 2001b. Activity areas and distance to water sources by white-tailed deer in northeastern Mexico. Vida Silvestre Neotropical 10, 30–37.
Bello, J., Gallina, S., Equihua, M., 2004. Movements of white tailed deer and their relationship with precipitation in northeastern Mexico. Interciencia 29, 357–361.
Bowyer, R.T., Kie, J.G., Ballenberghe, V.V., 1998. Habitat selection by neonatal black tailed deer: climate, forage or risk of predation? Journal of Mammalogy 79, 415–425.
Compton, B.B., Mackie, R.J., Dusek, G.L., 1988. Factors influencing distribution of white-tailed deer in riparian habitats. Journal of Wildlife Management 52, 544–548.
Davis, E., 1990. Deer Management in the South Texas Plains. Texas Parks and Wildlife Department.
Fox, K.B., Krausman, P.R., 1994. Fawning habitat of desert mule deer. The Southwestern Naturalist 39, 269–275.
Gallina, S., Pérez-Arteaga, A., Mandujano, S., 1998. Patrones de actividad del venado cola blanca en un matorral xerófilo de México. Boletín de la Sociedad de Biología de Concepción, Chile 69, 221–228.
Gallina, S., Corona-Zarate, P., Bello, J., 2004. El Comportamiento del venado cola blanca en zonas semiáridas del Noreste de México. In: Sánchez-Cordero, V., Medellín, R.A. (Eds.), Contribuciones Mastozoológicas en Homenaje a Bernardo Villa. Universidad Nacional Autónoma de México/Instituto de Biología e Instituto de Ecología, México D.F, pp. 191–202.
Germaine, S., Germaine, H.L., Boe, S.R., 2004. Characteristics of mule deer day-bed and forage sites in current-condition and restoration-treated ponderosa pine forest. Wildlife Society Bulletin 32, 554–564.
Gerlach, T.P., Vaughan, M.R., 1991. Mule deer fawn bedsite selection on the Pinon Canyon Maneuver site, Colorado. The Southwestern Naturalist 36, 255–258.
Griffith, B., Youtie, B.A., 1988. Two devices for estimating foliage density and deer hiding cover. Wildlife Society Bulletin 16, 206–210.
Huegel, C.N., Dahlgren, R.B., Gladfelter, H.L., 1986. Bedsite selection by white-tailed deer fawns in Iowa. Journal of Wildlife Management 50, 474–480.
InfoStat, 2002. InfoStat versión 1.1. Grupo InfoStat, Facultad de Ciencias Agropecuarias. Universidad Nacional de Córdoba, Argentina.
Jandel Corporation, 1995. SigmaStat for Windows 2.0.
Kroll, J.C., 1992. A Practical Guide to Producing and Harvesting White Tailed Deer. Stephen F. Austin State Univ.. Institute of White-tailed Deer Management and Research Center for Applied Studies in Forestry, Austin, Texas.
Lang, B.K., Gates, J.E., 1985. Selection of sites for winter night beds by white-tailed deer in a hemlock-northern hardwood forest. American Midland Naturalist 113, 245–254.
Marshal, J.P., Krausman, P.R., Bleich, V.C., Ballard, W.B., McKeever, J.S., 2002. Rainfall, El Niño, and dynamics of mule deer in the Sonoran Desert, California. Journal of Wildlife Management 66, 1283–1289.
Mysterud, A., Ostbye, E., 1999. Cover as a habitat element for temperate ungulates: effects on habitat selection and demography. Wildlife Society Bulletin 27, 385–394.
Nudds, T.D., 1977. Quantifying the vegetative structure of wildlife cover. Wildlife Society Bulletin 5, 113–117.
Ockenfels, R.A., Bissonette, J.A., 1984. Temperature related responses in north-central Oklahoma white-tailed deer. In: Krausman, P.R., Smith, N.S. (Eds.), Deer in the Southwest: a Workshop Symposium: Phoenix, AR. Arizona Chap. Wildlife Society, pp. 64–67.
Ockenfels, R.A., Brooks, D.E., Lewis, C.H., 1991. General ecology of Coues white-tailed deer in the Santa Rita Mountains. Arizona Game and Fish Department. Number 6. Technical Report, 73.
Ockenfels, R.A., Brooks, D.E., 1994. Summer diurnal bedsites of Coues white-tailed deer. Journal of Wildlife Management 58, 70–75.
Olson, R., 1992. Mule Deer Habitat Requirements and Management in Wyoming. University of Wyoming, USA.
Pollock, M.T., Whittaker, D.G., Demarais, S., Zaiglin, R.E., 1994. Vegetation characteristics influencing site selection by male white-tailed deer in Texas. Journal of Range Management 47, 235–239.
Riley, S.J., Dood, A.R., 1984. Summer movements, home range, habitat use, and behaviour of mule deer fawns. Journal of Wildlife Management 48, 1302–1310.
Shea, S.M., Osborne, J.S., 1995. Poor quality habitats. In: Marchinton, L., Krausman, P.R. (Eds.), Quality Whitetails. Stackpole Books, Mechanicsburg, PA, USA, pp. 193–209.
Smith, R.H., LeCount, A., 1979. Some factors affecting survival of desert mule deer fawns. Journal of Wildlife Management 43, 657–665.
Soriguer, R.C., Fandos, P., Bernaldez, B., Delibes, J.R, 1994. El ciervo en Andalucía. Junta de Andalucía, Consejería del Medio Ambiente, pp. 108–178.
Tull, J.C., Krausman, P.R., Steidl, R.J., 2001. Bed-site selection by desert mule deer in southern Arizona. Southwestern Naturalist 46, 354–357.
Villarreal, J.G, 1999. Venado cola blanca: Manejo y aprovechamiento cinegético. Unión Ganadera Regional de Nuevo León. Monterrey, N.L. México.
Zar, J.H., 1996. Biostatistical Analysis, second ed. Prentice-Hall, New Jersey.