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Article

Importancia del matorral desértico micrófilo para el venado cola blanca (*Odocoileus virginianus* Mearns, 1898) en Coahuila

Importance of the desert microphilous scrubland for the white-tailed deer (*Odocoileus virginianus* Mearns, 1898) in the state of *Coahuila*

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Resumen

El venado cola blanca es la especie cinegética más importante en México. El conocimiento sobre los componentes de la vegetación es importante en los planes de manejo e influyen en la presencia y mantenimiento de ese taxón. Se caracterizó la diversidad taxonómica y productividad de un matorral desértico en Coahuila y se enfatizó el valor de dicho ecosistema en la conservación de las poblaciones del venado; para ello, se utilizaron la línea *Canfield* y el método *Adelaide* en las cuatro estaciones del año, de octubre 2018 a agosto 2019, en la Unidad de Manejo para la Conservación de la Vida Silvestre Rancho San Juan, Monclova, Coahuila. Se estimó el Índice de Valor de Importancia (*IVI*) de cada especie vegetal por estación y el índice de Diversidad de *Shannon*. La producción de biomasa se expresó en kg ha^{-1} por estación y estrato. Se identificaron 46 taxa de plantas, algunas forrajeras: *Acacia berlandieri* y *Acacia rigidula*, además de otras que ofrecen protección térmica: *Cenchrus ciliaris* y *Yucca filifera.* De acuerdo al *IVI*, *Agave lechuguilla* (59.78 %) en primavera, *Hilaria mutica* en verano (62.02 %) y otoño (86.59 %), así como *Cenchrus ciliaris* en invierno (107.00 %) registraron las cifras más altas. El estrato medio aportó mayor cantidad de biomasa (> 1 000 kg ha^{-1}), a diferencia del estrato superior que produjo menos (≤ 250 kg ha^{-1}). Los taxones del matorral desértico que conforman pastos y arbustos brindan los recursos fundamentales para el desarrollo de las poblaciones de *Odocoileus virginianus* en el lugar.

Palabras clave: Biomasa, cobertura, diversidad, especies forrajeras, matorral desértico, valor de importancia.

Abstract

The white-tailed deer is the most important game species in Mexico. Knowledge about the components of the vegetation is important in management plans and influences the presence and maintenance of this species. The taxonomic diversity and productivity of a desert scrub in *Coahuila* was characterized and the value of said ecosystem in the conservation of deer populations was emphasized. The Canfield line and Adelaide method were used in the four seasons of the year, from October 2018 to August 2019, at the Management Unit for Wildlife Conservation *Rancho San Juan,* municipality of *Monclova*, *Coahuila*, Mexico. The importance value index (*IVI*) of each plant species per station and the Shannon diversity index were estimated. Biomass production was expressed in kg ha^{-1} per station and stratum. 46 species of plants were identified, some foragers such as *Acacia berlandieri* and *Acacia rigidula*. In addition, plants that provide thermal protection such as *Cenchrus ciliaris* and *Yucca filifera.* According to *IVI*, *Agave lechuguilla* (59.78 %) in spring, *Hilaria mutica* in summer (62.02 %) and autumn (86.59 %), and *Cenchrus ciliaris* in winter (107.00 %) were the most important. The middle stratum contributed a greater amount of biomass (> 1 000 kg ha^{-1}) unlike the upper stratum, which produced less (≤ 250 kg ha^{-1}). The desert scrub species that make up grasses and shrubs provide the fundamental resources for the development of *Odocoileus virginianus* populations in the area.

Key words: Biomass, cover, diversity, forage species, desert scrub, value of importance.

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Introduction

The white-tailed deer (*Odocoileus virginianus* Mearns, 1898) is the most important game species in the world from an economic perspective (Villarreal *et al*., 2014; Retana *et al*., 2015). In Mexico, *O. virginianis* ssp. *texanus*, is the subspecies with the largest body size and the highest hunting value, included in the international trophy records (Villarreal *et al.,* 2014). For this reason, since the 1960s, property owners in northeastern Mexico have focused the activities of their areas towards the use and conservation of this species, as a production alternative (Gallina *et al.,* 2009; Hernández *et al.,* 2018).

In Mexico and southern Texas, the United States of America, it is mainly related to desert scrub (Mandujano *et al.,* 2010). Because it provides food and protection to males and females with young, the ideal habitat for the white-tailed deer includes an association of shrubby vegetation and medium and tall grasses (Bello *et al.,* 2006). In addition, the presence of *nopales*, *agaves* and other succulents is necessary to cushion prolonged periods of drought (Espino-Barros and Fuentes, 2005). In both countries, in-depth studies have been carried out on the requirements of their habitat and population structure (Stocker and Gilbert, 1977; Gallina, 1993; Arceo *et al*., 2005; Bello *et al.,* 2006), and in particular on this type of scrub (Gallina *et al.,* 2010; Gallina and Bello, 2010; Gallina and Bello, 2014). In the state of *Coahuila*, the composition, diversity and importance of this community for the development and maintenance of white-tailed deer populations have not been studied.

Knowing and interpreting the function of the vegetation cover in the development of the populations of the white-tailed deer is essential for the correct management of its habitat (Stocker and Gilbert, 1977; Delfín *et al.,* 2009). With the aim that technical personnel, authorities and owners of properties for the management of this species have pertinent information for the implementation of tools and actions focused on its conservation in the desert scrubs of northeastern Mexico, the objective of this work was to identify and assess the diversity, composition and productivity of a microphyllous desert scrub to infer its importance in the conservation of white-tailed deer (*Odocoileus virginianus*), in a controlled management location.

Materials and Methods

Study area

The study was carried out in a 1 030 ha area intended for the white-tailed deer within the *Rancho San Juan* Wildlife Conservation Management Unit (UMA, for its acronym in Spanish) (code DGVS-CR-EX-3133-COA), in the *Monclova* municipality, state of *Coahuila* (Figure 1), located 38 km in a straight line east of the municipal seat and 43 km west of *Candela* municipality, between 26°49'31.11'' N and 101°01'57.77'' W.

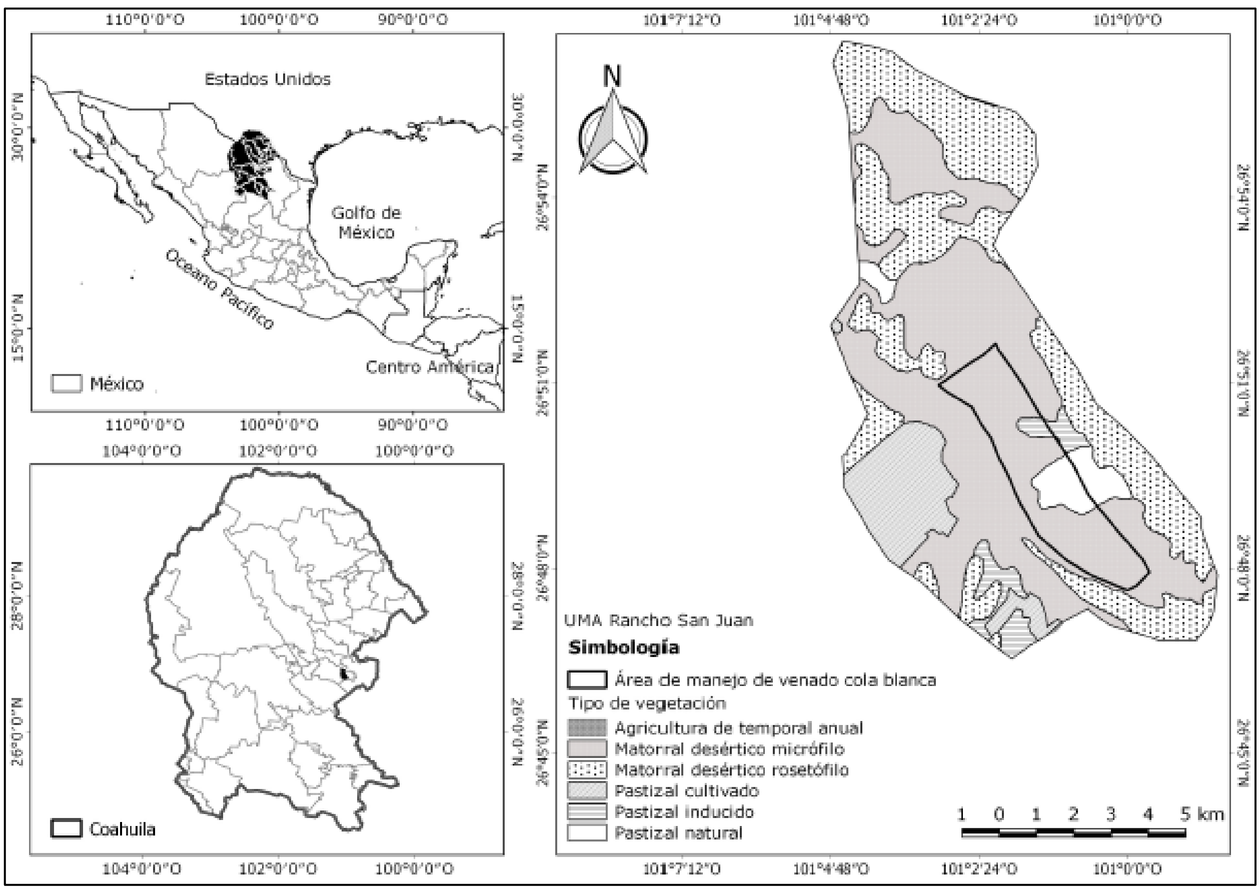

Figure 1. Location and type of vegetation of the *UMA Rancho San Juan*, *Monclova, Coahuila*, Mexico (INEGI, 2013).

The climate is dry (BS_0hw), with an annual average temperature of 21 °C. Annual precipitation varies from 200 mm to 900 mm. The elevation ranges between 600 and 1 000 masl (García, 1988). The dominant vegetation type is microphilous desert scrub, with an association of medium open grassland (Miranda and Hernández, 1963). The representative plant species of the shrubland are shrubs such as *Acacia berlandieri* Benth., *Acacia rigidula* Benth., *Castela texana* Torr & Gray, *Celtis pallida* Torr., *Flourensia cernua* DC., *Forestiera angustifolia* Torr., *Karwinskia humboldtiana* (Schult.) Zucc., *Larrea tridentata* (Sessé & Moc. ex DC.) Coville, grasses of the *Bouteloua* genus and succulents such as *Opuntia engelmannii* Salm-Dyck ex Engelm., among the main ones.

Description of the vegetation cover

To evaluate the composition and structure of the vegetation, the Canfield line method was used because it allows estimating relative values of abundance, frequency and dominance (González *et al.*, 2012). 18 permanent lines of 25 m in length were placed at random in each season of the year: autumn (October 2018), winter (February 2019), spring (May 2019) and summer (August 2019). The height and cover of each plant that intercepted the line was measured. The species were classified according to their height in: low stratum (≤ 50 cm), medium (51-150 cm) and high (> a 150 cm), which were measured from the base to the tip, with a rigid Truper™ measuring tape 1 1/4" wide and 3 m length. With the assessed parameters, the Importance Value Index (IVI) was determined according to Curtis and McIntosh (1951), using equation 1:

$$IVI = AR + FR + DR \quad ....(1)$$

Where:

AR = Relative abundance

FR = Relative frequency

DR = Relative dominance

The specific diversity (α) of the scrubland in each season of the year was estimated with equation 2 to calculate the Shannon diversity index (1948).

$$H' = -\sum_{i=1}^{n} P_i \times LogNP_i \quad \text{.................(2)}$$

Where:

P_i = Individuals of the *i* species ratio in regard to the total number of individuals in the season (relative abundance of the *i* species): $\frac{ni}{N}$

n = Number of individuals of the *i* species

N = Number of all the individuals of all the species in the season

To know if there is a significant difference in plant diversity among stations, the t-student test (α≤0.05) was applied by using the R Studio platform with the R programming language (R Studio Team, 2016).

Estimation of biomass production

Forage productivity in the four seasons of the year was expressed as the amount of biomass per plant stratum in kg ha^{-1} (Fulbright and Ortega, 2006). With the Adelaide Method (Foroughbakhch *et al*., 2005), the biomass production of the upper and middle stratum was evaluated, in 18 plots of 50 m^2 and 25 m^2, respectively. This method consists of taking a reference unit of each plant within the plots (representative in shape and foliar density of the entire plant). With it, the number of units of each specimen and of each sampled species was estimated. However, for the low stratum (pastures and herbaceous), a total cut of 18 plots of 1 m^2 was carried out (Chávez, 2000). The biomass samples of grasses, herbaceous and the reference units were placed in paper bags, labeled and dried in an INOX type oven, 120VAC. 60HZ. at 75 °C until constant weight. Finally, the samples were weighed on an ENTRIS 8201-1S balance to obtain dry weight.

Results and Discussion

Diversity and composition of the vegetation cover

A total of 42 plant species represented by 21 families were recorded, of which Poaceae (7 spp.), Asteraceae (6 spp.), Fabaceae (5 spp.) and Cactaceae (4 spp.) were the most common. 16 from them were present during the four seasons of the year (Table 1).

Table 1. Importance Value Index (*IVI*) of the recorded species in the four seasons in the *UMA Rancho San Juan, Monclova, Coahuila*, México.

Family	Species	Stratum	Importance Value Index (%)			
			Spring	Summer	Autumn	Winter
Fabaceae	*Acacia berlandieri* Benth.	Upper	7.13	12.25	2.48	1.77
Fabaceae	*Acacia rigidula* Benth.	Upper	19.39	14.58	2.39	6.02
Agavaceae	*Agave lechuguilla* Torr.	Middle	59.78	35.31	27.99	29.66
Agavaceae	*Agave scabra* Salm-Dyck	Middle	7.53	4.26	3.38	8.73
Verbenaceae	*Aloysia macrostachya* Moldenke	Middle	2.68	4.9	3.39	1.21
Poaceae	*Aristida adscensionis* L.	Low	-	-	1.87	-
Poaceae	*Bothriochloa laguroides* (DC.) Herter	Low	-	-	3.29	-
Poaceae	*Bouteloua curtipendula* (Michx.) Torr.	Low	2.22	-	8.22	2.08
Poaceae	*Bouteloua gracilis* (Kunth) Lag. ex Griffiths	Low	-	29.78	22.99	-
Asteraceae	*Brickellia glutinosa* S. Watson	Middle	-	-	-	2.27
Fabaceae	*Calliandra conferta* Benth.	Middle	15.09	8.97	-	-
Simaroubaceae	*Castela texana* Torr & Gray	Middle	-	-	-	1.17
Cannabaceae	*Celtis pallida* Torr.	Upper	1.44	0.97	1.14	1.44
Poaceae	*Cenchrus ciliaris* L.	Low	10.68	1.02	7.66	107
Cactaceae	*Cylindropuntia leptocaulis* (DC.) F. M. Knuth	Middle	9.19	1.92	5.43	7.06
Fabaceae	*Dalea greggii* A. Gray	Low	5.93	-	-	-
Ebenaceae	*Diospyros texana* Scheele	Upper	1.61	-	-	-
Ephedraceae	*Ephedra pedunculata* Engelm. ex S. Wats.	Middle	35.4	-	-	-

Euphorbiaceae	*Euphorbia antisyphilitica* Zucc.	Middle	17.39	23.8	12.94	9.53
Cactaceae	*Ferocactus sp.* Britton & Rose	Low	1.43	5.85	-	0.99
Asteraceae	*Flourensia cernua* DC.	Middle	-	17.87	20.13	31.92
Oleaceae	*Forestiera angustifolia* Torr.	Middle	11.01	1.34	0.9	1.38
Asteraceae	*Gochnatia hypoleuca* (DC.) A. Gray	Middle	1.03	-	1.91	-
Zygophyllaceae	*Guaiacum angustifolium* Engelm.	Middle	14.93	4.63	7.13	8.09
Bromeliaceae	*Hechtia glomerata* Mez.	Low	1.12	2.79	1.69	-
Poaceae	*Hilaria mutica* (Buckley) Benth.	Low	-	62.02	86.59	-
Euphorbiaceae	*Jatropha dioica* Sessé ex Cerv.	Middle	20.24	9.55	9.96	18.62
Rhamnaceae	*Karwinskia humboldtiana* (Schult.) Zucc.	Middle	7.55	4.2	1.94	1.14
Koeberliniaceae	*Koeberlinia spinosa* Zucc.	Middle	-	-	-	2.4
Zygophyllaceae	*Larrea tridentata* (Sessé & Moc. ex DC.) Coville	Middle	-	-	1.1	-
Scrophulariaceae	*Leucophyllum frutescens* (Berland) I. M. Johnston	Middle	4.61	2.23	1.72	2.36
Verbenaceae	*Lippia graveolens* Kunth	Middle	-	10.72	19.1	9.05
Cactaceae	*Opuntia engelmannii* Salm-Dyck ex Engelm.	Middle	25.23	15.16	13.08	23.62
Cactaceae	*Opuntia microdasys* (Lehm.) Pfeiff.	Middle	1.46	1.03	-	-
Asteraceae	*Parthenium argentatum* A. Gray	Low	1.32	-	-	-
Asteraceae	*Parthenium hysterophorus* L.	Low	-	-	8.7	-
Poaceae	*Paspalum notatum* Flüggé	Low	-	12.41	9.48	7.03
Achatocarpaceae	*Phaulothamnus spinescens* A. Gray	Middle	-	-	1.71	-
Fabaceae	*Prosopis glandulosa* Torr.	Middle	14.64	10.96	7.99	12.79
Lamiaceae	*Salvia coccinea* Buc'hoz ex Etl.	Middle	-	1.48	-	-
Apocynaceae	*Telosiphonia macrosiphon* (Torr.) Henrickson	Middle	-	-	-	2.67
Asteraceae	*Wedelia texana* (A. Gray) B. L. Turner	Low	-	-	2.55	-
Asparagaceae	*Yucca filifera* Hort. ex Engelm.	Upper	-	-	1.17	-

Some species recorded in this study have been previously consigned in the diet of the white-tailed deer in northeastern Mexico, such as: *Acacia rigidula* Benth., *Acacia berlandieri* Benth., *Calliandra conferta* Benth., *Celtis pallida* Torr., *Dyospiros texana* Scheele, *Forestiera angustifolia* Torr., *Karwinskia humboldtiana* (Schult.) Zucc., *Opuntia engelmannii* Salm-Dyck ex Engelm. and *Prosopis glandulosa* Torr., among the main ones (Ramírez, 2004). However, they are considered decreasing, because their availability decreases as a function of browsing (Dyksterhuis, 1948; Ramírez *et al*., 1996; Ramírez, 2004). In particular, *Acacia berlandieri* and *Acacia rigidula* are important forage plants for white-tailed deer. Ramírez *et al.* (1996) concluded that in northeastern Mexico these two species make up 75 % of the annual deer diet. In addition, its inflorescences represent an important source of food, necessary to recover the energy expenditure suffered during the reproductive season.

The scrubland also has emergency species (consumed in the absence or low availability of the preferred ones), also considered as growing (their availability increases in relation to low consumption) (Dyksterhuis, 1948; Ramírez 2004) that include: *Larrea tridentata* (Sessé & Moc. ex DC.) Coville, *Lippia graveolens* Kunth, *Parthenium argentatum* A. Gray, *Parthenium hysterophorus* L., *Phaulothamnus spinescens* A. Gray, *Salvia coccinea* Buc'hoz ex Etl., *Wedelia texana* (A. Gray) B. L. Turner and some grasses of the *Bouteloua* genus. Although these are not preferred by the deer, it may be essential in times of low availability and poor forage quality. However, Aguiar *et al.* (2011) mentioned that plants little consumed by deer produce adverse effects on the reproduction rate. Therefore, it is essential to keep areas with leguminosae.

On the other hand, in arid and semi-arid areas, the presence of the white-tailed deer is conditioned by the availability of species such as succulents, which function as buffer plants during the dry season (Gallina and Bello, 2010). In this sense, *Opuntia engelmannii* was identified as a dominant species within the scrub, and evidence of browsing by deer was observed (Figure 2). It is a forage plant of interest for the white-tailed deer in northeastern Mexico and southern Texas, due to its high water content (90 %) (Ramírez *et al.,* 2000). Other succulents such as *Agave lechuguilla* Torr., *Agave scabra* Salm-Dyck, *Hechtia glomerata* Mez., *Cylindropuntia leptocaulis* (DC.) F.M. Knuth and *Opuntia microdasys*

(Lehm.) Pfeiff., were identified in the study area. Only *Cylindropuntia leptocaulis* is recorded in the deer diet for northeastern Mexico.

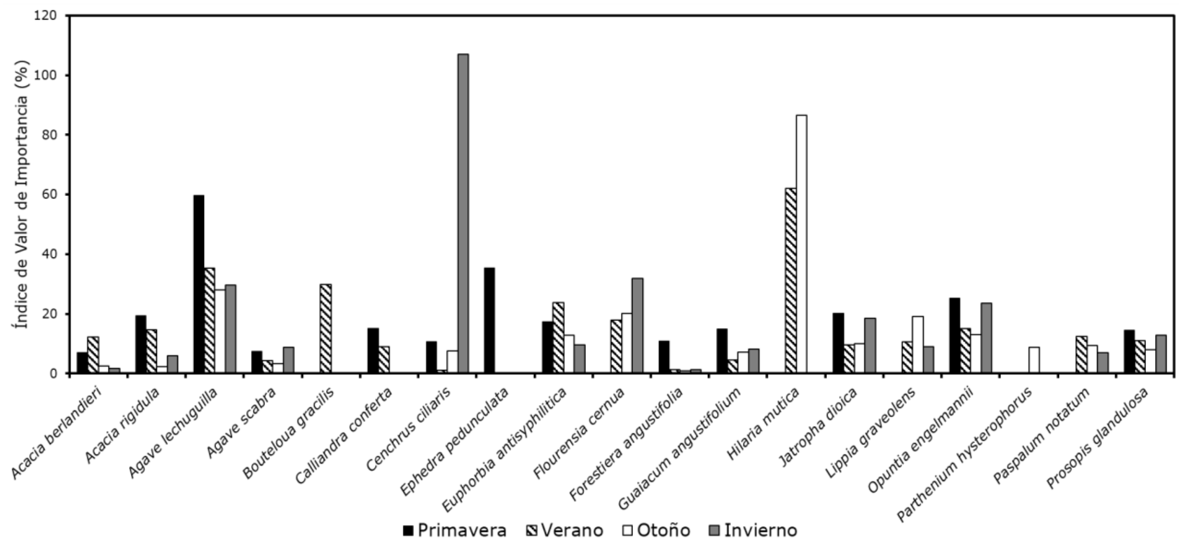

Figure 2. Dominant species in relation to the Importance Value Index by season of the year, in *the UMA Rancho San Juan, Monclova, Coahuila, Mexico.*

During spring and summer, the shrubs presented higher availability, 72.43 % and 50.07 %, respectively (Table 1). Because the white-tailed deer is selective in its food, the shrubs are essential in its habitat. For example, in Texas, USA, the increase in white-tailed deer populations in the 20th century was attributed to increased availability of shrubs (Taylor and Hahn, 1947). In addition, trees and shrubs have been reported to represent the majority of the deer diet (Ramírez *et al.*, 1996; Ramírez, 2004; Arceo *et al*., 2005). The high availability of shrubs in spring and summer indicates that during the calving season (July and August) the deer have enough stocks of shrubs for their consumption.

Pastures predominated during autumn and winter (59.94 % and 53.58 %, respectively). This is significant, as the patches of grass provide thermal coverage during the low-temperature months. In this context, it was found that the deer used these plant formations constituted by *Cenchrus ciliaris* L. with an average height of

50 cm (± 13.41), as resting and covering sites, mainly in winter. Furthermore, Ramírez (2004) has reported that deer consume grasses in the absence of their preferred forage species.

In relation to *IVI*, 19 dominant species were identified (Figure 2). With the exception of *Agave lechuguilla, Agave scabra, Euphorbia antisyphilitica* Zucc.*, Flourensia cernua* DC.*, Guaiacum angustifolium* Engelm.*, Lippia graveolens, Parthenium hysterophorus* and *Paspalum notatum* Flüggé, all have been recorded in the diet of white-tailed deer in northeastern Mexico (Ramírez 2004; Fulbright and Ortega 2004; , 2006; Olguín *et al*., 2017). *Euphorbia antisyphilitica* is avoided by deer due to the high wax content that makes digestion difficult (Ramírez, 2004).

Besides being a plant consumed by deer, *Guaiacum angustifolium* provides cover for escape (Ramírez, 2004). Although not identified as a dominant species, *Karwinskia humboldtiana* provides escape cover, especially in winter because it remains green (Taylor *et al.,* 1997). Furthermore, deer prefer open spaces with almost no shrubs, where grass and herbaceous species (e.g. *Lippia graveolens, Paspalum notatum* and *Parthenium hysterophorus*) predominate as feeding sites (Stewart *et al*., 2000). Scarnecchia *et al.* (1988) indicate that these sites are essential in the habitat for their nocturnal consumption.

The diversity of plants is an important component of the habitat for the nutrition of the white-tailed deer (Fulbright and Ortega, 2006), because when it is high it favors greater stability and flexibility of the system to tolerate phenomena such as drought, and offers a diet of nutritional value superior for animals (Ramírez, 2004). The Shannon diversity index indicates that the highest diversity of plants occurred in spring (2.45) and the lowest in winter (1.87). With the exception of the first two seasons of the year, a significant difference ($p \leq 0.05$) in diversity was identified (Table 2).

Table 2. Values of the Shannon diversity index (H ’) and significance level of the t-student test in the diversity of plants by station in the *UMA Rancho San Juan, Monclova, Coahuila, Mexico.*

Season	***H'***	**Level of significance (*p*≤0.05) of the *t-student* test in diversity**			
		Spring	**Summer**	**Autumn**	**Winter**
Spring	2.42		NS	0.036*	$3.354*e^{-11}$***
Summer	2.42			0.005**	$1.442*e^{-15}$***
Autumn	2.25				$2.457*e^{-8}$***
Winter	1.86				

Level of significance: ≤0.1*; ≤0.01**; ≤0.001***; NS = Non- significant.

To keep a relatively high plant diversity in spring is essential for good deer nutrition, since this is more relevant than the abundance of plants they prefer, since a single plant species does not cover all the nutritional requirements of deer during the year (Fulbright and Ortega, 2006; Aguiar *et al*., 2011). A study conducted in Minnesota, USA, showed that white-tailed deer with a more diverse diet consistently have a good nutritional level (Del Giudice *et al.,* 1989).

From the nutritional point of view, shrub species that stand out for their high calcium content (basic for antler development) were identified, such as *Castela texana*. In contrast, despite their relatively low content of this mineral, the native grasses of northeastern Mexico (eg *Aristida adscensionis* L., *Bouteloua gracilis* (Kunth) Lag. ex Griffiths*, Bouteloua curtipendula* (Michx.) Torr. and *Hilaria mutica* (Buckley) Benth.) meet the metabolic needs of calcium from Texan white-tailed deer (Ramírez *et al*., 1996). Others with a high content of vitamin K (necessary for blood clotting) such as *Diospyros texana* Scheele and *Jatropha dioica* Sessé ex Cerv. (Ramírez, 2004) were also determined in this study.

Biomass production and its importance in the management of white-tailed deer

An average biomass production of 621.20 (± 85.08) kg ha^{-1} per season was estimated. In summer and autumn the contribution was higher (744.36 ± 44.20 kg ha^{-1} and 607.93 ± 57.77 kg ha^{-1}, respectively) while in winter the lowest production occurred (553.36 ± 50.12 kg ha^{-1}) (Figure 3). This production is relatively low, compared to the 1 501 (± 492.35) kg ha^{-1} per season calculated by Olguín *et al*. (2017) in the state of *Tamaulipas* and the 929.2 (± 401.64) kg ha^{-1} by Navarro *et al.* (2018) in the state of *Zacatecas*.

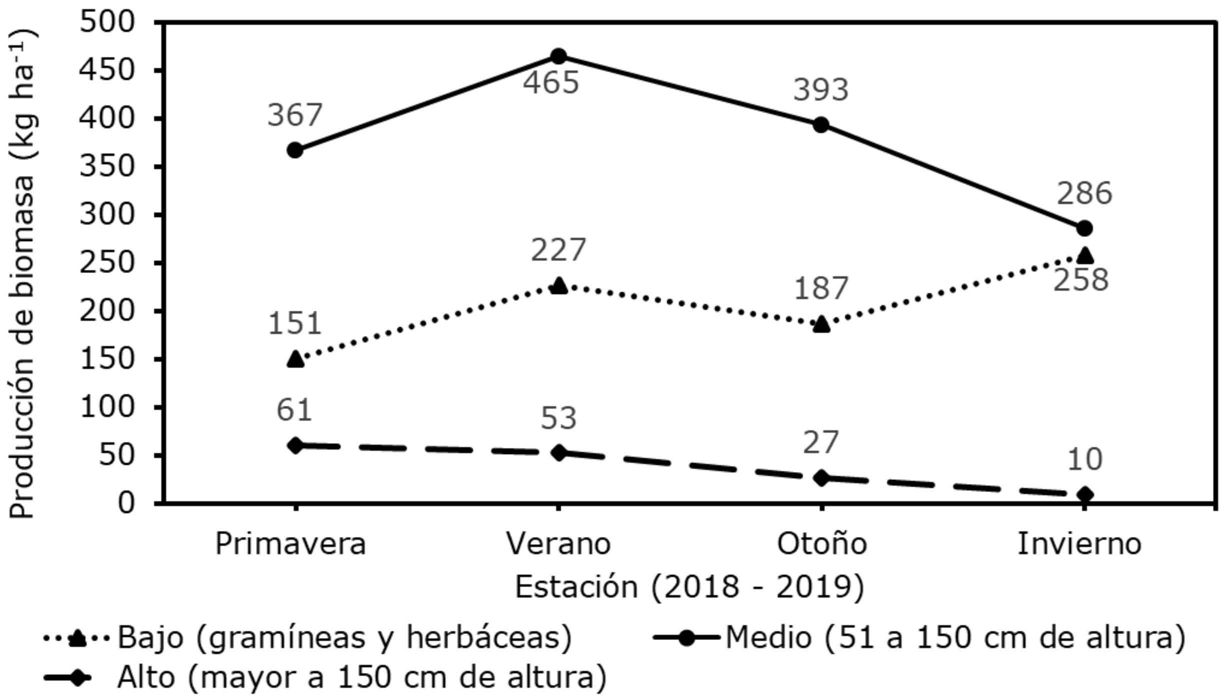

Figure 3. Variation in the seasonal biomass production by plant stratum in the *UMA Rancho San Juan, Monclova, Coahuila*, Mexico.

The biomass of the habitat is a basic factor in the development of deer. For this reason, this low production directly influences the bearing capacity of the scrub. It is documented that an adult individual requires a daily biomass consumption of 2 % to 4 % of their body weight (Kie *et al.,* 1983; Ramírez, 2004; Fulbright and Ortega, 2006). However, the requirement varies depending on the physiological state, age of the deer, nutritional value of the available plants, composition of the forage species and the spatial distribution of the forage (Stocker and Gilbert, 1977). Kie *et al.* (1983) indicated that the body weight of adult males increases rapidly during spring, and therefore, forage consumption increases.

The seasonal variations in biomass production in this study coincide with the variations in seasonal forage consumption by South Texas deer. A decrease in forage consumption is observed in summer, followed by an increase in autumn and the greatest decrease in winter (Wheaton and Brown, 1983). The middle stratum contributed the highest amount of biomass in the four seasons of the year (> 1 000 kg ha^{-1}), being summer, the season that contributed the highest biomass (1 858.52 kg ha^{-1}) (Figure 3). This was mainly due to the 80 mm of precipitation in the area in July. However, it was estimated that grasses and herbaceous plants produced a greater quantity in winter (1 032.70 kg ha^{-1}). The upper stratum was the one with the lowest biomass (≤ 250 kg ha^{-1}) (Figure 3).

White-tailed deer prefer to feed on leaves and young stems of shrubs, with higher protein content and relatively low in fiber and lignin (Ramírez, 2004). In this sense, the thicket provides the highest values of shrub biomass in the year, especially in summer (Figure 3), the time when deer require more forage to produce food for the fawns (Fulbright and Ortega, 2006).

On the other hand, the production of herbaceous and grasses is necessary since the deer consumes them if there is competition for food (Ramírez, 2004). As mentioned above, *Acacia berlandieri* and *Acacia rigidula* are preferred plants for deer, and although they were identified in this study as part of the scrubland, their average seasonal biomass production (18.79 ± 15.13 kg ha^{-1}) in regard to the average weight of biomass per station (621 ± 85.08 kg ha^{-1}) was not high (<5.5 %). On the contrary, in the pastures with high lignin content and low percentage of digestibility, a higher average biomass production was verified (187.11 ± 45.28 kg ha^{-1}) per season (Figure 4), and up to 43.84 % of biomass production in winter.

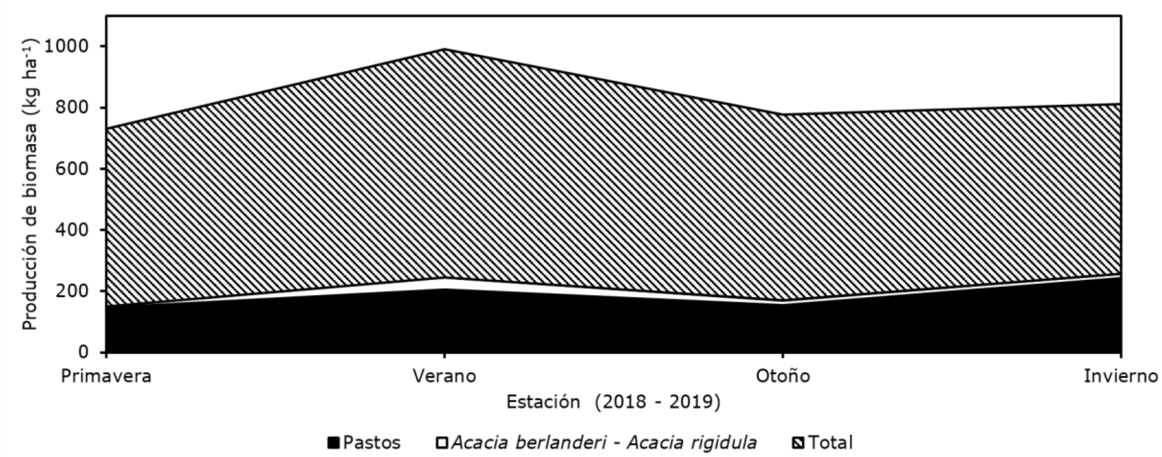

Figure 4. Comparison of seasonal biomass production of basic species in the diet of white-tailed deer in northeastern Mexico (*Acacia berlandieri* Benth. and *Acacia rigidula* Benth*.*) and pastures, in relation to total biomass productivity, in the *UMA Rancho San Juan, Monclova, Coahuila, Mexico.*

The relative low biomass production of species preferred as deer forage in the study area (Figure 4), can be reflected in a low carrying capacity of the scrub. The results presented here should be complemented with a study on the feeding habits of the white-tailed deer during the four seasons of the year. Although the scrubland provides forage species and thermal cover, the dominance of grasses such as *Cenchrus ciliaris* can be an indicator of disturbance.

In addition, it is relevant that studies of plant diversity continue to be carried out in another habitat of the white-tailed deer in northeastern Mexico, in order to have a reference point and establish improvements in plant cover that favor plant diversity. in the scrubland.

Conclusions

21 families and 42 species of plants were identified within the scrub, 25 of which are registered in the literature as species on which the white-tailed deer can feed. *Acacia berlandieri, Acacia rigidula* and *Opuntia engelmannii* stand out as their preferred species. The srubland gathers species that can provide thermal and escape cover such as *Cenchrus ciliaris, Guaiacum angustifolium, Karwinskia humboldtiana* and *Yucca filifera*.

The forage species did not represent a high biomass production, in relation to the production of pastures, which are little consumed by deer.

Although the scrubland has species that provide food, thermal cover, and escape, its productivity may not maintain a viable deer population in the long term. Average biomass production per season was relatively lower than at other sites in northeastern Mexico.

The information presented here is useful to more accurately estimate the carrying capacity of the shrubland and identify sites for repopulation of the white-tailed deer, for this it is recommended to complement these results with a seasonal study on the diet of the white-tailed deer.

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Conflict of interests

The authors declare no conflict of interest.

Contribution by author

Fernando Isaac Gastelum Mendoza: field work, statistical analysis and preparation of the manuscript; César Martín Cantú Ayala: results review, support in statistical analysis and review of the manuscript; José Isidro Uvalle Suceda: help in field work, identification of plants and review of the final manuscript; Eloy Alejandro Lozano Cavazos: review of results and of the final manuscript; Ricardo Serna Lagunes: support in the statistical analysis and review of the final manuscript; Fernando Noel González Saldívar: support in the discussion of results and review of the final manuscript.

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