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Article

Composición botánica del matorral sarcocaule en Baja California Sur durante las estaciones húmeda y seca

Botanical composition of the *sarcocaule* scrub in the state of *Baja California Sur* during the wet and dry seasons

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Resumen

El objetivo del presente estudio fue determinar la composición florística del matorral sarcocaule del desierto sonorense en un área de 800 ha dentro de una propiedad ejidal ubicada en los límites de la ciudad de La Paz, Baja California Sur. El muestreo se realizó durante la época de lluvias (septiembre-noviembre de 2018) y a finales de la épocade sequía (mayo-agosto de 2019), por medio de 20 cuadrantes de 5 m × 5 m. Se identificaron 29 especies de 1 634 individuos, entre las dos temporadas y se consideraron las variables de altura y diámetro de copa de cada ejemplar por especie, para determinar abundancia (A_r), dominancia (D_r), frecuencia (F_r), índice de valor de importancia (*IVI*) y los índices de *Shannon* para la diversidad de especies (*H´*) e índice de *Margalef* para la riqueza de especies (*S´*). Durante la época de lluvias, se observó a *Jatropha cinerea* como dominante D_r=7.15 % y con mayor *IVI* (10.7 %); *Turnera diffusa* fue la más abundante con A_r=3.2. En cambio, para la temporada seca, fue *Prosopis articulata* la especie dominante D_r=9.29 y con mayor *IVI* (12.51 %); *Mammillaria armillata* fue la más abundante, con A_r=4.56. Los índices de (*H´*) y (*S´*) durante la época de lluvias fueron 3.36 y 8.09, respectivamente, con diferencia entre ellos ($p \leq 0.05$) al compararlos con los de la temporada seca (2.88 y 4.88, respectivamente), debido a la ausencia de taxones y disminución del número de individuos, en relación con la época húmeda.

Palabras clave: Composición florística, desierto Sonorense, épocas de lluvias, indicadores ecológicos, La Matanza, sequía.

Abstract

The aim of the present study was to determine the floristic composition of the *sarcocaule* scrub of the Sonoran desert in an area of 800 ha within an *ejidal* property located in the limits of the city of *La Paz*, Southern *Baja California*. Sampling was carried out during the rainy season (September-November 2018) and at the end of the dry season (May-August 2019), using 20 quadrants of 5 m × 5 m. 29 species of 1 634 individuals were identified, between the two seasons and the variables of height and crown diameter of each specimen by species were considered, in order to determine abundance (A_r), dominance (D_r), frequency (F_r), importance value index (*IVI*) and the Shannon index for species diversity (*H´*) and the Margalef index for species richness (*S´*). During the rainy season, *Jatropha cinerea* is observed as the dominant species D_r = 7.15 % and with the highest *IVI* (10.7 %) and *Turnera diffusa* as the most abundant with A_r = 3.2. On the other hand, for the dry season, *Prosopis articulata* is the dominant species D_r = 9.29 and with the highest *IVI* (12.51 %) and *Mammillaria armillata* as the most abundant, with A_r = 4.56. The indices of *H*' and *S*' during the rainy season were 3.36 and 8.09, respectively, with a difference between them ($p \leq 0.05$) when compared with those of the dry season (2.88 and 4.88, respectively), due to the absence of species and decrease in the number of individuals, than in the wet season.

Key words: Floristic composition, Sonoran desert, rainy season, ecological indicators, *La Matanza*, drought.

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Introduction

Northern Mexico is covered by the deserts of North America, such as those of southern Arizona and California, which extend towards the states of *Sonora, Chihuahua, Baja California* and *Baja California Sur*, where the *Chihuahuense, Sonorense* and *Mojave* deserts are located (Whorley and Kenagy, 2007). The climate and soil characteristics of these places make it possible for the bushes to exhibit a different botanical composition with high diversity and richness of species (Cabrera, 2009).

There are three types of ecosystems in the state of *Baja California Sur*: pine-oak forest, tropical deciduous forest and *sarcocaule* scrub, this type of scrub being a variation of the xerophilous scrub (Rzedowski, 2006), characteristic of the areas arid; the latter is presented as the dominant one. The *sarcocaule* scrub covers a large part of the entity's territory and is located on the plains of areas near the city of *La Paz*. Among the dominant species of this type of vegetation stand out *Jatropha cinerea* (Ortega) Muell.-Arg. (*lomboy*), *J. cuneata* Wiggins & Rollins (*matacora*), *Bursera microphylla* A. Gray (*torote*), *Stenocereus gummosus* (Engelm.) A. Gibson & K. E. Horak (*pitaya dulce*), *Larrea divaricata* Cav. (*jarilla*) and *Fouquieria diguetti* (Tiegh.)I. M. Johnst. (*palo adán*) (Velderrain *et al.*, 2010). The vegetation is characterized by the dominance of shrub and tree plants, mainly legumes, particularly the Agavaceae and Cactaceae (succulent) and Burseraceae and Euphorbiaceae (semi-succulent) families with twisted stems and branches with medium presence of exfoliating bark (León *et al*., 2000). This great diversity of plants is grazed by livestock in this region of the country.

To know the structural characteristics of the vegetation of a forest ecosystem is important, since the distribution of the species and their abundance is not similar between the different seasons of the year from the influence of some edaphic or climatic factor. In this way, the information generated can be a means to make proposals for management, conservation and regeneration, in reduced areas or fragments of the scrub (Rosenzweig, 1995). Different studies have been carried out that refer to the botanical composition of *sarcocaule* scrub (León *et al*., 2000;

Velderrain *et al.*, 2010); however, there are other investigations that have focused on the functional traits of different species and their phenology in this type of vegetation (Maya and Arriaga, 1996; Perea *et al*., 2005).

The wide diversity of plants that establish in the vegetation of northeast Mexico occurs in response to extreme physical factors such as recurring droughts and intense temperatures in addition to human activities such as land use change and overgrazing (Reid *et al*., 1990), which favor important changes in its structure and composition. In this context, the aim of the present investigation was to know the floristic composition of the *sarcocaule* scrub present in the *Palmar de Abajo* Ranch in the town of *La Matanza*, at two different times of the year and its relationship with the climate. It was hypothesized that the presence of families is subject to the change of season. A difference in species presence and effects on the abundance, coverage, richness and diversity of plant varieties in the scrub would be expected.

Materials and Methods

Study area

This research was carried out in the area known as *Rancho Palmar de Abajo*, located in *La Matanza, La Paz* municipality, *Baja California Sur*, between 23°38′02′′ N and 110°17′05′′O (Figure 1). The climate of this area is desert-dry with average temperatures of 21.2 °C and temperatures of 9 °C in winter; the rainy season displays from July to September, but rains can occur in winter (Ramírez *et al*., 2011). The dry season is from February to June (Troyo *et al*., 2014).

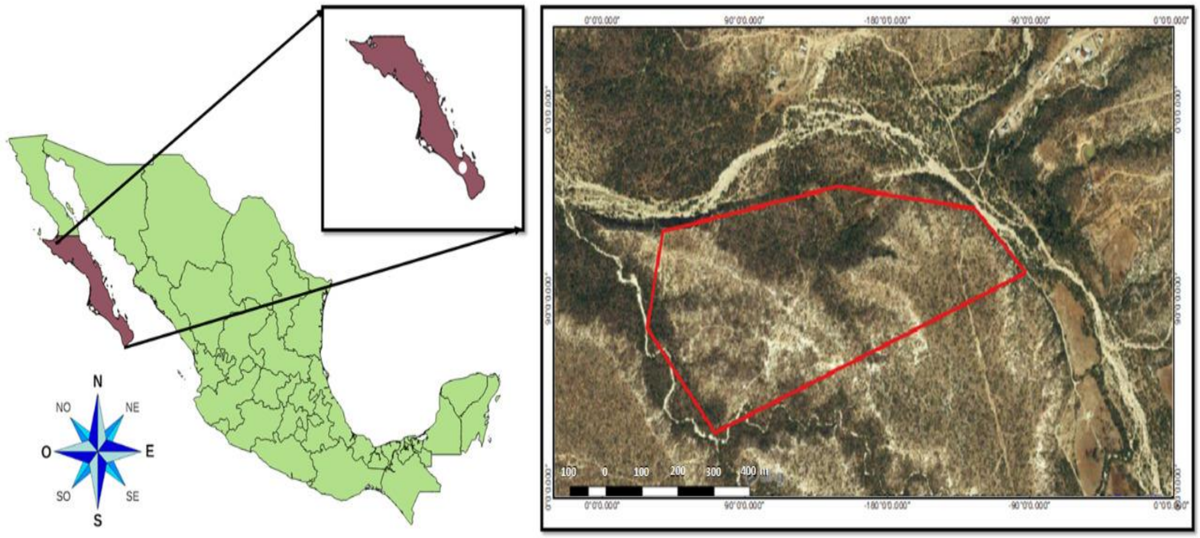

Figure 1. Location of the *Rancho Palmar* property, *La Paz* municipality, *Baja California Sur* (The study area is marked in red in the polygon).

In the study area, the soil type is Regosol, and, for the mostly covered by the *sarcocaule* scrub (INEGI, 2009). In general, the land is used in vegetable agriculture and the sowing of fodder for livestock.

Sampling method

The quadrant method was selected (Ferro-Díaz, 2015; Pequeño *et al.,* 2017) to describe the arboreal, shrub and herbaceous vegetation at the sampling site. Twenty 5 m × 5 m quadrants were delimited with metal stakes at an approximate distance of 100 m between them; its geoposition was taken at the vertex of each one of them with a *Garmin Oregon* 650 GPS. Inside each quadrant, the following data were taken: number of species and of individuals per species, height (cm) crown width (cm) and crown length (cm) of each plant with a 10 m Truper tape.

The results thus measured were used to determine the ecological indicators of Relative Abundance (AR_i), Relative Dominance (DR_i) and Relative Frequency (FR_i) of each species in the 20 quadrants. These data were used in the calculation of the

Importance Value Index (*IVI*), which obtains values on a scale from 0 to 100 expressed in per cent (García and Zavala, 2018). The formulas for each indicator are shown below (Marroquín *et al*., 2017):

$$A_i = \frac{N}{S} \qquad AR_i = \left(\frac{A_i}{\sum A_i}\right) * 100$$

Where:

AR_i = Relative abundance of the *i* species, in respect to total abundance

A_i = Number of individuals of the *i* species

$\sum A_i$ = Sum of the number of individuals of all species

S = Sampling area (ha)

$$Di = \frac{Ab(i)}{S(ha)} \qquad DR_i = \left(\frac{D_i}{\sum D_i}\right) * 100$$

Where:

DR_i =Relative dominance of the *i* species, in respect to total dominance

D_i = Absolute dominance of individuals

$\sum D_i$ = Sum of the dominance of individuals of all species

S = Area (ha)

$$F_i = \frac{P_i}{NS} \qquad FR_i = \left(\frac{F_i}{\sum F_i}\right) * 100$$

Where:

FR_i = Relative frequency of the *i* species*,* in respect total frequence

F_i = Number of quadrants in which the species is present

$\sum F_i$ = Sum of the number of quadrants in which all the species are present

P_i = Number of quadrants in which the *i* species is present

NS = Total number of sampling sites

$$IVI = (AR_i + DR_i + FR_i)/3$$

Where:

IVI= Importance Value Index

AR_i = Relative abundance of the *i* species in respect to total abundance

DR_i = Relative dominance of the *i* species in respect to total dominance

FR_i = Relative frequency of the *i* species in respect to total frequency

In the same way, the Margalef index (*S´*) was determined to know the diversity of species and the Shannon-Wienner index (*H'*) for species richness (Marroquín *et al.,* 2017) and finally the Jaccard similarity index between the quadrants sampled in the two periods (I_j) (Reyes and Torres-Florez, 2009), using the following formulas:

$$\boldsymbol{S' = \frac{S - 1}{ln\, N}}$$

Where:

S´= Margalef index

S = Number of species

ln = Natural logarithm

N = Total number of individuals

$$H' = -\sum_{i=1}^{S} p_i * ln\,(p_i)$$

$$p_i = n_i/N$$

Where:

H' = Shannon-Wienner diversity índex

S = Number of present species

ln = Natural logarithm

p_i = Rate of the *i* species

n_i= Number of individuals of the *i* species

N= Total number of individuals

$$I_j = \frac{c}{a+b-c}$$

Where:

I_j = Jaccard similarity index

a = Number of species present at the A quadrant

b = Number of species present at the B quadrant

c = Number of species present at both A and B quadrants

Samplings were carried out in the same quadrants, in the wet season (September 28 to November 2, 2018) and dry (May 27 to August 5, 2019); It should be noted that rain events were delayed during these activities.

Data analysis

The information was analyzed using a multivariate test to detect the differences between each season (wet and dry), coverage and species similarity in each quadrant, using the Past 3.2 program (Medina *et al.,* 2017). For the statistical analysis of the data, the SPSS version 22.0 package was used (IBM, 2013), using the non-parametric test for Wilcoxon-dependent samples, for the variables of Abundance (N ha^{-1}), Dominance (m^2 ha^{-1}), Species diversity (*H´*) and Species richness (*S´*) in order to detect differences between the wet and dry seasons (Ramírez *et al*., 2013). Each one of the species and families sampled throughout the investigation, were corroborated with what was published in the work of Rebman and Roberts (2012) referring to the botany of the *Baja California* peninsula.

Results

Floristic composition

A total of 1 466 individuals of 60 species and 27 families were gathered during the wet season. The largest number of species was recorded for the families Asteraceae and Fabaceae (8), followed by Cactaceae (7), Euphorbiaceae (6), Solanaceae and Rhamnaceae (3 each), Burseraceae, Amaranthaceae, Acanthaceae and Malvaceae (2 each), the other families present a single species, for the wet season. In the dry season, a total of 168 individuals from 27 species and 14 families were recorded, which were distributed as follows: from highest to lowest diversity: Cactaceae (7), Euphorbiaceae (4), Fabaceae (4) and Malvaceae (2), the other families showed only one species per family.

Ecological indicators

Table 1 orders the results obtained in the two seasons of the year, and Table 2 lists the families and life forms of each species recorded in the research.

Table 1. List of observed species, with their respective values of Relative Abundance, Relative Dominance, Relative Frequency and Importance Value Index, at the site known as *Palmar de Abajo* Ranch, during the wet and dry seasons.

Vegetal species	Wet season				Dry season			
	A_r (%)	D_r (%)	F_r (%)	*IVI* (%)	A_r (%)	D_r (%)	F_r (%)	*IVI* (%)
Acacia farnesiana (L.) Willd.	0.136	0.109	0.575	0.82	0.595	0.659	1.220	2.474
Adelia virgata Brandegee	0.455	1.844	1.054	3.352	0.794	1.296	0.813	2.903
Agave deserti Gentry	0	0	0	0	0.397	0.050	0.407	0.853
Amaranthus fimbriatus (Torr.) Benth.	0.182	0.002	0.479	0.663	0	0	0	0
Ambrosia bryantti (Curran) Payne	0.023	0	0.096	0.119	0	0	0	0
Antigonon leptopus Hook & Arn.	0.659	2.459	1.149	4.268	0	0	0	0
Bahiopsis chenopodina (Greene) E.E.Schill. & Panero	0.114	0.083	0.192	0.389	0	0	0	0
Bebbia juncea (Benth.) Greene	0.045	0.003	0.096	0.144	0	0	0	0
Boerhavia coulteri (Hook. F.) S. Watson	2.206	0.757	1.245	4.207	0	0	0	0
Bourreria sonorae S. Watson	0.068	0.134	0.192	0.394	0.397	0.537	0.407	1.340
Bursera microphylla A. Gray	0.75	0.213	1.149	2.113	0	0	0	0
Bursera odorata Brandegee	0.25	1.074	0.383	1.707	0	0	0	0
Calliandra californica (Benth.) D. Gibs.	0.546	0.509	0.575	1.629	0	0	0	0
Celosia floribunda A. Gray	0.023	0.002	0.096	0.12	0	0	0	0
Chamaesyce polycarpa (Benth.) Millsp. ex Parish	1.182	0.125	0.862	2.169	0	0	0	0
Cnidoscolus angustidens Torr.	0.296	0.379	0.575	1.25	0.992	0.272	1.220	2.484
Colubrina glabra S. Watson	0.091	0.327	0.192	0.609	0	0	0	0
Condalia globosa I.M. Johnston	0.705	0.395	0.287	1.388	0	0	0	0

Cryptostegia grandiflora Roxb. ex R.Br.	0.296	0.051	0.287	0.634	0	0	0	0
Cylindropuntia cholla (Engelm. & Bigelow) F.M. Knuth	0.409	0.393	1.149	1.952	2.579	2.217	4.065	8.862
Cylindropuntia molesta (Brandegee) F.M.Knuth	0.091	0.151	0.192	0.433	0.992	1.193	0.813	2.998
Cyperus hermaphroditus (Jacq.) Standl.	0.114	0.01	0.096	0.219	0	0	0	0
Cyrtocarpa edulis Standl.	0.296	0.318	0.766	1.38	0.397	0.097	0.407	0.900
Datura discolor Bernh.	0.023	0.002	0.096	0.12	0	0	0	0
Euphorbia californica Boiss.	2.683	0.603	0.958	4.243	1.984	0.101	0.407	2.491
Ferocactus chrysacanthus (Orcutt) Britton & Rose	0.045	0.001	0.096	0.142	0.595	0.033	0.813	1.441
Fouquieria diguetti (Tiegh.) I. M. Johnst.	0.659	2.33	1.341	4.331	0.198	1.017	0.407	1.621
Haematoxylon brasiletto H. Karst.	0.091	0.823	0.192	1.105	0	0	0	0
Ibervillea sonorae (S. Watson) Green	0.023	0	0.096	0.119	0	0	0	0
Ipomea meyeri G.Don	0.091	0.081	0.192	0.364	0	0	0	0
Ipomopsis tenuifolia (A. Gray) V. Grant	0.477	0.047	0.383	0.908	0	0	0	0
Jatropha cinerea (Ortega) Muell.-Arg.	1.728	7.155	1.82	10.70	0	0	0	0
Jatropha cuneata Wiggins & Rollins	0.841	1.297	0.575	2.713	0	0	0	0
Karwinskia humboldtiana Zucc.	0.045	0.27	0.096	0.411	0	0	0	0
Krameria parvifolia Benth.	0.136	0.409	0.383	0.929	0.794	1.431	1.220	3.444
Lippia palmeri S. Watson	1.933	1.502	1.054	4.489	0	0	0	0
Lycium brevipes Benth.	0.227	0.641	0.575	1.444	0.595	1.212	0.813	2.621
Mammillaria armillata K.Brandegee	2.478	0.014	1.533	4.025	4.563	0.027	2.846	7. 436
Melochia tomentosa L.	0.296	0.202	0.862	1.36	1.190	0.213	1.626	3.029
Merremia aurea (Kellogg) O'Donell	0.159	0.104	0.383	0.646	0	0	0	0
Mimosa distachya Cav. Vent.	0.091	0.032	0.192	0.315	0.794	0.154	0.407	1.354
Olneya tesota A. Gray.	0.114	0.187	0.479	0.78	0.198	0.314	0.407	0.919
Pachycereus pringlei (S. Watson) Britton & Rose	0.296	0.407	0.575	1.277	2.183	0.363	2.439	4.985

Parkinsonia florida (Benth. ex A. Gray) S. Watson	0.023	0.076	0.096	0.195	0	0	0	0
Pectis rusbyi Greene ex A. Gray	1.432	0.038	0.862	2.333	0	0	0	0
Perityle californica Benth.	0.045	0.005	0.096	0.146	0	0	0	0
Perityle incompta Brandegee	0.023	0.017	0.096	0.135	0	0	0	0
Porophyllum crassifolium S.Watson	0.591	0.367	0.862	1.82	0	0	0	0
Portulaca halimoides L.	2.024	0.03	0.287	2.341	0	0	0	0
Proboscidea altheifolia (Benth.) Decne.	0.045	0.026	0.192	0.263	0	0	0	0
Prosopis articulata S. Watson	0.182	1.948	0.575	2.705	1.19	9.295	2.033	12.51
Ruellia californica I.M. Johnst.	2.501	2.519	2.012	7.032	4.167	4.848	3.252	12.26
Rynchosia pyramidalis (Lam.) Urb.	0.273	0.464	0.096	0.833	0	0	0	0
Sida xanti A. Gray	0.455	0.042	0.958	1.454	0.198	0.877	0.407	1.482
Solanum hindsianum Benth.	0.432	0.266	0.575	1.272	1.389	0.068	1.626	3.083
Sonchus oleraceus L.	0.136	0.009	0.287	0.433	0	0	0	0
Stenocereus gummosus (Engelm.) A.Gibson &y K.E.Horak	0.364	0.78	0.766	1.911	2.778	4.621	2.846	10.24
Stenocereus thurberi (Engelm.) Buxb.	0.068	0.328	0.287	0.684	0.397	1.256	0.813	2.466
Tribulus terrestris L.	0.136	0.048	0.287	0.471	0	0	0	0
Turnera diffusa Willd. ex Schult.	3.206	0.916	1.341	5.463	2.778	0.4	1.22	4.398
Vallesia glabra (Cav.) Link	0	0	0	0	0.198	0.006	0.407	0.611
Yucca valida Brandegee	0.023	0.009	0.096	0.127	0	0	0	0
Total	33.33	33.33	33.34	100	33.33	33.33	33.34	100

A_r = Relative abundance (%), D_r = Relative dominance (%), F_r = Relative frequency (%), *IVI* = Importance Value Index (%).

Table 2. Floristic relationship ordered by family type, species and way of life.

Family	Species	Life form
Acanthaceae	*Ruellia californica* I.M. Johnst.	Herb
Agavaceae	*Yucca valida* Brandegee	Succulent
Amaranthaceae	*Amaranthus fimbriatus* (Torr.) Benth.	Herb
	Celosia floribunda A.Gray	Shrub
Anacardiaceae	*Cyrtocarpa edulis* Standl.	Succulent
Apocynaceae	*Vallesia glabra* (Cav.) Link	Shrub
Asclepiadaceae	*Criptostegia grandiflora*	Climbing
Asparagaceae	*Agave deserti* Gentry	Succulent
Asteraceae	*Bahiopsis chenopodina* (Greene) E.E.Schill. & Panero	Shrub
	Bebbia juncea (Benth.) Greene	Herb
	Ambrosia bryantti (Curran) Payne	Shrub
	Pectis rusbyi Greene ex A. Gray	Herb
	Perityle californica Benth.	Herb
	Perityle incompta Brandegee	Herb
	Porophyllum crassifolium S.Watson	Shrub
	Sonchus oleraceus L.	Herb
Boraginaceae	*Bourreria sonorae* S. Watson	Shrub
Burseraceae	*Bursera microphylla* A. Gray	Succulent
	Bursera odorata Brandegee	Succulent
Cactaceae	*Cylindropuntia cholla* (Engelm. & Bigelow) F.M. Knuth	Succulent
	Cylindropuntia molesta (Brandegee) F.M.Knuth	Succulent
	Ferocactus chrysacanthus (Orcutt) Britton & Rose	Succulent
	Mammillaria armillata K. Brandegee	Succulent

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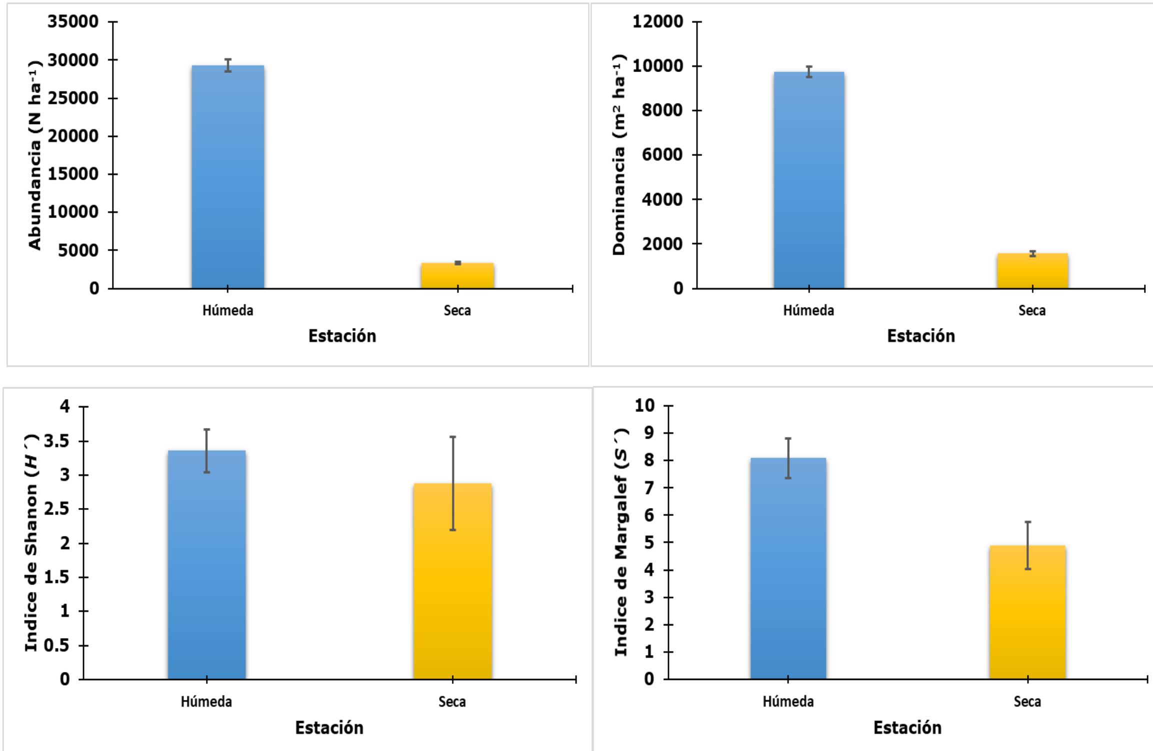
	Pachycereus pringlei (S. Watson) Britton & Rose	Succulent
	Stenocereus gummosus (Engelm.) A.Gibson & K.E.Horak	Succulent
	Stenocereus thurberi (Engelm.) Buxb.	Succulent
Convolvulaceae	*Ipomea meyeri* G.Don	Climbing
	Merremia aurea (Kellogg) O'Donell	Climbing
Cucurbitaceae	*Ibervillea sonorae* (S. Watson) Green	Climbing
Cyperaceae	*Cyperus hermaphroditus* (Jacq.) Standl.	Herb
Euphorbiaceae	*Adelia virgata* Brandegee	Shrub
	Chamaesyce polycarpa (Benth.) Millsp. ex Parish	Herb
	Cnidoscolus angustidens Torr.	Herb
	Euphorbia californica Boiss.	Shrub
	Jatropha cinerea (Ortega) Muell.-Arg.	Succulent
	Jatropha cuneata Wiggins & Rollins	Succulent
Fabaceae	*Acacia farnesiana* (L.) Willd.	Shrub
	Calliandra californica (Benth.) D. Gibs.	Shrub
	Haematoxylon brasiletto H. Karst.	Shrub
	Mimosa distachya Cav. Vent.	Shrub
	Olneya tesota A. Gray.	Tree
	Parkinsonia florida (Benth. ex A. Gray) S. Watson	Tree
	Prosopis articulata S. Watson	Tree
	Rynchosia pyramidalis (Lam.) Urb.	Climbing
Fouqueriaceae	*Fouquieria diguetti* (Tiegh.) I. M. Johnst.	Tree
Kramariaceae	*Krameria parvifolia* Benth.	Shrub
Malvaceae	*Melochia tomentosa* L.	Shrub a
	Sida xanti A. Gray	Herb
Martyniaceae	*Proboscidea altheifolia* (Benth.) Decne.	Herb
Nyctaginaceae	*Boerhavia coulteri* (Hook. F.) S. Watson	Herb
Polemoniaceae	*Ipomopsis tenuifolia* (A. Gray) V. Grant	Herb
Polygonaceae	*Antigonon leptopus* Hook & Arn.	Climbing

Portulacaceae	*Portulaca halimoides* L.	Herb
Rhamnaceae	*Colubrina glabra* S. Watson	Shrub
	Condalia globosa I.M. Johnston	Shrub
	Karwinskia humboldtiana Zucc.	Shrub
Solanaceae	*Datura discolor* Bernh.	Herb
	Lycium brevipes Benth.	Shrub
	Solanum hindsianum Benth.	Shrub
Turneraceae	*Turnera diffusa* Willd. ex Schult.	Shrub
Verbenaceae	*Lippia palmeri* S. Watson	Shrub
Zygophyllaceae	*Tribulus terrestris* L.	Herb

The *IVI* results show among the main species *Jatropha cinerea* with 10.7 %, *Ruellia californica* I.M. Johnst, with 6.7 %, *Turnera diffusa* Willd. ex Schult. with 5.46 %, *Lippia palmeri* S. Watson with 4.48 % and *Fouquieria diguetti* with 4.33 %, as species with the highest *IVI* for the rainy season (wet). In contrast, for the dry season, an *IVI* was obtained in *Ruellia californica* of 12.48 %, *Prosopis articulata* S. Watson with 11.76 %, *Stenocereus gummosus* with 9.87 %, *Cylindropuntia cholla* Engelm. & Bigelow) F.M. Knuth with 8.61 % and *Mammillaria armillata* K. Brandegee with 7.7 %, with the highest values in the dry season. The richness (*S´*) of species is greater for the rainy season, with an *S´* = 8.09 and for the dry season an *S´* = 4.88 is shown.

For the diversity of species (*H´*), in the rainy season a value of *H´* = 3.36 was observed and in the dry season a value of *H´* = 2.88, which indicates high diversity during the wet season, as expected, which coincides with the results of Alanís *et al*. (2015a) in this type of scrub in *Nuevo León*. For abundance (N ha^{-1}) and dominance (m^2 ha^{-1}), significant differences were detected between the two seasons (p = 0.000087) and (p = 0.000085), respectively, which is extensive for diversity (*H´*) and species richness (*S´*) (p = 0.000088) between the two seasons (Figure 2).



Estación = Season; Abundancia = Abundance; Dominancia = Dominance; Índice de Shannon = Shannon Index; Húmeda = Wet; Seca = Dry.

Figure 2. Abundance (N ha^{-1}), Dominance (m^2 ha-^{1}), Shannon-Wienner Index and Margalef Index during the wet and dry seasons of the study site. The bars indicate the values found for the different variables, with differences (p = ≤0.05) between the two seasons.

Floristic similarity

The Jaccard index shows values of I_j = 38.71, in species similarity between the two seasons. The results show similarities between sites 16, 17, 18 and 19 (I_j> 0.05) through the dendogram (Figure 3) with coverage (m^2 * quadrant) and species in common, in each of the quadrants (*Cilindropuntia cholla, Pachycereus pringlei* and *Stenocereus gummosus*). Those with the greatest similarity between seasons are 16 and 19 (I_j = 0.06) and coincide with species such as *Acacia farnesiana, Bourreria sonorae, Cylindropuntia cholla, Cnidoscolus angustidens, Krameria parvifolia, Mammillaria armillata, Prosopis articulata, Ruellia californica, Solanum hindsian*

Stenocereus gummosus and *Turnera diffusa*. The other group of quadrants that indicates homogeneity in coverage and species are sites 8 and 13 (I_j <0.05) with *Cylindropuntia cholla, Cnidoscolus angustidens, Ferocactus chrysacanthus* and *Mammillaria armillata.*

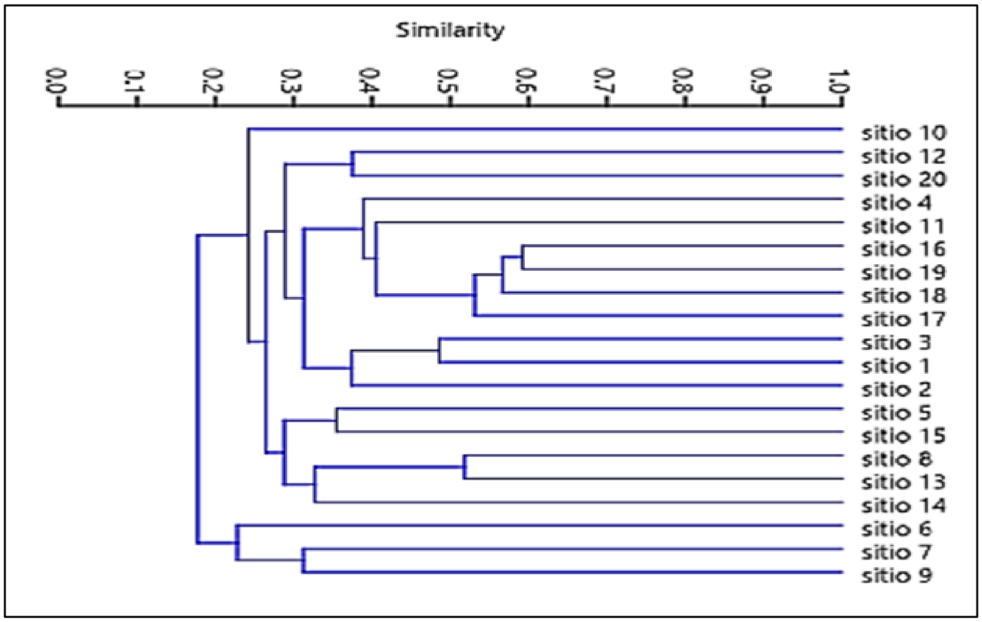


Figure 3. Dendrogram of floristic similarity between sites sampled for the two seasons.

Discussion

The *sarcocaule* scrub is characterized by the presence of arboreal and shrub species and, in general, of *Jatropha cinerea, Stenocereus gummosus, Fouquieria diguetti Cylindropuntia cholla* and *Prosopis articulata* as the most important taxa for the ecosystem, as documented by Velderrain *et al.* (2010) in his research on mounds with this type of scrub on the outskirts of the city of *La Paz*. However, these authors do not refer to the existence of *Lippia palmeri* and *Turnera diffusa* in their study, which can be explained because these species are located in the south of the municipality and not near the bay of *La Paz.*

Rascón *et al*. (2018) mention *Lippia palmeri* and *Turnera diffusa* with high value of importance in the municipality of *Todos Santos*, *Baja California Sur*, particularly in the *Sierra de La Laguna*, which is an area close to the study area and shows a botanical composition similar to that of the *La Matanza* valley.

Regarding the diversity of species, the presence of different families within this type of scrub favors a high index of diversity and richness of species (H' = 3.36 and 2.88, S'= 8.09 and 4.88, for the wet and dry seasons, respectively) in this study, which is consistent with that obtained by Alanís *et al.* (2015b), in the submontane scrub around *Monterrey, Nuevo León*; they proved that this type of vegetation can have values of H' = 3 for the Shannon-Wienner index and for the Margalef index, S'= 6, since values less than 2 are considered of low diversity and richness.

Based on the above, the values of the present study for species diversity (H') are good for this index in both seasons, and in turn, are similar to those of other scrub research studies such as those of Molina *et al.* (2013); Medina *et al.* (2015) and González *et al.* (2017). On the other hand, those of wealth are higher in the rainy season and slightly lower in the dry season (S' = 8.09 and 4.88, respectively), which contrasts with that obtained by Medina *et al.* (2017) and with that of Marroquín *et al.* (2017), which show a low Margalef index in a xerophilous scrub (S'= 0.87 and 1.80). This is explained by the effect of the restoration of the vegetation and is lower than the data from the study described here for the wet and dry seasons.

Finally, the Jaccard similarity index indicates few similar quadrants in terms of species in common between the two seasons, since the climatic conditions determine the presence of some of them as well as families according to the season of the year, such as González *et al.* (2010), Domínguez *et al*. (2013) and Ramírez *et al.* (2013).

Conclusions

The described study provides data about the botanical composition of *Palmar de Abajo* Ranch, which belongs to the town of *La Matanza*, with the presence of *sarcocaule* scrub that is very diverse and rich in species. Knowledge of the type of families and genera of this site is relevant, since the abundance, dominance and frequency of taxa seem to be subject to seasonal changes in the seasons. A considerable reduction of species was observed between the two seasons evaluated (wet and dry), when the drought conditions are present.

Therefore, the results gathered here can serve as a basis to develop strategies for the conservation and monitoring of the flora of this area, since it presents some protected species. It would be convenient to update the list of species, carry out these analyzes regularly and cover more extensive areas in order to enrich the information provided.

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Conflict of interest

The authors declare that they have no conflict of interest.

Contribution by author

Emanuel Junco Carlón: manuscript writing, design and sampling of the experiment; Humberto González Rodríguez: design of the experiment, writing and correction of the manuscript; José Ángel Armenta Quintana: correction of the manuscript and sampling of the experiment; Israel Cantú Silva: review, correction and edition of the manuscript; Andrés Eduardo Estrada Castillón: review and edition of field data and manuscript correction; Mauricio Cotera Correa: review and correction of the manuscript; Marco Vinicio Meza Gómez: statistical data analysis and interpretation of results.

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