DOI: 10.29298/rmcf.v13i73.1271

Article

Caracterización del arbolado urbano del centro de Hualahuises, Nuevo León

Urban tree characterization in the downtown area of Hualahuises, Nuevo León

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Fecha de recepción/Reception date: 20 de abril de 2022
Fecha de aceptación/Acceptance date: 22 de julio del 2022

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Abstract

Trees are an important resource in urban areas due to the environmental services they provide. The objective of this study was to evaluate the floristic composition, structure, and diversity of urban trees in the center of *Hualahuises*, *Nuevo León*. The urban trees of the public spaces in the center of *Hualahuises* were evaluated, covering the public squaresand sidewalks. Total height, normal diameter and crown diameter were measured for each tree. For each species, abundance, cover, and frequency were determined to obtain its Importance Value Index. Species richness was also determined using the Margalef index, Shannon's diversity index, and the number of effective species. 38 species of vascular plants distributed in 35 genera and 22 families were recorded. 63.20 % (25 species) are introduced and 36.85 % (21 species) are native. The most representative family was Fabaceae with four species. The graphs of diameter and height classes indicate the existence of a higher proportion of individuals with small diameters ($d_{1.30}$<5 cm) and intermediate heights (h>3 m and <6 m). The plant community presents intermediate-high values of richness and high values of diversity of species compared to other urban green areas of northeastern Mexico. More than half (63 %) of the species are introduced, among which *Fraxinus americana* and *Thuja occidentalis* stand out for their Importance Value Index. The native species with the highest importance value was *Quercus virginiana*.

Key words: Green areas, urban forests, species diversity, introduced species, native species, species richness.

Resumen

Los árboles constituyen un recurso importante en las zonas urbanas debido a los servicios ambientales que brindan. El objetivo de este estudio fue evaluar la composición florística, estructura y diversidad del arbolado urbano del centro de Hualahuises, Nuevo León. Se evaluó el arbolado urbano de los espacios públicos del centro de Hualahuises, abarcando las plazas públicas y aceras. A cada árbol se le midieron su altura total, el diámetro normal y diámetro de copa. Para cada especie se determinó su abundancia, su cobertura, y su frecuencia, para obtener su Índice de Valor de Importancia. También se determinó la riqueza de especies mediante el índice de *Margalef*, el índice de diversidad de *Shannon*, y el número de especies efectivas. Se registraron 38 especies de plantas vasculares distribuidas en 35 géneros y 22 familias. El 63.20 % (25 especies) son introducidas y el 36.8

% (21 especies) son nativas. La familia más representativa fue Fabaceae con cuatro especies. Los análisis de clases diamétricas y de altura indican una mayor proporción de individuos con diámetros bajos ($d_{1.30}$<5 cm) y alturas intermedias (h>3 m y <6 m). La comunidad vegetal presenta valores intermedios-altos de riqueza y altos de diversidad de especies comparado con otras áreas verdes urbanas del noreste de México. Más de la mitad de las especies (63 %) son introducidas, entre las cuales *Fraxinus americana* y *Thuja occidentalis* sobresalen por su Índice de Valor de Importancia. La especie nativa con mayor valor de importancia fue *Quercus virginiana*.

Palabras clave: Áreas verdes, bosques urbanos, diversidad de especies, especies introducidas, especies nativas, riqueza de especies.

Introduction

Trees are an important resource in urban areas for the environmental services they provide to society, mainly for their ornamental role or scenic beauty (Corona, 2021). The foliage and fruit of the trees offer habitat, shelter and food for birds, insects, and other animal groups that have adapted to live in anthropized ecosystems (de Almeida y Cándido *et al.*, 2017). In addition, urban trees are a source of oxygen, an significant carbon sink and contribute to lower the temperature at the microclimate level (Livesley *et al.*, 2016).

Although the study of urban forests has its foundations about two centuries ago, interest in their study has increased notably in recent years, especially in Latin America (Devisscher *et al.*, 2022). In Mexico, in particular, the creation of new urban forests has been supported for centuries, among the first very notorious are the *Alameda Central* and *Bosque de Chapultepec* in Mexico City (Benavides and Fernández, 2012). The latter was created by King *Netzahualcayotl*, who planted the first *ahuehuetes* (*Taxodium* spp.) in 1430 (Alcántara, 2019). Currently, urban trees are characteristic in large and small cities of the national territory.

In the case of northeastern Mexico, research on urban forests has been concentrated in the state of *Nuevo León* and more intensely in the metropolitan area of *Monterrey* (Rocha *et al.*, 1998; Alanís, 2005, 2011). Recently, studies of urban trees have been carried out in smaller cities such as *Linares* (Leal *et al.*, 2018) and *Montemorelos* (Canizales *et al.*, 2020). However, there are still some municipalities in *Nuevo León*, such as *Hualahuises*, where knowledge about their urban trees is still scarce.

Hualahuises is not a large place, although its artisan tradition and its deep-rooted culture of indigenous origin favored its nomination as Magical Town in 2015. Despite not having very big areas with urban trees, in this municipality there are green areas in squares, gardens and along streets and avenues. Given that until now the current state of the trees in this place was unknown, the present study was carried out with the objective of evaluating the floristic composition, structure and diversity of its urban trees.

Materials and Methods

Study area

The study was carried out in the *Hualahuises* municipality, *Nuevo León* State (northeast Mexico), located between 24°51’09” north and 99°46’22” west, at 405 meters above sea level. The predominant climate is semi-warm sub-humid with rains in summer. The average annual temperature is 20 to 24 °C, with a rainfall range of 700–900 mm. The dominant soil type is Vertisol (INEGI, 2009).

Field evaluation

In January 2022, the urban trees in public spaces in the center of *Hualahuises* were evaluated, covering public squares and sidewalks. All individuals of arboreal and shrubby size with a normal diameter ($d_{1.30}$ m) ≥1 cm were measured. The dendrometric variables evaluated were total height (*h*), which was measured with a model III Haglöf Vertez III® hypsometer, normal diameter ($d_{1.30}$ m), with a model 283D/5m Forestry Suppliers Inc™ diameter tape, and crown diameter (*k*) with a 50 m fiberglass model TP50ME Truper™ tape. To verify the correct nomenclature of the species, the Tropicos® platform (Tropicos, 2022) was used. The botanical material was identified with the help of the use of dendrological keys and was deposited in the herbarium of the Graduate School of Forest Sciences, *Universidad Autónoma de Nuevo León*.

Data analysis

For each species its abundance was determined, according to the number of trees, its coverage depending on the crown area, and its frequency based on its presence in the sections of the park (it was divided into four sections) (Alanís *et al.*, 2020).

To evaluate the crown, the crown surface area (*ASC*) (Rodríguez-Laguna *et al.*, 2009) and the crown volume (V_{copa}) (Mõttus *et al.*, 2006; Zhu *et al.*, 2021) were estimated. The *ASC* is known as the most active photosynthetic region of the crown where light radiation is absorbed and comprises the lateral surface of the crown without the shadow surface of the crown (Rodríguez-Laguna *et al.*, 2009) and is expressed in m^2. The volume of the tree crown is a basic characteristic of the tree because it correlates with the production of forest biomass and the most relevant environmental and ecosystem functions, such as carbon sequestration and the reduction of air pollution (Zhu *et al.*, 2021).

The relativized variables were used to obtain a weighted value at the taxon level called the Urban Importance Value Index (*IVIU*), which acquires percentage values on a scale of 0 to 100. This index is intended to rank the importance of each species in a horizontally by including abundance, dominance and frequency, as well as vertically and three-dimensionally, by including height, volume and crown surface area (Saavedra-Romero *et al.*, 2019). This index has turned out to be successful in measuring the importance value of urban trees, since it makes the calculation of the *IVI* more robust and complete by including four crown variables in its quantification: (a) the composite volume of the crown, (b) crown surface area (composite-three-dimensional variables) and two absolute variables, (c) crown density, and (d) live crown proportion (Saavedra-Romero *et al.*, 2019).

Species richness was also determined using the Margalef index (D_{Mg}), the Shannon diversity index, and the number of effective species (^{1}D) (Jost, 2006; Cultid-Medina and Escobar 2019). Table 1 lists the formulas for calculating the *IVIU* and the species diversity indices.

Table 1. Formulas used to determine the structural and diversity indexes of the species.

Formula	Where

$A_i = \frac{N_i}{S}$ $AR_i = \left[A_i / \sum_{i=1}^{n} A_i\right] \times 100$	A_i = Absolute abundance AR_i = Relative abundance per species N_i = Number of individuals of the *i* species S = Sampling area (ha)
$D_i = \frac{G_i}{S}$ $DR_i = \left[D_i / \sum_{i=1}^{n} D_i\right] \times 100$	D_i = Absolute dominance DR_i = Relative dominance of the *i* species with respect to total dominance G_i = Basimetric area of the *i* species S = Area (ha)
$F_i = \frac{P_i}{NS}$ $FR_i = \left[F_i / \sum_{i=1}^{n} F_i\right] \times 100$	F_i = Absolute frequency FR_i = Relative frequency of the *i* species with respect to total frequency P_i = Number of sites where the *i* species is present NS = Total number of sampling sites
$ASC = \frac{\pi \times r}{6LC^2}[(4LC^2 + r^2)^{1.5} - r^3]$	ASC = Canopy or crown area r = Canopy or crown radius LC = Canopy or crown length
$V_{copa} = \left(\frac{4}{3} \times \pi \times DC^3 \times LC\right) \times {}^{1}/_{8}$	V_{copa} = Canopy or crown volume Π = 3.1416 DC = Canopy or crown diameter LC = Canopy or crown length
$IVIU = \frac{\sum_{i=1}^{n}(AR_i, DR_i, FR_i, ASC, V_{copa})}{5}$	AR_i = Relative abundance by species with respect to the total density DR_i = Relative dominance of the *i* species with respect to the total dominance FR_i = Relative frequency of the *i* species with respect to the total frequency. ASC = Canopy or crown area V_{copa} = Canopy or crown volume
$H' = -\sum_{i=1}^{S} p_i \times ln(p_i)$ $p_i = n_i / N$	H' = Shannon-Weiner index S = Number of present species N = Total number of individuals n_i = Species number of individuals ln = Natural logarithm

$D_{Mg} = \frac{S-1}{\ln(N)}$	D_{Mg} = Margalef index S = Number of present species N = Total number of individuals ln = Natural logarithm
${}^{1}D = exp(H')$	${}^{1}D$ = Number of effective species exp = Exponential H' = Shannon-Weiner index

Results

38 species of vascular plants distributed in 35 genera and 22 families were recorded, 63.2 % (25 species) are introduced and 36.8 % (21 species) are native. The most representative family was Fabaceae with four species, followed by Arecaceae, Fagaceae and Rutaceae with three species each (Table 2).

Table 2. Abundance, basal area, canopy area, frequency, canopy area, canopy volume and Urban Importance Value Index (*IVIU*) of tree, shrub and palm species in *Hualahuises* downtown.

Species	Family	Origin	Abundance		Basimetric area		Canopy area		Frequency		Supposed canopy area		Canopy volume		*IVIU*
			Absolute	Relative	Absolute (m²)	Relative %	Absolute (m²)	Relative %	Absolute No. sites	Relative %	Absolute (m²)	Relative %	Absolute (m³)	Relative %	
Fraxinus americana L.	Oleaceae	Introduced	38	9.90	2.07	30.56	826.00	17.93	4	4.88	1 492.43	17.61	852.11	33.09	16.68
Quercus virginiana Mill.	Fagaceae	Native	83	21.61	1.04	15.33	977.43	21.22	4	4.88	1 717.43	20.27	391.46	15.20	16.64
Thuja occidentalis L.	Cupressaceae	Introduced	35	9.11	0.93	13.79	748.16	16.24	4	4.88	1 074.04	12.67	439.01	17.05	11.99
Cordia boissieri A.DC.	Cordiaceae	Native	34	8.85	0.43	6.33	411.31	8.93	4	4.88	782.37	9.23	144.12	5.60	7.50
Ligustrum lucidum W. T. Aiton	Oleaceae	Introduced	21	5.47	0.17	2.53	158.31	3.44	4	4.88	338.07	3.99	48.91	1.90	3.93
Morus celtidifolia Kunth	Moraceae	Native	10	2.60	0.21	3.10	191.91	4.17	3	3.66	333.13	3.93	111.15	4.32	3.74
Quercus macrocarpa Michx.	Fagaceae	Introduced	8	2.08	0.29	4.35	155.50	3.38	4	4.88	251.44	2.97	73.25	2.84	3.23
Washingtonia filifera (Gloner ex Kerch., Burv., Pynaert, Rodigas & Hull) de Bary	Arecaceae	Introduced	11	2.86	0.31	4.60	61.59	1.34	4	4.88	388.62	4.59	38.49	1.49	3.03
Lagerstroemia indica L.	Lythraceae	Introduced	15	3.91	0.04	0.60	91.90	2.00	4	4.88	178.32	2.10	21.46	0.83	2.74
Ehretia anacua (Terán & Berland.) I. M. Johnst.	Ehretiaceae	Native	8	2.08	0.14	2.04	88.56	1.92	3	3.66	182.35	2.15	48.45	1.88	2.34
Syagrus romanzoffiana (Cham.) Glassman	Arecaceae	Introduced	4	1.04	0.16	2.29	101.75	2.21	1	1.22	214.27	2.53	81.63	3.17	2.03
Nerium oleander L.	Apocynaceae	Introduced	8	2.08	0.03	0.48	51.47	1.12	4	4.88	116.06	1.37	10.68	0.41	1.97
Tecoma stans (L.) Juss. ex Kunth	Bignoniaceae	Native	16	4.17	0.01	0.11	34.47	0.75	2	2.44	76.21	0.90	2.75	0.11	1.67
Eriobotrya japonica (Thunb.) Lindl.	Rosaceae	Introduced	11	2.86	0.04	0.56	49.40	1.07	2	2.44	104.42	1.23	15.52	0.60	1.64
Leucophyllum frutescens (Berland.) I. M. Johnst.	Scrophulariaceae	Native	11	2.86	0.01	0.15	27.74	0.60	3	3.66	55.96	0.66	2.17	0.08	1.57
Helietta parvifolia (A. Gray ex Hemsl.) Benth.	Rutaceae	Native	9	2.34	0.03	0.42	75.80	1.65	1	1.22	139.86	1.65	25.29	0.98	1.57
Psidium guajava L.	Myrtaceae	Native	7	1.82	0.04	0.62	42.74	0.93	3	3.66	72.87	0.86	6.32	0.25	1.50
Acer negundo L.	Sapindaceae	Native	4	1.04	0.10	1.47	86.01	1.87	1	1.22	136.91	1.62	42.10	1.63	1.48
Prosopis laevigata (Humb. & Bonpl. ex Willd.) M.C. Johnst.	Fabaceae	Native	1	0.26	0.07	1.06	78.54	1.71	1	1.22	103.60	1.22	76.09	2.95	1.47
Delonix regia (Bojer ex Hook.) Raf.	Fabaceae	Introduced	7	1.82	0.11	1.63	51.83	1.13	2	2.44	100.43	1.19	17.98	0.70	1.45
Jacaranda mimosifolia D. Don	Bignoniaceae	Introduced	3	0.78	0.11	1.55	65.44	1.42	1	1.22	149.97	1.77	43.18	1.68	1.37

Melia azedarach L.	Meliaceae	Introduced	4	1.04	0.02	0.29	23.84	0.52	3	3.66	50.35	0.59	8.25	0.32	1.23
Quercus rubra L.	Fagaceae	Introduced	4	1.04	0.05	0.78	39.97	0.87	2	2.44	73.95	0.87	9.96	0.39	1.12
Prunus persica (L.) Batsch	Rosaceae	Introduced	4	1.04	0.00	0.07	17.02	0.37	2	2.44	34.99	0.41	1.89	0.07	0.87
Platanus occidentalis L.	Platanaceae	Native	1	0.26	0.06	0.86	30.19	0.66	1	1.22	73.63	0.87	29.77	1.16	0.83
Phoenix roebelenii O'Brien	Arecaceae	Introduced	8	2.08	0.11	1.55	10.32	0.22	1	1.22	24.85	0.29	0.46	0.02	0.77
Cupressus sempervirens L.	Cupressaceae	Introduced	3	0.78	0.04	0.55	2.48	0.05	2	2.44	14.30	0.17	0.22	0.01	0.69
Pseudobombax ellipticum (Kunth) Dugand	Malvaceae	Introduced	1	0.26	0.03	0.42	35.78	0.78	1	1.22	47.27	0.56	15.85	0.62	0.69
Moringa oleifera Lam.	Moringaceae	Introduced	2	0.52	0.00	0.01	3.28	0.07	2	2.44	8.38	0.10	0.29	0.01	0.63
Grevillea robusta A. Cunn. ex R. Br.	Proteaceae	Introduced	1	0.26	0.01	0.22	14.86	0.32	1	1.22	30.71	0.36	5.84	0.23	0.48
Citrus limon (L.) Osbeck	Rutaceae	Introduced	3	0.78	0.01	0.09	6.85	0.15	1	1.22	14.01	0.17	0.49	0.02	0.47
Persea americana Mill.	Lauraceae	Introduced	2	0.52	0.02	0.24	10.70	0.23	1	1.22	20.83	0.25	1.93	0.07	0.46
Calia secundiflora (Ortega) Yakovlev	Fabaceae	Native	1	0.26	0.02	0.31	14.19	0.31	1	1.22	26.46	0.31	4.62	0.18	0.46
Citrus sinsensis (L.) Osbeck	Rutaceae	Introduced	1	0.26	0.02	0.24	12.25	0.27	1	1.22	19.25	0.23	2.63	0.10	0.42
Yucca filifera Chabaud	Asparagaceae	Native	2	0.52	0.01	0.19	2.37	0.05	1	1.22	10.46	0.12	0.18	0.01	0.38
Ficus benjamina L.	Moraceae	Introduced	1	0.26	0.04	0.57	3.30	0.07	1	1.22	8.55	0.10	0.38	0.01	0.33
Leucaena leucocephala (Lam.) de Wit	Fabaceae	Introduced	1	0.26	0.00	0.00	1.89	0.04	1	1.22	5.68	0.07	0.15	0.01	0.32
Forestiera angustifolia Torr.	Oleaceae	Native	1	0.26	0.00	0.00	0.64	0.01	1	1.22	1.49	0.02	0.01	0.00	0.30
		Sum	384	100	6.77	100	4 605.81	100	82	100	8 473.92	100	2 575.01	100	100

According to the characterization, the abundance of individuals was 384, the total basal area (dominance) of the urban trees was 6.77 m^2, with 4 605.81 m^2 of crown area. Based on the vertical and three-dimensional attributes, the crown area was 8 473.92 m^2 and the crown volume was 2 575.01 m^3. The four species with the highest values in all the variables were *Fraxinus Americana* L., *Quercus virginiana* Mill., *Thuja occidentalis* L. and *Cordia boissieri* A. DC. (Table 2).

The two species with the highest Importance Value Index were *Fraxinus americana* (introduced species) and *Quercus virginiana* (native species). In addition, *Q. virginiana* showed the highest abundance values (obtaining a value more than double that of *F. americana*), crown area and presumed crown area, while *F. americana* presented the highest values of basimetric area and crown volume, in both variables obtained values of almost double that of *Q. virginiana* (Table 2).

Figure 1 shows the graph of diameter classes. The curve describes a negative exponential trend, as the number of individuals decreases as the normal diameter increases. This revealed that a high number of individuals with small diameters and a low number of individuals with high diameters prevail. In total, 136 individuals with a normal diameter less than 5 cm and 34 >30 cm were counted.

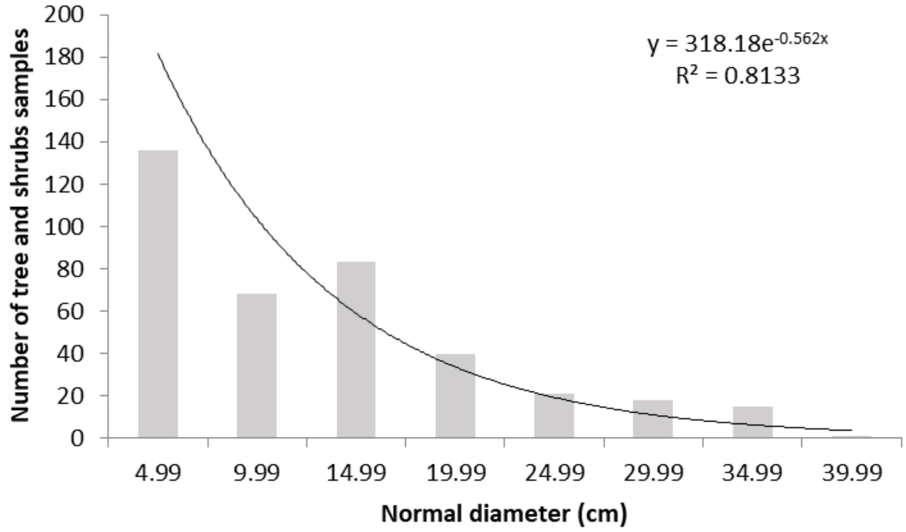

Figure 1. Number of tree and shrubs samples in *Hualahuises* downtown based upon normal diameter (cm).

Figure 2 illustrates height classes, in which it is noted that the greatest presence of trees was recorded in the 3 to 5.99 m category with 192 individuals, followed by the ≤2.99 m category with 100 samples. There are few individuals with a height greater than 12 m. The distribution of the specimens with respect to their height category represented a positive asymmetric distribution.

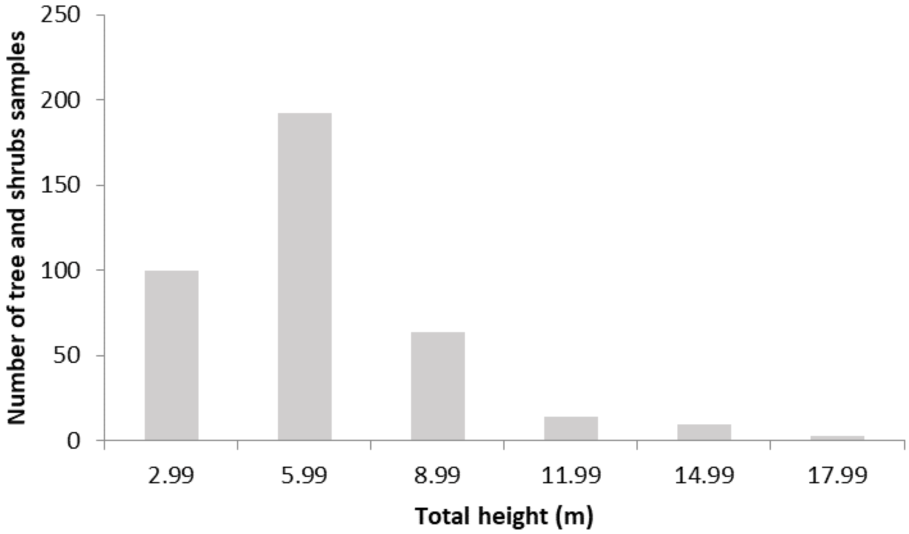

Figure 2. Number of tree and shrubs samples in *Hualahuises* downtown based upon total height (m).

According to the richness and diversity indexes, the evaluated plant community recorded a D_{Mg} Margalef index of =6.21 and a Shannon entropy index of H'=2.94. Shannon's true diversity index was 18.93.

Discussion

38 species were recorded in *Hualahuises* downtown, a value higher than the 13 species reported by Canizales *et al*. (2020) in the green areas of *Montemorelos*, but similar to the 41 species by Leal *et al*. (2018) in the green areas of *Linares*, to the 39 species declared by Zamudio (2001) in *Linares* downtown and to the 39

inventoried by Alanís *et al*. (2014) in a university *campus* also in *Linares* municipality. Qualitative research carried out in the *Monterrey* Metropolitan Area (AMM), *Nuevo León* State, has recorded 115 species (Alanís, 2005) and up to 137 (Rocha *et al.*, 1998).

The Fabaceae family was the most representative with four species. These findings are consistent with the results of Alanís (2005), Alanís *et al.* (2014), Leal *et al.* (2018) and Canizales *et al*. (2020), who conducted their studies in northeastern Mexico with similar data. The families that follow are Arecaceae, Fagaceae and Rutaceae with three species each. From them, all three species of Arecaceae and two species of Fagaceae and Rutaceae are introduced.

In the present study, 63.2 % (25 species) introduced and 36.8 % (21 species) native were recorded. These results are common in the region, as found in Canizales *et al* (2020) who determined 54 % of introduced species in *Montemorelos*, in the study by Alanís (2005) identified 53 % of introduced species in *Monterrey* Metropolitan Area and in Martínez-Trinidad *et al*. (2021) work, 61 % are introduced in three parks in Mexico City. This pattern of more introduced than native species is recognized in much of the world and is related to the increase in the production of ornamental trees in nurseries (Pagès i Clavaguera, 2005).

Fraxinus americana reached the highest value of Urban Importance Value Index, with 16.7 %. Various studies have established this species as the most ecologically important in urban green areas in northeastern Mexico (Rocha *et al.*, 1998; Alanís *et al.*, 2014; Leal *et al.*, 2018; Canizales *et al.*, 2020). Alanís (2005) explained that it was frequently includedd in urban reforestation in northeastern Mexico in the 1980's, even earlier, but this species was no longer used in the early 1990's, when natives began to be used.

The second species with the highest urban importance value was *Quercus virginiana* with 16.64 %. Leal *et al.* (2018) and Canizales *et al.* (2020) also recorded *Q.*

virginiana as the second most important species in *Linares* and *Montemorelos*, *Nuevo León*, and Alanís *et al.* (2014) identified it as the most significant in a university *campus* in northeastern Mexico. Their high presence is related to the greater preference for incorporating them in the green areas of the cities of northeastern Mexico during the 1990's (Alanís, 2005).

Thuja occidentalis was the third species with a high urban importance value. It is exotic as it is native to eastern Canada and much of north central and northeastern United States (Housset *et al.*, 2015); it is an evergreen conifer of the Cupressaceae family. It was introduced to several cities in Mexico, such as *Guadalajara* (MacGregor-Fors, 2008), *Monterrey* (Rocha *et al*., 1998) and *Linares* (Leal *et al*., 2018) among others, due to its beauty and resistance to frost (Alanís, 2011).

The graph of diameter classes (Figure 1) showed a negative exponential trend, since the number of individuals decreases as the normal diameter increases; therefore, it is concluded that a large part of the arboreal individuals in *Hualahuises* are young samples. These results are similar to those provided by Martínez-Trinidad *et al.* (2021) in four parks in Mexico City, but opposed to the positive asymmetric distribution identified by Leal *et al.* (2018) and Canizales *et al.* (2020) in the green areas of cities in northeastern Mexico. The greater presence of juvenile arboreal individuals than adults may be associated with the fact that afforestation activities have intensified in cities in recent years (Alanís, 2005).

The height class plot (Figure 2) depicts a positive skewed distribution. This behavior was similar to that reported by Leal *et al.* (2018) and Canizales *et al.* (2020) in urban green areas of *Linares* and *Montemorelos*, respectively. Most of the trees are between 2 and 5.99 m tall, similar to the results of Canizales *et al.* (2020) in *Montemorelos*, but opposite to those of the *Linares* trees (Leal *et al.,* 2018), which with higher height (from 6.40 to 9.60 m) already prevail. The size of the *Hualahuises* trees may be a response to their youth (Alanís, 2005), or to the fact that they have been pruned, since their vertical development interferes with cable lines and public lighting (Macías-Sámano, 2010).

The Margalef richness index (D_{Mg}=6.21) suggests a medium-high diversity, a value similar to the 7.62 recorded by Alanís *et al.* (2014) for the urban trees of a university *campus* in *Linares*, *Nuevo León*, and at 5.24 of Leal *et al.* (2018) for the one corresponding to the city of *Linares*. The Shannon-Wiener index value was 2.94. Ortíz and Luna (2019) took the value of 1.50 as the minimum criterion for the Shannon diversity index in an urban area, so, in reference to the same, the results indicate high diversity. This value of 2.94 is higher than the 1.17 reported by Canizales *et al.* (2020) in *Montemorelos* and at 1.99 recorded by Leal *et al.* (2018) in *Linares*, but lower than 3.89 registered by Martínez-Trinidad *et al.* (2021) in Mexico City.

Conclusions

Individuals with small diameters are the most abundant ($d_{1.30}$ <5 cm), as well as those of intermediate heights (h>3 m and <6 m), which indicates a young plant community. Species richness presents intermediate values and high diversity, compared to that of other urban green areas in northeastern Mexico. More than half (63 %) of the species are introduced, among which *Fraxinus americana* and *Thuja occidentalis* stand out for their Importance Value index. In this context, the native species with the highest value is *Quercus virginiana*.

This research could provide important information on which tree species are most successful in urban reforestation in the city of *Hualahuises*, *Nuevo León* State.

Acknowledgements

The authors thank the staff of *RENAC S.A. de C.V.* company for their support in the field activities, as well as Israel Garza Gaona and Guadalupe Pérez Malacara.

Conflict of interests

The authors declare no conflict of interest.

Contribution by author

Eduardo Alanís-Rodríguez: manuscript development and statistical analysis; Arturo Mora-Olivo: interpretation of results; Víctor Manuel Molina-Guerra: data analysis; Homero Gárate-Escamilla: review of the manuscript; José Ángel Sigala Rodríguez: statistical analysis.

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