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Article

Diversidad, estructura y servicios ecosistémicos del arbolado en cuatro parques de Texcoco mediante *i-Tree Eco*

Diversity, structure and ecosystem services of trees in four parks in *Texcoco* using *i-Tree Eco*

Tomás Martínez-Trinidad[1*], Pablo Hernández López[1], Stephanie Fabiola López-López[2] y Leopoldo Mohedano Caballero[3]

Resumen

El objetivo fue conocer la estructura, diversidad y los servicios ecosistémicos del arbolado en cuatro parques de la ciudad de Texcoco de Mora, Estado de México. Se realizó un censo y análisis de los árboles existentes en las áreas verdes seleccionadas. Se determinó una población arbórea compuesta por 391 individuos, pertenecientes a 19 familias y 34 especies. Los taxones más comunes fueron *Ficus benjamina* (23 %), *Schinus molle* (13.8 %), *Hesperocyparis lusitanica* (10.2 %) y *Ligustrum lucidum* (10 %). El índice de *Simpson* (1-*D*) presentó un valor de 0.73 y el índice de *Shannon-Wiener* *H'*= 3.89, lo que indica una alta diversidad. Las tres especies más abundantes sobrepasan la regla de diversidad 10-20-30 de *Santamour.* Se estimaron tres servicios ecosistémicos principales a través del *software i-Tree Eco* v6: almacén de C, captura de C y producción de O_2. El arbolado evaluado almacenó 28.85 Mg C ha^{-1}, capturó 2.56 Mg C $año^{-1}$ y produjo un total de 6 Mg O_2 $año^{-1}$. Además de lo anterior, se calculó que los árboles removieron un total de 0.06 Mg $año^{-1}$ de contaminantes y contribuyeron a reducir la escorrentía del agua de lluvia en 107.9 m^3 $año^{-1}$. La información generada es útil para la administración y conservación del recurso arbóreo, así como en la valoración del arbolado de la ciudad de Texcoco.

Palabras clave: Bosque urbano, captura de Carbono, inventario arbóreo, servicios ambientales, valoración del arbolado, remoción de contaminantes.

Abstract

The purpose of this work was to know the structure and diversity, and ecosystem services provided by the trees at four parks in the city of *Texcoco de Mora*. A census and analysis of the tree composition in the green areas was carried out. A tree population composed of 391 individuals belonging to 19 families and 34 species was determined. The most common species were *Ficus benjamina* (23 %), *Schinus molle* (13.8 %), *Hesperocyparis lusitanica* (10.2 %), and *Ligustrum lucidum* (10 %). Simpson's index (1-*D*) had a value of 0.73, and the Shannon-Wiener index (*H*') equaled 3.89, which indicates a high diversity. The three most abundant species recorded do not comply with 10-20-30 rule. The *i-Tree Eco* v6 software was used to estimate that the trees store 28.85 Mg C ha^{-1}, capture 2.56 Mg C yr^{-1}, produce a total of 6 Mg O yr^{-1}, remove a total of 0.06 Mg yr^{-1} of pollutants, and contributes to reduce runoff by 107.9 m^3 yr^{-1}. This information is useful for the management and tree conservation, as well as in the valuation of trees in the city of *Texcoco.*

Key words: Urban forest, carbon sequestration, tree inventory, environmental services, tree valuation, pollution removal.

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[1]Colegio de Postgraduados. Posgrado en Ciencias Forestales. México.
[2]Consultora de Programas Internacionales, US Forest Service
[3]Universidad Autónoma Chapingo. División de Ciencias Forestales. México.
[*]Autor para correspondencia; correo-e: tomtz@colpos.mx

Introduction

The structure, diversity and health condition of trees directly and indirectly influence environmental quality and human well-being (Nowak *et al*., 2007; Benavides and Fernández, 2012; Pérez *et al.,* 2018). In fact, diversity, structure and distribution are the most relevant characteristics for the evaluation of the condition of urban green areas (Savard *et al*., 2000).

Species diversity is recognized as an important attribute in stability, as it provides tree stands with resistance to diseases, pests and environmental variations (Bourne and Conway, 2014). Knowledge of the composition, diversity and structure of tree species contributes to the understanding of the dynamics of the urban forest and facilitates the definition of strategies for its management (Islas-Rodríguez *et al.,* 2012; Sánchez-Gutiérrez *et al.,* 2017). For example, tree diversity and structure indicators are part of the diagnosis of the health status of tree stock (Saavedra-Romero *et al.,* 2019), and they also support the definition of areas for reforestation and the management of public trees (Leal *et al.,* 2018). However, information on urban green areas in Mexico is still scarce (Leal *et al*., 2018).

City dwellers are placing increasing importance on green spaces as essential components of the urban landscape and infrastructure (Alanís *et al.,* 2014). Among them, public parks are a category for recreation and leisure purposes (Flores-Xolocotzi and González-Guillén, 2010). In this sense, urban parks provide various ecosystem services, such as pollutant removal, carbon storage and sequestration, runoff reduction, among others (López–López *et al.,* 2018). It should be noted that the number of benefits that trees provide are directly related to their health condition (Saavedra-Romero *et al.,* 2016).

Estimation of the ecosystem services of trees is complex; however, there are now specialized computer programs available for this purpose; for example, the i-Tree tools (Cowett, 2014), developed by the United States Forest Service (USFS) and other partners (USDA, 2018). In particular, i-Tree Eco was recently adapted for use in Mexico (USDA, 2018) and is useful for assessing urban forest structure, quantifying carbon capture and sequestration, removing air pollutants, reducing storm water runoff, and determining the economic value attributed to these services (Martin *et al.,* 2011).

The main objective of this study was to know the structure, diversity, and the ecosystem services of trees in four parks in the city of *Texcoco de Mora*, in order to contribute to their management, conservation and valuation.

Materials and Methods

Study area

The study was conducted in four of the best known and most visited parks in the city of *Texcoco de Mora*, State of Mexico: a) the Central Park, with a surface area of 8 700 m^2 (19°30’51” N and 98°52’58” O); b) the Senior Citizen Park, with a surface area of 9 000 m^2 (19°30’ 35” N and 98°53’08” O); c) the *Niños Héroes* Park, with 1 655 m^2 (19°30’32” N and 98°52’32” O), and d) the *Silverio Pérez* Sports Complex, with a surface area of 4 027 m^2 (19°31’12” N and 98°53’06” O) (Figure 1).

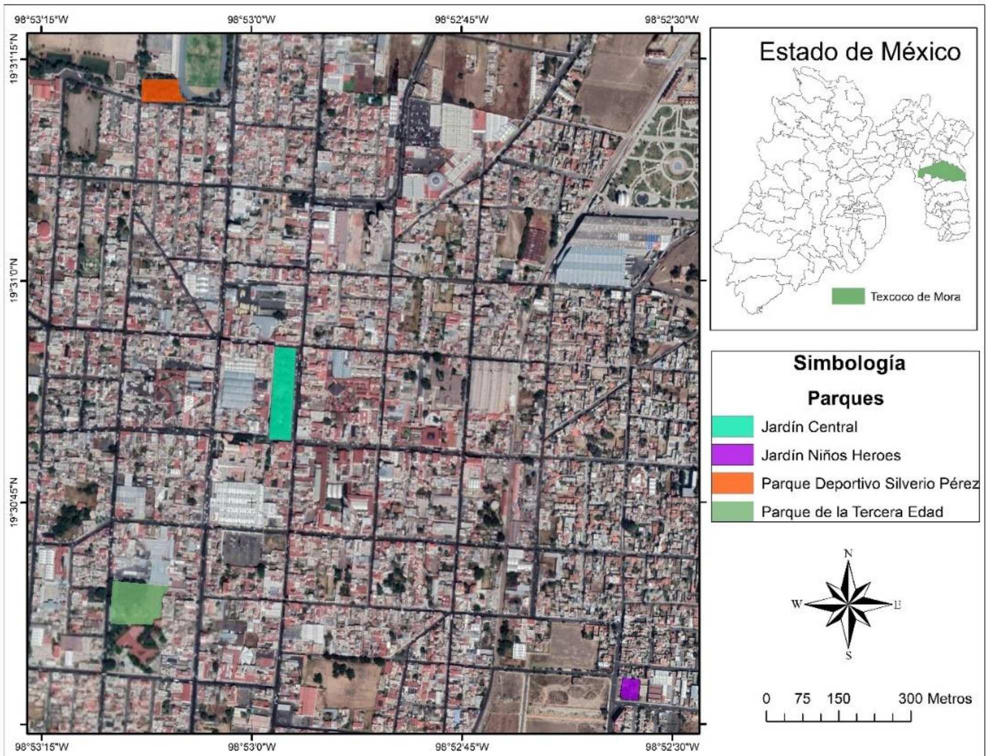

Figure 1. Location of the four selected parks in the city of *Texcoco de Mora*, State of Mexico.

Tree inventory

A census of the trees present in the four green areas under study was carried out; the measurements were made according to the i-Tree ECO v6 data collection manual (USDA, 2018). The species of each tree was recorded in the field and numbered on a sketch; in case of doubt, botanical samples were taken to the herbarium of the *Colegio de Postgraduados* for identification by specialists. Their normal diameter (D_n) was measured with a 10 m diameter tape (Forestry Suppliers® Model 283D/10M), and the diameter of the crown, with a 50 m measuring tape (Truper® Model TFC-50ME Code 12647), based on its length in two directions: north-south and east-west. The total height of each specimen, the height of the live crown and the height of the base of the crown were also measured with a Haga altimeter (Haga GmbH + Co KG®). The percentage of missing crown foliage, the percentage of regressive death, and the crown exposure to light were estimated. The survey was conducted from November 2018 to February 2019.

Diversity

Alpha diversity was calculated using Simpson's index (1-*D*), which provides a good estimate of diversity in relatively small samples (Magurran, 2004), like those evaluated in this work. The Shannon-Wiener index (*H*'), which is non-parametric and measures species richness, abundance and evenness, was also utilized (Bourne and Conway, 2014). Finally, Santamour's 10-20-30 diversity rule was used as a reference (1990), i.e., as an indicator of tree diversity to prevent pests and diseases in the urban forest (Canizales *et al.,* 2020).

Simpson's index was determined according to the following equation (Bouza and Covarrubias, 2005):

$$D = \sum_{i=1}^{S} p_i^{2} \quad (1)$$

Where:

D = Simpson's index

S = Number of species present

p_i = Proportion of individuals in the i^{th} species

As *D* increases, diversity decreases; therefore, Simpson's index is generally expressed as 1-*D* and will be referred to as such in this research. The Shannon index (*H*') corresponds to a positive number, which has a normal value between 2 and 3; values above 3 indicate a high diversity (Mora-Donjuán *et al*., 2017). This index was calculated using the following equation (Magurran, 2004):

$$H' = -\sum_{i=1}^{S} p_i * \ln(p_i) \quad (2)$$

Where:

H' = Shannon's Index

S = Number of species present

P_i = Proportion of recorded individuals of the i^{th} species

Based on the information obtained from the tree inventory and the results of the i-Tree ECO v6 software, a descriptive analysis of the number of trees by species, genus and families existing in the four evaluated parks was carried out in order to relate them and determine whether they comply with Santamour's diversity rule (1990), according to which individuals of the same taxon should not exceed 10 %, specimens of a genus should not exceed 20 %, and trees of a family should not exceed 30 % of the total tree population.

Data analysis

The census data were recorded in a spreadsheet of the 2016 Microsoft Excel® software and subsequently exported to the i-Tree ECO v6 software. In addition, due to their recent adaptation for Mexico, the following items were quantified: carbon (C) storage and sequestration, (O_2) oxygen production, removal of air pollutants (O_3, CO, NO_2, SO_2, and $PM_{2.5}$), and reduction of surface runoff.

A price of $10 USD per ton of CO_{2e}, which is the average value estimated in the informal carbon market in Mexico, was considered for estimating the price of C storage and capture (USDA, 2018). For the valuation of runoff prevention and pollutant removal, the prices used in the United States, standardized to Mexico and proposed in i-Tree Eco v6, were considered: $2.14 USD per m^3 of prevented runoff, $1 532.80 per Mg of CO, $24 961.90 per Mg of O_3, $1 358.4 USD per Mg of SO_2, $3 728.40 per Mg of NO_2, and $866.00, $474.7 USD per Mg of $PM_{2.5}$.

Results and Discussion

Composition

In the four parks studied in the city of *Texcoco*, a total of 391 trees belonging to 19 families and 34 species were recorded (Table 1). The average density was 167 trees ha^{-1}; this value is lower than that of the city of *Montemorelos, Nuevo León*, of 194.6 trees ha^{-1} (Canizales *et al.,* 2020). However, it is higher than that documented for urban trees in the city of Linares (75.43 trees ha^{-1}) (Leal *et al*., 2018) and the cities of *Mérida* and *Playa del Carmen* with 96 trees ha^{-1} and 104 trees ha^{-1}, respectively (de la Concha *et al.,* 2017).

Table 1. Tree species and average dasometric variables of the trees present in four parks in the city of *Texcoco de Mora*.

Family	Species	Origin	Variables		
			D_n (cm)	H_t (m)	C_d (m)
Altingiaceae	*Liquidambar styraciflua* L.	Native	14.88	8.31	3.71
Anacardiaceae	*Schinus molle* L.	Introduced	29.17	9.55	4.75
Arecaceae	*Phoenix canariensis* L.	Introduced	60.11	13.39	6.86
	Roystonea regia Kunth.	Introduced	24.50	6.65	1.08
	Washingtonia robusta H. Wendl.	Native	96.00	12.00	5.13
Bignoniaceae	*Jacaranda mimosifolia* D. Don.	Introduced	49.68	11.23	7.38
Casuarinaceae	*Casuarina equisetifolia* L.	Introduced	22.46	9.50	3.40
Cupressaceae	*Cupressus macrocarpa* Hartw.	Introduced	48.00	18.00	13.50
	Cupressus sempervirens L.	Introduced	11.78	4.92	2.35
	Hesperocyparis lusitanica (Mill) Bartel	Native	23.22	9.68	3.24
	Taxodium macronatum Ten.	Native	31.42	9.96	4.29
Euphorbiaceae	*Euphorbia cotinifolia* L.	Native	14.00	4.00	3.85
Fabaceae	*Bauhinia variegata* L.	Introduced	13.50	7.00	6.23
Lauraceae	*Persea americana* Mill.	Native	33.00	5.20	2.10
Lythraceae	*Punica granatum* L.	Introduced	20.00	1.40	3.15
Magnoliaceae	*Magnolia glandiflora* L.	Introduced	22.75	8.25	3.54
Moraceae	*Ficus benjamina* L.	Introduced	22.61	5.79	2.76
	Ficus microcarpa Lf.	Introduced	21.93	4.01	2.39
Myrtaceae	*Eucalyptus camaldulensis* Dehnh.	Introduced	68.00	21.00	10.00
	Eucalyptus sp.	Introduced	42.83	13.47	4.71
Oleaceae	*Fraxinus uhdei* (Wenz.) Lingelsh.	Native	18.70	7.73	2.80
	Ligustrum lucidum WT Aiton.	Introduced	19.60	7.48	2.91
	Olea europaea L.	Introduced	35.00	7.50	6.75
Pinaceae	*Pinus chiapensis* Martínez.	Native	36.00	5.00	6.00
	Pinus greggii Englem.	Native	40.00	15.50	8.48
	Pinus maximinoi H.E. Moore.	Native	32.50	14.00	4.25
	Pinus sp.	Native	35.50	16.00	4.95
Rosaceae	*Eriobotrya japonica* Lindl.	Introduced	11.00	4.40	3.50
	Prunus persica L.	Introduced	12.38	5.45	4.14
	Prunus serotina Ehrh.	Native	10.00	5.90	4.70
Rutaceae	*Citrus x sinensis* Osbeck.	Introduced	15.50	5.10	3.20
Salicaceae	*Populus alba* L.	Introduced	21.75	8.00	3.15
	Populus nigra L.	Introduced	29.00	8.67	3.55
Ulmaceae	*Ulmus mexicana* (Liebm.) Planch.	Native	12.00	9.00	2.00
	Overall average		25.33	8.04	3.67

*D_n = Normal diameter, H_t = Total height, C_d = Crown diameter.

At the park level, the Central Park had a density of 181.6 trees ha^{-1}; the park with the greatest richness was Senior Citizens' Park, with 14 species. The most common taxa were *Ficus benjamina* L. (23 %), *Schinus molle* L. (13.8 %), *Hesperocyparis lusitanica* Mill. (10.2 %), and *Ligustrum lucidum* Ait. (10 %); which represented 57 % of the total tree population. In this regard, Dolan (2015) points out that, despite the significant reduction of urban green areas, they possess a great diversity of species, and exotic genera such as *Ficus, Jacaranda, Casuarina*, and *Ligustrum* are very frequent in these environments (Velasco *et al.,* 2013).

In the studied parks, *Ficus benjamina* was the most frequent in the Central Park; in the *Niños Héroes* Park, *Cupressus sempervirens* L. had the highest abundance, and exotic species even accounted for more than 60 % of the recorded population. Similar values have been cited in several studies; for example, 63 % of the urban tree stock in the city of Linares is constituted by introduced taxa (Leal *et al*., 2018); the same percentage is recorded in 21 median strips and six parks in the city of *Montemorelos* (Canizales *et al*., 2020), and they constitute 53 % of the total trees in the *Monterrey* Metropolitan Area (Alanís, 2005).

City parks are often composed of a mixture of species of different origins (Dolan, 2015; Saavedra-Romero *et al*., 2019). As a result, they have a higher diversity of trees compared to other types of landscapes. However, most of its taxa are of exotic origin, possibly as it is difficult to get native specimens in local nurseries. In addition, the lack of information on propagation, management and even the high production costs of native plants are some of the reasons for which the use of introduced species is preferred (Velasco *et al.,* 2013), even though long-term problems may occur and intensive management may be required (Muller and Bornstein, 2010). In this regard, the four parks analyzed have a very similar number of species among them, which is useful in the planning of urban tree management programs (Maco and McPherson, 2003; Benavides and Fernández, 2012; López-López *et al*., 2018).

Diversity

Simpson's index (1-*D*) showed a value of 0.73 for the four parks; this index measures both species diversity and species dominance. Therefore, the trees in the parks are considered to be relatively diverse, but there is a certain dominance of abundant species (Morales-Salazar *et al*., 2012). On the other hand, the value of the Shannon-Wiener index (*H*'= 3.89), which is a reasonable measure of the biological complexity (Lou and González-Oreja, 2012), indicates a high diversity (Mora-Donjuán *et al.,* 2017) in the study area (2.33 ha), and is similar to that calculated for the urban trees of a university faculty in *Nuevo León*, with *H*'= 3.05, in an area of 0.8 ha (Alanís *et al*., 2014). It is worth mentioning that it was higher than that cited for natural temperate forests, *H*'= 1.37 to 1.74 (Graciano-Ávila *et al.,* 2017; López-Hernández *et al.,* 2017). The above corroborates that there is greater diversity in urban forests than in natural temperate forests.

The three most abundant species (*Ficus benjamina, Schinus molle*, and *Hesperocyparis lusitanica*) failed to comply with Santamour's rule because they exhibited a frequency of over 10 %. In addition, the genus *Ficus* exceeded 20 % of the tree population; although no family had a value above 30 %. Therefore, these taxa may be susceptible to attacks by pests and diseases (Santamour, 1990).

Similar patterns have been determined for different urban areas; for example, in the *San Juan de Aragón Forest*, four tree species had a frequency above 10 %, and the *Casuarina* genus, of over 20 % (Saavedra-Romero *et al.,* 2019). Likewise, the three most frequent tree species at the *Montecillo campus* of the *Colegio de Postgraduados* not comply with Santamour's rule (Islas-Rodríguez *et al.,* 2012).

Structure

The average height of the inventoried individuals was 8±4.4 m, with an average crown diameter of 3.6±2.3 m. Therefore, most of the trees were considered to be small in size; however, some specimens of *Fraxinus uhdei*, *Eucalyptus* sp., and *Schinus molle* were recorded as having heights above 20 m.

Regarding the normal diameter, only 15.3 % of the total trees had a diameter of 38 cm, and 71.1 % had a diameter of 7.5 to 30 cm. This diameter distribution indicates that a large part of the trees in the evaluated parks are juvenile, although there were some large trees: 3.8 % with a D_n>68.6 cm (Figure 2).

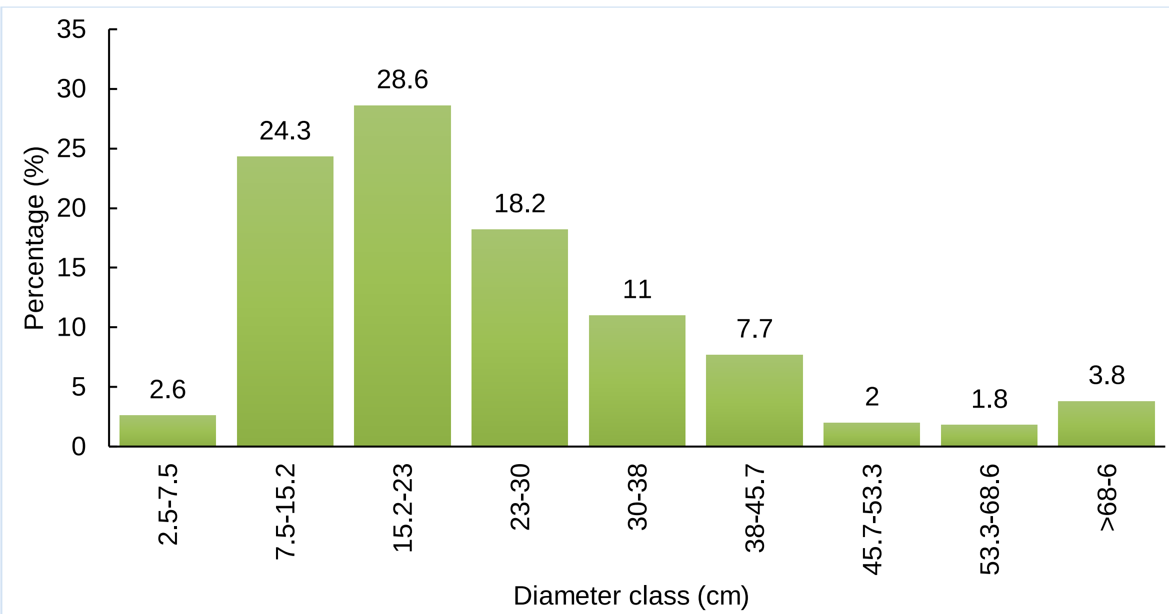

Figure 2. Percentage distribution by diameter class of trees inventoried in four parks of the city of *Texcoco de Mora*.

Ecosystem services

The carbon storage that was quantified in the study area with the i-Tree Eco program was 67.24 Mg, which is equivalent to 246.55 Mg of CO_2 sequestered. Likewise, it was estimated that trees store an average of 28.85 Mg C ha^{-1} (Table 1); this value is high compared to that reported for the city of *Mérida*, where 7.55 Mg ha^{-1} of C was calculated in urban trees (de la Concha *et al.,* 2017). However, the C storage per hectare in the four parks of the city of *Texcoco de Mora* was lower than the values documented by Santoyo-Gómez *et al.* (2014) in the *Miguel Hidalgo* demarcation (64 Mg C ha^{-1}) and by López-López *et al.* (2018) in the first section of the *Chapultepec* Forest (61.68 Mg C ha^{-1}), an area considered an important reservoir of C.

The Central Park had the highest value of stored C, as it is the largest; however, the *Silverio Pérez* Sports Complex registered the highest amount of C per hectare (41.9 Mg). As for the *Niños Héroes* Park, although it has the highest tree density, it exhibits the lowest carbon storage value. This is because it is the smallest assessed area, with 0.16 ha, and the density is expressed in trees ha^{-1}. Thus, only 43 individuals store C, which is the lowest number of trees evaluated in the four parks.

Regarding C sequestration, the total estimate for the four parks was 2.56 Mg yr^{-1}, which represents 9.39 Mg of CO_2. The estimated rate per surface area unit (1.06 Mg ha^{-1} yr^{-1}) was higher than that calculated for the city of *Mérida* (0.69 Mg C ha^{-1} yr^{-1}) by de la Concha *et al.* (2017). Notably, the Central Park stands out for its capture of this greenhouse gas, due both to its wooded area and to the presence of numerous young trees, which are in an active growth period (Table 2).

Table 2. Quantification of C storage and capture of the inventoried trees in four parks of the city of *Texcoco de Mora*.

Park	Density (trees ha^{-1})	Carbon storage (Mg)	Carbon capture (Mg yr^{-1})	Carbon storage (Mg ha^{-1})	Carbon capture (Mg ha^{-1} yr^{-1})
Central Park	182	30	1.33	34.48	1.53
Senior Citizens' Park	109	17.13	0.63	19.03	0.70
Niños Héroes Park	259	3.35	0.16	20.94	1.00
Silverio Pérez Sports Complex	229	16.76	0.43	41.90	1.08
Total	167	67.24	2.56	28.86	1.10

The oxygen production of trees is directly proportional to the amount of sequestered carbon, which in turn is linked to the accumulation of tree biomass (Nowak *et al.,* 2002). According to i-Tree Eco, the trees in the study area produce a total of 6 Mg O_2 yr^{-1}, and each surface area unit produces 2.5 Mg O ha^{-1} yr^{-1} (Table 3). In addition, the evaluated trees remove a total of 0.06 Mg yr^{-1} of air pollutants (O_3, CO, NO_2, SO_2, and $PM_{2.5}$); considered per surface area unit, this represents a removal of 25 kg ha^{-1} yr^{-1} of pollutants. The above values are higher than those recorded in other urban green areas; for example, in the city of Mérida, an oxygen production of 1.36 Mg ha^{-1} yr^{-1} and a pollutant removal of 7.3 kg ha-1 yr^{-1} were estimated (de la Concha *et al.,* 2017).

Table 3. Quantification of the pollutant removal and the runoff prevented by tree planting in four parks of the city of *Texcoco de Mora*.

Park	Density (trees ha^{-1})	Removal of pollutants (Mg yr^{-1})	Prevented runoff (m^3 yr^{-1})	Removal of pollutants (Mg ha^{-1} yr^{-1})	Prevented runoff (m^3 ha^{-1} yr^{-1})
Central Park	182	0.02	41.52	0.02	47.72
Senior Citizens' Park	109	0.02	34.05	0.02	37.83
Niños Héroes Park	259	0.01	8.37	0.06	52.31
Silverio Pérez Sports Complex	229	0.01	24	0.03	60.00
Total	167	0.06	107.94	0.03	46.33

The trees in the *Niños Héroes* Park contributed the most to the air pollutants removal (0.06 Mg ha^{-1}) and had the highest density of trees (259 trees ha^{-1}). In contrast, the Senior Citizens' Park obtained the lowest values of service generation per unit of surface area because it has a low density of trees (109 trees ha^{-1}) (tables 2 and 3).

Another benefit provided by trees is the avoided, as they intercept precipitation, and their root systems promote infiltration and storage of water in the soil (McPherson, 2007). The analysis of surface runoff reduction indicated that the evaluated tree stand contributed to avoid runoff by 107.9 m^3 yr^{-1} and represents a reduction of 46.3 m^3 ha^{-1} yr^{-1} per unit area (Table 3). Again, this value is higher than those estimated for the city of *Mérida* (19.04 m^3 ha^{-1} yr^{-1}) and for *Playa del Carmen* (36.98 19.04 m^3 ha^{-1} yr^{-1}) (de la Concha *et al.,* 2017).

As in the case of the C storage, the *Silverio Pérez* Sports Complex had the highest value for prevented runoff per unit of surface area, since it had a high density (229 trees ha^{-1}) and a significant proportion of large-sized individuals.

Large trees generally provide greater ecosystem benefits (more pollutant removal, higher carbon storage values) (Saavedra-Romero *et al.,* 2019). An example of this is the study by López-López *et al.* (2018), in which carbon storage were observed to be higher in areas with large trees, with a normal diameter of up to 148 cm, compared to sites whose specimens had smaller diameters (82 cm) and a low density. In addition, large trees generate more oxygen production. Therefore, an average of 30 trees are required to compensate for the annual oxygen consumption of an adult. However, in New Jersey the number was 81 trees, and in Frehold, 17 trees; this variation was a reflection of the different sizes of the trees (Nowak *et al.*, 2007).

Economic valuation

The valuation of the benefits quantified with the i-Tree Eco software is equivalent to MXN$244 427.8, of which MXN$192 639.17 are generated annually by the trees in the four parks evaluated. It is important to point out that trees have a greater economic importance in the removal of pollutants, since they have a value of more than MNX$ 180 000.00 per year (Figure 3). Based on the above, one hectare of green area produces MXN$82 677.8 of benefits per year.

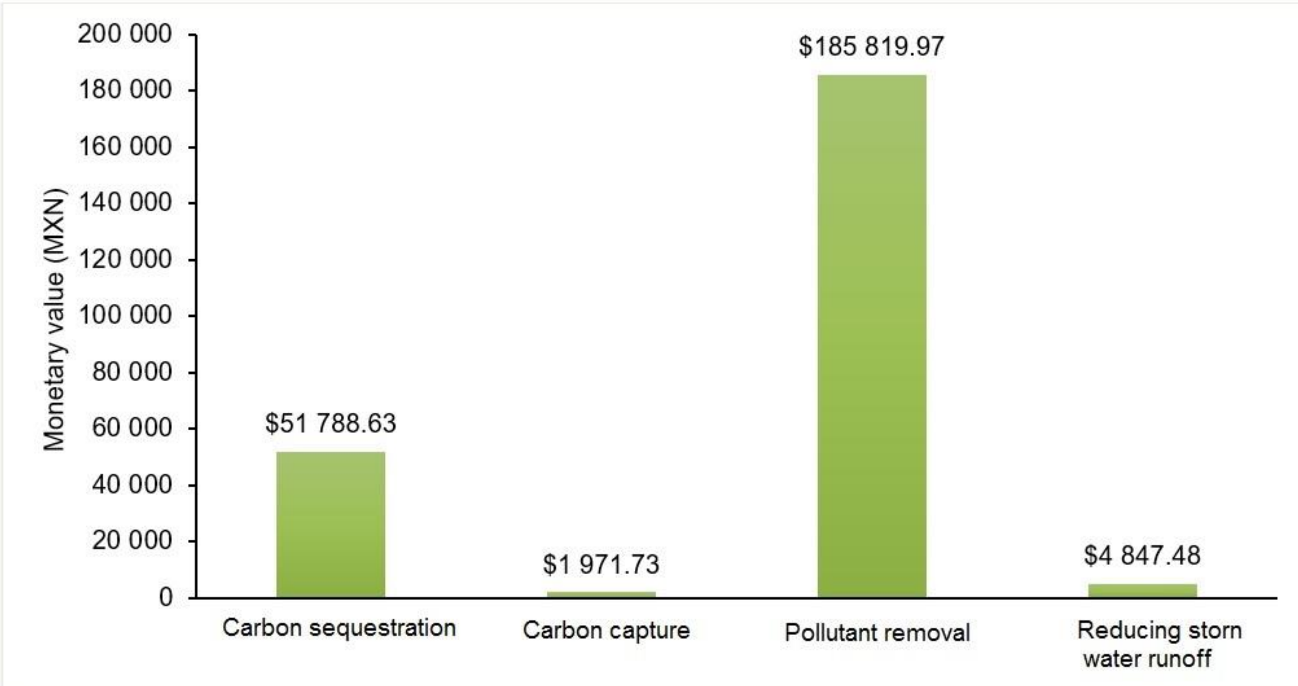

Figure 3. Economic value of the ecosystem services generated by trees in four parks of the city of *Texcoco de Mora*.

Conclusions

The dominance and frequency of species in the four evaluated parks mainly corresponds to exotic species, and they exhibit a high diversity *H*'. In these parks, the C storage represents 67.24 Mg, the C capture amounts to 2.56 Mg yr^{-1}, the trees produce 6 Mg O_2 yr^{-1}, runoff is reduced by 107.9 m^3 ha^{-1}, and 0.06 Mg of pollutants are removed every year. The i-Tree Eco software is a useful and easy to apply tool for the analysis of the structure, composition and ecosystem services of tree species in four parks of the city of *Texcoco de Mora*. The information generated thereby is useful for urban forest managers, as it contributes to the valuation of urban trees.

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Conflict of interest

The authors declare no conflict of interest.

Contributions by author

Tomás Martínez-Trinidad: project management, planning and monitoring, data analysis, and review of the manuscript; Pablo Hernández López: field data review and drafting of the manuscript; Stephanie Fabiola López-López: review of the data and of the manuscript; Leopoldo Mohedano Caballero: project monitoring and review of the manuscript.

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