

Article

Perceptions, Associated Drivers, and Bundles: An Assessment of Cultural Ecosystem Services in Urban Parks in the Latin American City of Xalapa, Mexico

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Abstract

In an increasingly urbanized world, green spaces provide Cultural Ecosystem Services (CES) that support human well-being and are often perceived as the most valued benefits in cities. Yet, their perception and co-occurrence remain underrepresented in Latin American regions. In this study, we assess the diversity and bundling of CES perceived by visitors across five urban parks in the Mexican city of Xalapa, Veracruz, and examine how park identity (synthesizing park-specific ecological and structural characteristics) and sociodemographic factors influence these perceptions. Using a mixed-methods approach, we analyzed 373 surveys using general linear models. We identified 13 CES, with an average of three services per park. ‘Recreation’, ‘Mental health’, ‘Physical health’, and ‘Contact with nature’, the most frequently mentioned services, together with ‘Social relations’, consistently formed a dominant CES bundle, suggesting patterns in how cultural benefits are co-experienced. Park identity, visitor Age, and Gender were key predictors of CES perception variation, highlighting joint spatial and social influences. By integrating CES bundles with park-specific characteristics and sociodemographic drivers, this study advances current understanding of CES perception comprehensively and demonstrates that CES are not uniformly experienced across urban green spaces, underscoring the need for context-sensitive planning and management that account for both place identity and user diversity.

Keywords: CES bundles; mixed-methods approach; nature’s intangible values; park visiting motives; social preferences; urban ecology; urban green spaces; visitor’s perception



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1. Introduction

Ecosystems supply goods and services to people, favoring human well-being [1,2]. In urban environments, ecosystem services are provided by a wide range of urban green spaces (UGS)—including parks, gardens, and street trees—[3]. These services include the promotion of physical, mental, and emotional health, and have served as a foundation for the preservation and creation of green spaces in cities [4,5]. In many urban contexts, UGS are often the only places where people can interact directly with nature [6,7].

Among the ecosystem services provided by UGS, Cultural Ecosystem Services (CES), defined as non-material benefits obtained through personal experiences and direct interactions with ecosystems and nature [3,8,9], are often the most recognized by citizens [10] and are strongly linked to the local context, reflecting circumstances, spatial arrangements, and temporal changes [11]. Different CES can also be region- and community-specific, depending on the capabilities, preferences, and cultural background of those who benefit from them [6,12].

CES may be perceived differently by people even within a relatively homogeneous local context [13], creating specific profiles. Furthermore, the types and intensities of CES experienced in UGS can vary according to visitors' sociodemographic characteristics—such as Age, Sex, and Educational level—which influence how people interact with nature [14,15].

Still, CES are deeply interrelated and are not typically perceived by people as discrete categories. Instead, individuals tend to experience these services as intertwined values that emerge through holistic interactions with ecosystems [10]. These sets of CES are referred to as “bundles” [16], which provide a useful framework for evaluating ecosystem services by capturing the full spectrum of people's perceptions [17]. Analyzing these co-occurrence patterns helps to understand which combinations of benefits are most relevant for the population and, consequently, informs the management, design, and urban planning of UGS to maximize their collective cultural value [18].

CES studies are particularly important in the regional context of Latin America, where they remain scarce and where historical, biological, social, and economic conditions differ markedly from those in other regions [17,19]. In this context, the present study aims to identify and analyze the CES provided by UGS—specifically, five urban parks—through visitors' perceptions in the neotropical city of Xalapa, Veracruz, and the pattern of bundles that emerge from them in both quantitative and qualitative terms. We also aim to evaluate the relationship between the CES provided and both the urban parks' identity (a synthesis of the combination of ecological characteristics and built infrastructure that distinguishes each urban park) and the sociodemographic characteristics of the visitors.

Besides providing empirical evidence from a Latin American context, our study contributes to knowledge of urban environmental systems and ecosystem services by offering a more comprehensive perspective on how CES are experienced in urban green spaces. By combining qualitative identification with quantitative analyses, it captures complementary dimensions of CES and CES bundles that may not be fully represented by a single methodological approach. Furthermore, the study offers additional insights into the factors shaping human–nature interactions in urban parks by evaluating the influence of individual-level drivers (e.g., age and gender) and place-based drivers (i.e., park identity) on CES perception.

Finally, our findings highlight the value of assessing CES for supporting context-sensitive planning, management, and conservation of UGS through evidence-based decision-making that accounts for both user diversity and the distinct characteristics of urban parks, ultimately contributing to improved urban livability and more resilient urban environments [9,12,20–23].

2. Materials and Methods

2.1. Study Area

The city of Xalapa-Enríquez (hereafter referred to as Xalapa) is in the municipality of the same name in the state of Veracruz. It covers an area of ~60 km² and has an elevation from 1120 to 1450 m.a.s.l. [24–26]. Its climate is semi-warm to humid temperate, with rainfall distributed throughout the year and occasional periods of extreme heat. The average annual temperature ranges between 19.3 and 19.6 °C [27]. Vegetation covers

~45% of the city [28], while 14% is distributed across public green spaces, including parks, walkways, public gardens, protected natural areas, and a green belt [29].

2.2. Study Sites: Urban Park Selection and Description

The selection of green spaces was based on vector data from the municipal system of public green spaces in Xalapa [30]. We selected five parks: Tecajetes, Haya, Macuiltépetl, Natura (currently 'Naturalia'), and Alameda based on their distribution across the city, the social marginalization index of the neighborhood where each green space was located, their size and tree cover, and that they were enclosed green spaces to facilitate survey administration. To estimate the percentage of vegetation cover at each park, we used satellite images from 2023 to create polygons for vegetation and non-vegetation surfaces in Google Earth Pro Version 7.3.6.9796 (Google LLC, Mountain View, CA, USA) [31]. To further characterize the parks, we used non-participatory observation, which included the recording of the most frequently visited hours and the types of activities in which users engaged.

The selected parks share features such as pedestrian paths, benches, children's play areas, and sports courts; having a vegetation cover higher than 90%, except for park Haya, with 86%. However, they differ in size, facilities, and the types of activities people engage in. Tecajetes is in the city center and is notable for its natural spring, water features, and lush, native vegetation. Alameda is a neighborhood park featuring a central plaza, a canal, and a kiosk, though it lacks formal surveillance or entry control. In contrast, Haya, Macuiltépetl, and Natura are larger and more ecologically oriented.

2.3. Sample Size Estimation

To estimate the sample size, we first counted the number of visitors per day for a week in each park. We used the recorded total number of visitors to calculate the size of the visitor population (>16 years old) for each park, using the Legget formula [32]:

$$Y = Ny, \quad (1)$$

where Y is the population of visitors in the parks, N is the targeted data-collection period (assumed to be 30 days), and y is the average number of visitors on sampled days.

The recorded populations for each park were summed and then used to calculate the sample size using the finite proportion estimation formula, considering what we wanted to estimate: the proportion of each CES that the population experienced. The formula:

$$n = \frac{(N) \left(Z_{\alpha}^2 \right) (p)(q)}{d^2 (N - 1) + Z_{\alpha}^2 (p)(q)}, \quad (2)$$

was used considering N as the size of the population (estimated population obtained with the Legget formula), a Z_{α} value with a 95% confidence level, a probability of success (p) and failure (q) of 0.5, and a margin of error (d) of 0.05. The resulting sample size for the five parks was 356 visitors, rounded to 360 to ensure each park had a sample size of 72 visitors, for an equitable distribution [33].

The face-to-face application of surveys to the visitor population over 16 years of age was done under the principle of prior, free, and informed consent [34]. We applied the surveys from September 2023 to January 2024 from 8:00 am to 5:00 pm every day of the week, including weekends, aiming to cover mostly the different users who visit these UGS. The corresponding permits for surveys and data collection were requested from the Environmental Department of the municipality of Xalapa and the Secretary of the Environment.

2.4. Identification of CES

To describe and characterize the CES provided by urban parks, we primarily focused on thirteen services (Table A1 in Appendix A) based on the work of MEA [8], de Groot [35], NEA [11], and TEEB [36], considered as a framework for the classification of CES in urban environments for this work: ‘Recreation’, ‘Cultural diversity’, ‘Tourism’, ‘Aesthetic value’, ‘Spiritual value’, ‘Educational value’, ‘Sense of place’, ‘Inspiration’, ‘Heritage and cultural patrimony’, ‘Social relations’, ‘Contact with nature’, ‘Physical health’ and ‘Mental health’.

The identification of CES was based on the experience of park visitors, using a survey designed to gather information on their reasons for visiting (Appendix B). Visit motivations were used as both qualitative and quantitative proxies for the perceived CES of green spaces [37]. The survey included questions to collect information on (1) visitors’ perceived CES of green spaces, (2) participants’ sociodemographic data, (3) visit frequency to the selected areas, and (4) the amount of greenery perceived by visitors in the parks (Appendix B).

We applied a pilot survey to Xalapa residents with different education levels and ages to mitigate the bias effect and confusing questions [38].

We also recorded the comments of participants who wished to share testimonies, anecdotes, or reflections about their experiences in the parks over the years by including a final open-ended, optional question inviting further comments. Allowing participants freedom in survey responses has been shown to unlock internal perspectives on various CES, helping capture multiple values that would otherwise be overlooked through strictly quantitative methods and closed-ended questions [39,40].

2.5. Identification of CES Bundles

To identify the co-occurrence structure among CES, we constructed a binary presence/absence matrix for each observation. Based on this matrix, we calculated a distance matrix using the Jaccard index, which is appropriate for binary data [41,42], as implemented in the `vegdist` function from the `vegan` package in RStudio 2024.04.0+735 (Posit Software, PBC, Boston, MA, USA) [43]. This distance matrix was then used to perform a hierarchical clustering analysis employing the Ward.D2 linkage method, which minimizes within-cluster variance [42,44], using the `hclust` function from the `stats` package. The optimal number of clusters was assessed using the silhouette coefficient, computed across multiple values of k [45], using the `silhouette` function from the `cluster` package.

In addition, we estimated the joint probabilities $P(A \cap B)$ of co-occurrence for each pair of CES to visualize the absolute magnitude of their overlap through a heatmap. A co-occurrence happened when the same participant mentioned two CES at the same time as the reasons to go to the park. The joint probabilities were estimated following the frequentist definition of probability [46,47]:

$$P(A \cap B) = \frac{n(A \cap B)}{N}, \quad (3)$$

where $n(A \cap B)$ is the number of respondents reporting both CES simultaneously, and N is the total number of respondents. This approach was adopted for descriptive purposes, as services were recorded as binary presence/absence variables and no causal or conditional relationships were evaluated. The combination of the dendrogram (reflecting relative similarity patterns) and the heatmap (reflecting absolute co-occurrence probabilities) provided a robust characterization of cultural service bundles [48]. All analyses were conducted in RStudio [43].

We conducted a directed qualitative content analysis of participants’ open-ended comments on the benefits they perceive from the parks. Participants’ responses were compiled

into a summary table and systematically reviewed using CES as predefined analytical categories. Each comment was qualitatively coded to identify CES simultaneously referenced within the same narrative, allowing us to examine patterns of thematic co-occurrence across responses. This approach enriches the interpretation of CES bundles by incorporating user-generated narratives [49,50].

2.6. Analysis of CES in Relation to Parks and Visitor Demographics

Differences in the number of services mentioned across parks were assessed using a Kruskal–Wallis test, as the data did not meet parametric assumptions. Dunn’s post hoc test was applied to identify pairwise differences among parks [51,52].

To evaluate possible relationships between reported CES and visitors’ demographics and park identity, we built Generalized Linear Models (GLMs) [53] in RStudio [43]. Park identity was treated as a conceptual construct [54,55] representing the unique combination of attributes that distinguish each park, including its size, vegetation, spatial configuration, ecological structure, and available facilities. As these individual attributes were not measured directly, the categorical variable Park served as a proxy for this construct in the statistical models [56,57]. We considered the type of CES mentioned as a response variable using a Binomial distribution family. The independent variables used were Park, Age, Perceived vegetation in the park, Frequency of visits, Sex, Education level, and Occupation. In all cases, a selection of the best model was performed using backward stepwise reduction, based on the significance of the variables according to subsequent ANOVA results and the models’ AIC scores [52]. We used backward stepwise reduction because the explanatory variables were selected a priori based on theoretical and ecological considerations, and it also facilitates the identification of a more parsimonious model while retaining explanatory power. However, we acknowledge that the final model is conditional on the initial set of variables and should be interpreted as the best-supported model among those evaluated, rather than the only plausible model [58]. For each adjusted model, we obtained the pseudo R^2 to know the explanatory percentage of the variation in the proportion of visitors who perceived and reported the CES in RStudio [42] with the pseudo rsq function [59].

During the preparation of the manuscript, we used AI-assisted language tools to improve clarity and readability of the text. We developed all scientific content, including the study design, analyses, interpretation of the results, conclusions, and the final manuscript, and we remain entirely responsible for its content.

3. Results

3.1. Description of the Sample

A total of 373 participants were surveyed across the five parks. 55.8% were women and 44.2% were men with an average age of 39.3 (± 18.5) years, within the range from 16 to 89 years old. Most respondents were workers/employees, followed by a much smaller percentage of retirees or pensioners and university students. Individuals engaged in housework represented 9.9%, followed by graduate students and high school students. Only two people indicated being unemployed, and four reported engaging in other activities. Most participants had completed university or high school. A smaller percentage had a graduate degree or a secondary school level. Only one person reported having no formal education, and eight had a primary school level. Most of the respondents lived in the city, 14.4% came from another location within the state, only seven individuals mentioned coming from another Mexican state, and 3.2% were from another country. The distribution of the sociodemographic characteristics of the total sample and by park is in Table 1.

Table 1. Distribution of respondents' sociodemographic characteristics by park in Xalapa.

		T ¹ n = 75		H n = 72		M n = 72		N n = 74		A n = 80		Total n = 373	
Visitor Characteristics		F	%	F	%	F	%	F	%	F	%	F	%
<i>Sex</i>													
	Woman	43	57.3	39	54.2	42	58.3	41	55.4	43	53.8	208	55.8
	Man	32	42.7	33	45.8	30	41.7	33	44.6	37	46.3	165	44.2
<i>Degree of studies</i>													
	None	0	0.0	0	0.0	0	0.0	0	0.0	1	1.3	1	0.3
	Elementary	1	1.3	0	0.0	2	2.8	2	2.7	2	2.5	8	2.1
	Secondary	3	4.0	3	4.2	5	6.9	11	14.9	11	13.8	33	8.8
	Highschool	26	34.7	23	31.9	31	43.1	20	27.0	17	21.3	118	31.6
	University	41	54.7	36	50.0	29	40.3	34	45.9	39	48.8	177	47.5
	Postgraduate	4	5.3	10	13.9	5	6.9	7	9.5	10	12.5	36	9.7
<i>Occupation</i>													
	Unemployed	1	1.3	0	0.0	1	1.4	0	0.0	0	0.0	2	0.5
	Retired	2	2.7	8	11.1	11	15.3	14	18.9	17	21.3	52	13.9
	Houseworker	11	14.7	1	1.4	9	12.5	14	18.9	2	2.5	37	9.9
	Highschool student	2	2.7	4	5.6	2	2.8	5	6.8	3	3.8	16	4.3
	University student	15	20.0	18	25.0	7	9.7	3	4.1	8	10.0	51	13.7
	Postgraduate	4	5.3	13	18.1	3	4.2	2	2.7	2	2.5	24	6.4
	Worker	37	49.3	28	38.9	39	54.2	36	48.6	47	58.8	187	50.1
	Other	3	4.0	0	0.0	0	0.0	0	0.0	1	1.3	4	1.1
<i>Residency</i>													
	Resident	54	72.0	51	70.8	51	70.8	73	98.6	70	87.5	299	80.2
	State tourist	15	20.0	15	20.8	15	20.8	0	0.0	10	12.5	55	14.7
	National tourist	2	2.7	2	2.8	2	2.8	1	1.4	0	0.0	7	1.9
	International tourist	4	5.3	4	5.6	4	5.6	0	0.0	0	0.0	12	3.2
<i>Age</i>													
	Average ($\pm$ SD)	34.36 ($\pm$ 14.2)		36.69 ($\pm$ 14.4)		37.83 ($\pm$ 15.6)		45.64 ($\pm$ 15.9)		44.63 ($\pm$ 18.5)		39.34 ($\pm$ 18.5)	

¹ T—Tecajetes, H—Haya, M—Macuiltépetl, N—Natura, A—Alameda.

Regarding visit frequency, most participants reported visiting the parks “almost daily” (29.5%) or “two to four times per week” (27.6%). The next most common frequencies were “once to three times per month” (13.9%) and “once a week” (11.5%). The least frequent responses were “less than once a week” (9.1%) and “this time only” (8.3%), both with similarly low percentages. Tecajetes had the highest proportion of first-time visitors at the time of the survey. In contrast, Natura had the highest proportion of participants who visited the park daily or almost daily.

3.2. Quantifying Perceived Cultural Ecosystem Services Across Xalapa's Parks

Overall, the average of perceived CES was 3.0 ($\pm$ 2.0 SD; median = 2), with a range between 0 and 13 services. The average number of CES was similar in four of the five parks; however, the range of services varied across the five evaluated sites, with higher ranges in Macuiltépetl and Alameda (Table 2).

According to the Kruskal–Wallis test, the number of services mentioned differed significantly among parks ($\chi^2 = 16.979$, $df = 4$, $p = 0.001$). Dunn's test indicated that these differences occurred primarily between Alameda and Haya ($z = -3.657$, $p = 0.002$), and between Haya and Macuiltépetl ($z = 3.467$, $p = 0.005$). Although most visitors across sites mentioned a relatively small number of services, in Haya, a significantly lower number of services was reported (Table 2).

Table 2. Descriptive statistics of the number of Cultural Ecosystem Services (CES) reported by participants across five urban parks.

Park	Average ($\pm$ SD)	Median	Range	Dunn's Test ¹
Tecajetes	3.0 ($\pm$ 3.0)	4	0 to 5	ab
Haya	3.0 ($\pm$ 2.1)	2	0 to 5	a
Macuiltépetl	3.0 ($\pm$ 2.4)	2	0 to 13	b
Natura	3.0 ($\pm$ 2.0)	3	1 to 9	ab
Alameda	2.8 ($\pm$ 2.1)	2	0 to 12	b

¹ Different letters indicate significant differences at $p \leq 0.05$.

3.3. Proportions of Reported CES

The most frequently mentioned CES by visitors to Xalapa's green areas was 'Recreation', followed by 'Mental health', 'Physical health', and 'Contact with nature'. The benefits associated with 'Aesthetic value', 'Social relationships', 'Spiritual value', 'Sense of place', and 'Educational values' ranged between maximums of 20.4% and 29.0%. The least mentioned services were 'Inspiration', 'Tourism', 'Cultural diversity', and 'Heritage and cultural patrimony' (Figure 1a).

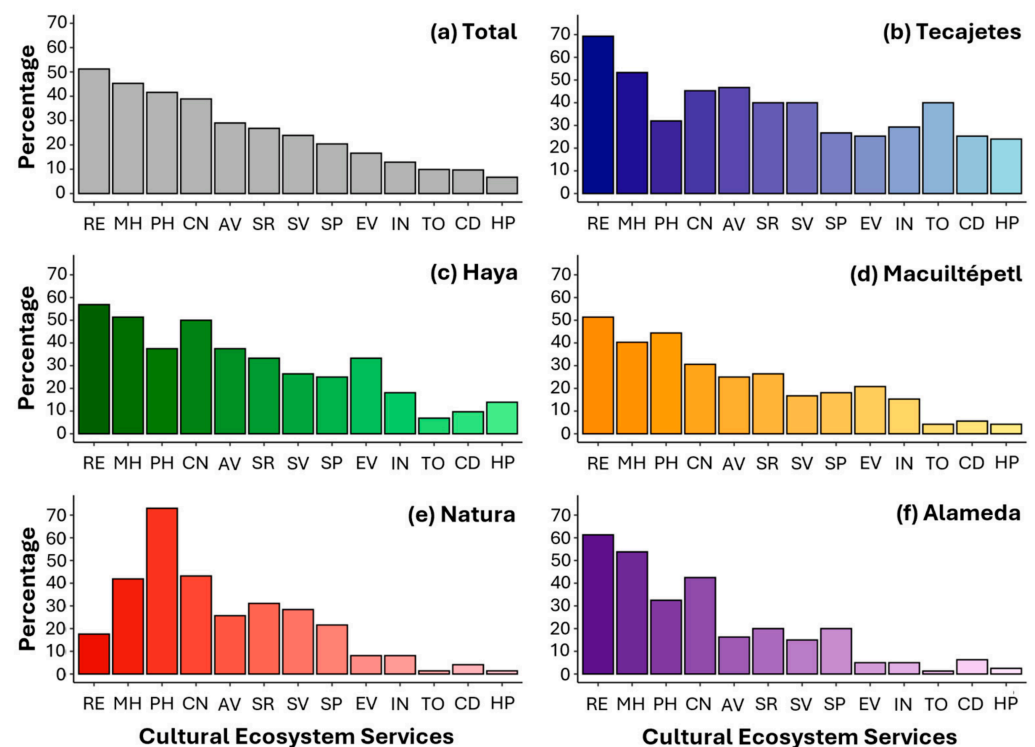


Figure 1. Perceived Cultural Ecosystem Services by visitors to the urban parks in Xalapa. (a) Total perceived CES across the five parks; (b) Tecajetes; (c) Haya; (d) Macuiltépetl; (e) Natura; (f) Alameda. (a–f) RE—Recreation; MH—Mental health; PH—Physical health; CN—Contact with nature; AV—Aesthetic value; SR—Social relations; SV—Spiritual value; SP—Sense of place; EV—Educational value; IN—Inspiration; TO—Tourism, CD—Cultural diversity; HP—Heritage and cultural patrimony.

In four of the five sampled parks, 'Recreation' was the most frequently reported benefit, except in the Natura Park, where this service ranked eighth in frequency (Figure 1e). The 'Tourism' service was among the least perceived and reported benefits in four parks, except for Tecajetes, where it was one of the most frequently mentioned, given that it is in the downtown and is the most visited by tourists and first-time visitors. 'Physical health', 'Mental health', and 'Contact with nature' were consistently among the most reported benefits across all parks, whereas 'Cultural diversity' and 'Heritage and cultural patrimony'

were infrequently mentioned. Notably, in Natura Park, ‘Physical health’ was the most frequently reported benefit; this might be related to the park’s size, which allows people to run and bike, as well as to its open spaces for exercise group activities.

The services ‘Aesthetic value’ and ‘Sense of place’ showed similar proportions across all parks, while ‘Inspiration’ was particularly frequent in Tecajetes. ‘Educational value’ was identified more prominently in Haya and Tecajetes, where student groups tend to arrive to learn about biology, and postgraduate students to take classes or data for their projects (Figure 1).

3.4. Identification of CES Bundles

The co-occurrence probabilities of services varied between 0.06 and 0.24 as shown in the heatmap (Figure 2a). According to the silhouette coefficient and the dendrogram based on Jaccard, we identified three final clusters prioritizing thematic interpretability and hierarchical structure (Figure 2b):

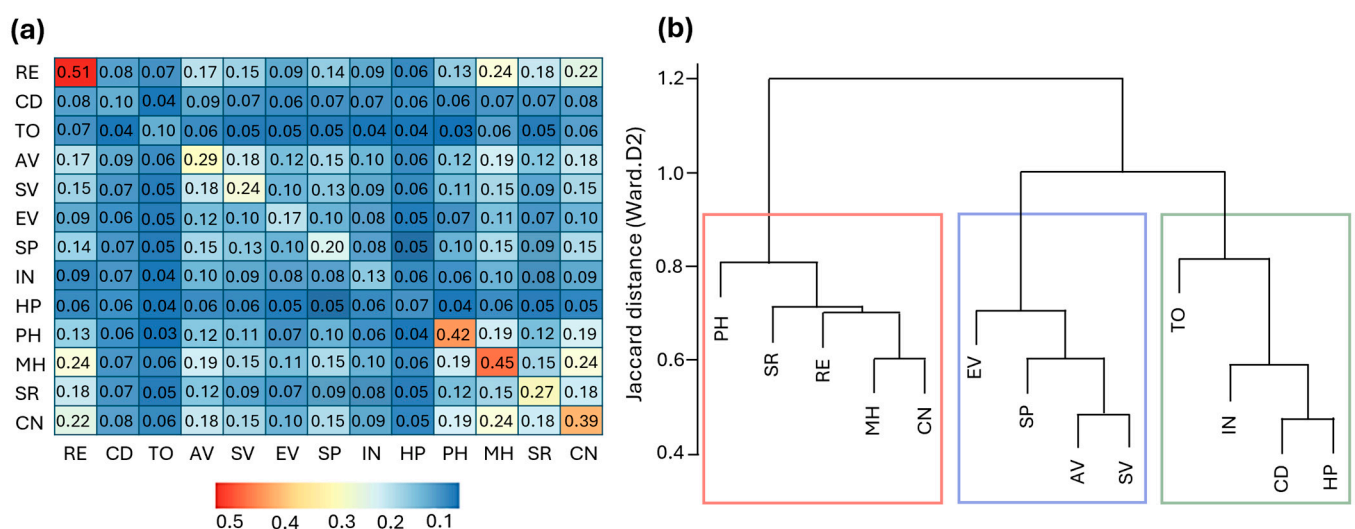


Figure 2. (a) Heatmap of Joint Probabilities of service co-occurrence. The values in the diagonal from left upper to right bottom represent the co-occurrences between the same service, and they are not considered in the range of probabilities. (b) Dendrogram of CES bundles (Jaccard Distance + Ward.D2). The colors in the lines indicate the tree clusters (red = bundle 1—holistic well-being, green = bundle 2—symbolic and aesthetic orientation, and blue = bundle 3—cultural experiences and creativity). (a,b) RE—Recreation; MH—Mental health; PH—Physical health; CN—Contact with nature; AV—Aesthetic value; SR—Social relations; SV—Spiritual value; SP—Sense of place; EV—Educational value; IN—Inspiration; TO—Tourism, CD—Cultural diversity; HP—Heritage and cultural patrimony.

Bundle 1: holistic well-being. This was the largest group (five services) and displayed the highest probabilities of co-occurrence (between 0.12 and 0.24) (Figure 2a). It represents a bundle oriented toward holistic well-being, in which recreational experiences, contact with nature, and social interactions jointly contribute to both the physical and mental health of visitors (Figure 2b).

Bundle 2: symbolic and aesthetic orientation. This bundle exhibited moderate co-occurrence values (0.10–0.20; Figure 2a) for ‘Aesthetic value’ and ‘Spiritual value’, together with ‘Sense of place’, indicating the strongest internal associations within this group. While ‘Educational value’ was also included in this bundle, it showed a lower co-occurrence probability with the other three services.

Bundle 3: cultural experiences and creativity. This bundle also showed moderate co-occurrences (0.10–0.20, Figure 2a), but following a clear pattern as it groups services related to cultural experiences and creativity, where ‘Inspiration’, ‘Cultural diversity’, and

‘Heritage and cultural patrimony’ tend to occur among the same individuals who report tourism-related experiences (Figure 2b).

3.5. Participants’ Comments Related to the Identified CES and Derived CES Bundles

Twenty-five participants, representing 6.7% of participants, provided testimonies describing how the park offered them specific benefits based on experiences, emotions, and sensations they had during their visits to the places by themselves or with their family, friends, or pets (Table 3). According to the qualitative approach, only eight services were mentioned by park visitors. In some testimonies, we found from two to four CES mentioned in the same narrative. Most of the CES mentioned simultaneously were: ‘Mental health’, ‘Physical health’, and ‘Contact with nature’, showing an interconnection between them or as an ensemble.

Table 3. Comments made by participants regarding the evaluated CES, with corresponding CES categories identified in each comment.

Comment	MH	PH	CN	AV	SR	SV	SP	IN ¹
“I prefer to do cardio here in the park rather than at the gym. In fact, I just came from there, but I like it better getting active here among the plants”.—(Female, 32, Macuiltépetl)		X	X					
“I feel a connection with the trees and plants here, which heals my soul and my heart, making me love myself more.”—(Female, 56, Tecajetes).	X		X			X		
“I come here to clear my mind and think about myself and the value of life. I also come here to exercise and breathe in the scent of nature. In general, it’s good for the soul and the body.”—(Male, 45, Tecajetes).	X	X	X					
“I come here to calm my soul, to breathe fresh air, and to be in contact with nature. The trees bring me so much peace.”—(Male, 18, Macuiltépetl).	X		X					
“Honestly, coming to the park is often the reason I get up. It kick-starts my day, calms me, and cheers me up.”—(Female, 57, Natura).	X						X	
“Coming to the park gives me a routine; I feel satisfied and fulfilled once I’m here.”—(Female, 66, Natura).	X						X	
“The park provides me with a magical place where I can practice my meditation; the sound of the water and the cool temperature are very relaxing.”—(Female, 48, Tecajetes).	X		X					
“As soon as I arrive here (to the park), I feel content and happy. Here I can forget about all the worries out there.”—(Male, 35, Natura).	X							
“Every day, I stop by this park before going to work and before going home. The park is very far away from me; I walk an hour and a half to get here, but I like to sit and relax. I [...] look at the vegetation and feel good, and then I start walking again to work or home.”—(Male, 32, Alameda).	X		X					
“The park seems to be the only place where I can feel the way I should, without anyone judging me or making me feel worse [...], it has been an ally in my recovery, as it encourages me to run early every day.”—(Female, 24, Alameda).	X	X					X	

Table 3. Cont.

Comment	MH	PH	CN	AV	SR	SV	SP	IN ¹
"I come here to hug the trees—an activity I really enjoy, and here (in the park) there are many trees"—(Female, 26, Tecajetes).	X		X					
"I come here because it's very hard to find places with nature in the city, and this one is very beautiful"—(Male, 40, Tecajetes).			X	X				
"I like to take off my shoes, over there where there's grass, and feel the grass with my feet, I feel that it gives me energy"—(Female, 49, Haya).	X		X					
"Here, among the trees, the smell is much more pleasant, and the noise of the city disappears"—(Female, 28, Haya).			X					
"The park relaxes me and inspires new ideas for drawing. I think nature can be a great muse and forces you to get away from everyday problems."—(Male, 18, Tecajetes)	X		X					X
"When you enter the park, the noise outside disappears, and you can focus more on what's inside and paint it."—(Male, 22, Tecajetes)	X		X					X
"I've been coming to this park to exercise for over 30 years. It's very special to me. It's now part of my routine."—(Female, 38, Macuiltépetl)		X					X	
"Coming here brings back many memories, most of them very beautiful."—(Male, 49, Macuiltépetl)	X						X	
"I've lived in this place (a house near the park) for many years. I moved to Xalapa 40 years ago, and I used to bring my children here to play when the park was more well-kept and had much more vegetation. It's changed a lot over time, but I remember it fondly because of the memories I have here, and I would like it to continue for many more years."—(Female, 62, Alameda)					X		X	
"My wife comes to Zumba, and I come for a walk. We like to spend time outdoors and enjoy an activity here together."—(Male, 50, Natura)	X	X	X		X			
"My friends and I have been gathering here for many years, even more so now. The people around here know each other very well, and we try to keep an eye on the park, but it's difficult with so little supervision."—(Female, 62, Alameda).					X		X	
"I like coming here to exercise and for my dog to relax when we come."—(Male, 26, Haya)	X	X						
"Just like us (humans), dogs also need to exercise, and that's why I brought him. He's a great companion for these walks because here the park tends to be very lonely, too, further down the road (from the park)."—(Male, 65, Haya)		X						
"Many times, it's my dog who brings me to the park, because sometimes I'm too lazy to come, and he's the one who insists we come for a walk and a run."—(Female, 25, Alameda)		X						

¹ MH—Mental health; PH—Physical health; CN—Contact with nature; AV—Aesthetic value; SR—Social relations; SV—Spiritual Value; SP—Sense of place; IN—Inspiration. The "X" indicates the CES categories identified in each participant comment. CES not identified in the comments were not included in the table.

‘Social relations’ and ‘Spiritual value’ were also mentioned together with this first ensemble. Other services like ‘Sense of place’, ‘Inspiration’ or ‘Aesthetic value’ tend to appear together with CES like ‘Mental health’ and ‘Physical health’. Participants mentioned that their physical activities in the parks resulted in positive mental benefits, as well as being intermingled with the benefit of ‘Contact with nature’.

Remarkably, while people could benefit their health in other settings, they preferred to exercise in more open, natural spaces. Some others experience emotions and feelings like relaxation, calm, connection, a clear mind, love, happiness, and satisfaction. Focusing on ‘Contact with nature’, there were comments that reflected specific, direct sensorial interactions with nature, such as touching the grass, smelling the environment, and hugging the trees; experiences that can be had in places like parks with vegetation. Even though the ‘Inspiration’ service did not have a high reported frequency, some people, especially young people, mentioned that the park provided them with a mental clarity that allowed them to generate new ideas to create drawings and paintings.

In parks where dogs are allowed (i.e., Haya and the Alameda), people commented that their main reason for visiting the areas was because of their dogs: for them to walk, exercise, and socialize with other dogs. Many of those surveyed stated that they visited the parks more for their pets than for their own reasons, as it was a place where the canines could exercise, feel happy, and return home to rest.

Additionally, ten participants indicated that none of the predefined CES categories represented their reason for visiting the parks. Instead, they cited work-related purposes, a desire to be alone, or teaching activities like dancing or running.

3.6. Model Results: What Determines the Perception of a Service?

Regarding the GLMs fitted to assess the associations between the different CES proportions and the visitors and the park characteristics, for ‘Sense of place’, ‘Contact with nature’, and ‘Mental health’, none of the models showed significant associations between these services and any of the variables considered. For the remaining services, the final GLMs included from two to four explanatory sociodemographic variables from 6 in total (Park, Sex, Age, Education level, Occupation, Frequency of visits, and Perceived vegetation), and all of them kept the variable Park. It is worth noting that Educational Level and Occupation did not show significant associations with the CES proportions, even though they were retained in the models according to ANOVA and AIC results (Table 4; see Table S1 for standard errors, *p*-values, 95% CI, and model diagnostics for the fitted GLMs).

Table 4. Estimated coefficients from fitted GLMs for the relationship between the CES perceived and urban parks in Xalapa and visitors’ demographic characteristics.

Variables ¹	RE	CD	TO	AV	SV	EV	IN	HP	SR	PH
Age	−0.015 *	−0.048 **				−0.160	−0.033 ***	−0.063 **	−0.026 **	0.039 **
Sex (Man)										
Woman				0.767 **	1.009 ***					
Frequency (Almost daily)										
2–4 times a week	0.398		0.937		0.432					0.100
Once a week	0.676		0.029		1.057 *					−0.231
1–3 times a month	0.505		0.667		−0.161					−1.071 *
Less than once a month	1.055 *		0.349		0.156					−2.033 **
Only this time	−0.860 **		2.567 **		−0.862					−2.579 ***
Perceived vegetation (Fully covered)										
High vegetation cover					−0.713 *		−0.759 *	−1.515 **		
Low vegetation cover					−0.038		0.427	0.696		
Educational level (Elementary)										
Secondary				14.692						
Highschool				14.549						
University				15.360						
Postgraduate				15.456						

Table 4. Cont.

Variables ¹	RE	CD	TO	AV	SV	EV	IN	HP	SR	PH
<i>Occupation</i>										
(Unemployed)										
Postgraduate student		0.189		0.043		16.709				−15.127
Highschool student		0.183		−0.441		14.696				−16.365
University student		0.177		−0.219		15.195				−16.383
Retired		0.762		−2.235		14.509				−16.975
Homemaker		0.151		−2.038		14.931				−16.434
Worker		0.163		−1.280		14.052				−16.680
<i>Park (Alameda)</i>										
Macuiltépetl	−0.650	0.242	1.164	0.585	0.048	1.556 *	1.267 *	0.688	0.200	0.968 *
Natura	−2.018 ***	0.393	0.149	0.795	1.189 *	0.512	0.795 *	−0.140	0.648	1.972 ***
Haya	−0.452	0.821	0.937	0.364 **	−0.202	1.130	0.353	−0.484	−0.499	−0.434
Tecajetes	0.360	1.577 **	3.577 ***	1.394 ***	1.822 ***	1.612 ***	2.152 ***	2.898 **	0.751 *	1.136 *
R ² (%)	17.6	18.6	32.4	16.9	18.8	19.4	12.6	24.7	6.2	29.5

¹ Statistically significant coefficients are indicated as follows: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$. For categorical and ordinal variables, the category used as the intercept is shown in parentheses. RE—Recreation; CD—Cultural diversity; TO—Tourism; AV—Aesthetic value; SV—Spiritual value; EV—Educational value; IN—Inspiration; HP—Heritage and cultural Patrimony; SR—Social relations; PH—Physical health.

3.6.1. Sociodemographic Variables

Regarding participants' Age, the GLMs showed an overall negative relationship with CES proportions, being significant for 'Recreation', 'Cultural diversity', 'Inspiration', 'Heritage and cultural patrimony', and 'Social relations'. On the contrary, Age had a positive relation with 'Physical health', being more frequently mentioned by older participants. The Sex variable was significant only for 'Aesthetic value' and 'Spiritual value', with both services being more frequently mentioned by women.

The proportion of CES mentioned varied depending on the Frequency of Park Visits. Participants visiting the site for the first time mentioned 'Tourism' significantly more, and 'Recreation' and 'Physical health' to a lesser extent. Those people who visited the park once a week mentioned the service 'Spiritual Value' more often, while those individuals who visited the park almost daily mentioned 'Recreation' and 'Physical health' more frequently.

The Perceived Vegetation variable showed a positive relation with the frequency of 'Spiritual value', 'Inspiration', and 'Heritage and cultural patrimony'. This means that people who perceived more vegetation in parks mentioned one or more of these services as a reason to visit the parks.

3.6.2. Park Variable

This variable was significant in eight of the 10 GML's of services ('Educational value' and 'Social relations' as exceptions), especially in 'Recreation', where we found a lower frequency in Natura Park compared to the other four parks (Table 4).

Regarding the differences among parks, Tecajetes appears to be the most distinct, showing positive coefficients in comparison with Alameda, Macuiltépetl, and Natura. In the first case, it had higher mentions of the services 'Tourism', 'Aesthetic value', 'Spiritual value', 'Inspiration', and 'Heritage and cultural patrimony'. When compared with Macuiltépetl, it showed higher values for 'Tourism', 'Inspiration', and 'Heritage and cultural patrimony', whereas in contrast with Natura, the values were higher for 'Recreation', 'Cultural diversity', and 'Tourism'. The mention of the service 'Physical health' was significantly higher in Natura than in Haya, Macuiltépetl, and Alameda (Table 5).

Mentions of the services 'Educational value' and 'Social relationships' were similar among all parks, whereas 'Cultural diversity' and 'Inspiration' only showed differences between Tecajetes–Natura and Tecajetes–Alameda, respectively. The explanatory power of the GLMs for each CES ranged from 6.2% for 'Social Relation' (which only included the explanatory variable Park) to 32.4% for 'Tourism' and 29.5% for 'Physical health', the latter including Park, Frequency of Visits, and Occupation (Table 5).

Table 5. Estimated pairwise differences for CES between urban parks from Tukey's post hoc test.

Parks	RE ¹	CD	TO	AV	SV	EV	IN	HP	SR	PH
Macuilitépetl-Alameda	−0.655	−0.124	1.164	0.585	0.048	1.556	1.267	0.688	0.200	0.968
Natura-Alameda	−2.018 ***	−0.393	0.149	0.795	1.189	0.512	0.795	−0.140	0.648	1.972 ***
Haya-Alameda	−0.452	−0.821	0.937	0.364	−0.202	1.130	0.353	−0.484	−0.499	−0.434
Tecajetes-Alameda	0.360	1.576	3.577 ***	1.394 ***	1.822 ***	1.612	2.152 ***	2.898 ***	0.751	1.136
Natura-Macuilitépetl	−1.363 ***	−0.268	−1.014	0.210	1.140	−1.044	−0.472	−0.829	0.447	1.003
Haya-Macuilitépetl	0.203	−0.697	−0.227	−0.220	−0.251	−0.426	−0.913	−1.172	−0.699	−1.402 ***
Tecajetes-Macuilitépetl	1.016	1.700	2.413 ***	0.809	1.774 *	0.055	0.884	2.210 ***	0.551	0.167
Haya-Natura	1.566 ***	−0.428	0.787	−0.430	−1.391 *	0.618	−0.441	−0.343	−1.147	−2.406 ***
Tecajetes-Natura	2.379 ***	1.969* **	3.427 ***	0.599	0.633	1.100	1.356	3.039 ***	0.1033	−0.836
Tecajetes-Haya	0.813	2.398	2.640	1.029	2.025	0.481	1.798	3.382	1.250	1.570

¹ Statistically significant differences are indicated as follows: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$. RE—Recreation; CD—Cultural diversity; TO—Tourism; AV—Aesthetic value; SV—Spiritual value; EV—Educational value; IN—Inspiration; HP—Heritage and cultural patrimony; SR—Social relations; PH—Physical health.

4. Discussion

4.1. Diversity of Services and Variability Across Parks

UGS in Xalapa ranged from 1 to 13 CES. These services emerged in all studied parks, although with varying frequency, reflecting heterogeneous experiences and opportunities for interaction with nature. While the quantitative method reported a diversity of 13 services, the qualitative approach (through comments) recorded a maximum of eight services. This aligns with findings reported by Carmona for Xalapa [29]. This suggests that users tend to focus on a limited range of benefits during routine park experiences.

4.2. CES Bundles and Their Frequency in Urban Parks

The tendency of 'Recreation', 'Mental health', 'Physical health', and 'Contact with nature' as the most frequently valued bundle of CES was strongly reinforced with the qualitative testimonies provided by visitors demonstrating that interactions with nature often translated into physical benefits, psychological restoration, and emotional well-being, as some visitors described experiences such as relaxation, calmness, happiness, and satisfaction, which they directly attributed to their visits to the parks.

The frequency of specific services and the participants' comments, along with the bundle analysis, reflect what conceptual reviews [15,20,60] and recent empirical studies [61] emphasized: CES are deeply interconnected and are not typically perceived as discrete categories (e.g., spiritual, aesthetic, or recreational). Instead, individuals tend to experience these services as intertwined values that emerge through holistic interactions with landscapes, in this case, urban parks [60]. This was particularly evident in Bundle 1, where 'Recreation'—widely recognized as a dominant service in urban environments [62–64]—was closely linked to health (physical and mental), social relationships, and contact with nature.

Nonetheless, 'Recreation' was not mentioned in the comments made by participants, where the other CES of the bundle were present simultaneously. This could be related to what Dai et al. mentioned [65], that although 'Recreation' is an outstanding service in urban parks, in an analysis of comments by users, the frequency of words associated may differ, and maybe a terminological disconnect between how users think about and express their perceptions of recreation [66].

Co-occurrences among these services have been previously documented [67–69], showing that UGS foster positive social interactions that enhance social cohesion through recreational activities, which in turn are associated with physical and psychological health benefits. Environmental factors such as a sense of immersion and coolness, good air quality, and reduced noise can further promote users' physical and mental well-being [68,70,71].

Direct contact with nature, particularly vegetation, has been strongly linked to improvements in physical and mental health, supported by theories of restorative urban ecology such as Attention Restoration Theory [72], investigations into the Neurobiological

Regulation of Stress and Allostasis [73], and the Biophilia hypothesis [74]. In this study, although perceived vegetation cover was significant in only three CES in the model, we documented direct interactions with nature, including embodied and sensory experiences, associated with health benefits, thus reinforcing these theoretical frameworks [72,73,75,76].

In Bundle 2, which had a symbolic and aesthetic connotation, services such as ‘Aesthetic value’, ‘Spiritual value’, and ‘Educational value’ were commonly found together, also consistent with previous studies [39,77,78]. The aesthetic qualities of a place—well-maintained vegetation, water features, or the presence of fauna—have been shown to enhance learning, spiritual reflection, and sense of belonging [12,68,79,80].

Bundle 3, which included services related to tourism, cultural heritage, and creativity but appeared with low frequency, showed similarities with other studies in the city [29]. These studies highlight a persistent underuse of urban green spaces for cultural and tourism development in Xalapa, despite its importance as a state capital and emerging visitor destination [81]. In Latin American contexts, the relationship between ‘Aesthetic value’ and ‘Sense of place’ has been documented, demonstrating how people develop emotional connections to trees and parks, attributing aesthetic and symbolic value to them [12]. Additionally, the relationship between ‘Heritage’ and ‘Tourism’ has been used to argue for the potential of green areas as drivers of cultural tourism and inspiring experiences [82–84].

In this study, we integrated quantitative and qualitative data to identify CES and their associated bundles. This mixed-methods approach allowed us not only to obtain robust quantitative evidence, such as the number of services identified, their average occurrence, and statistical models linking sociodemographic variables to perceived benefits, but also to gain deeper insight into how these services were experienced and articulated by users through their narratives.

4.3. Social Differences That Shape Cultural Valuation of Urban Nature

Sociodemographic characteristics also influenced CES valuation, consistent with previous evidence [85–87]. Age, Sex, Vegetation perception, and Visitation frequency were significant predictors. Younger respondents more often recognized relational values and cultural diversity, reflecting generational inclusion tendencies [88–90]. In contrast, the valuation of ‘Physical health’ tended to increase among older visitors, consistent with [91–94].

Women more frequently identified aesthetic and spiritual benefits, corroborating prior research on gendered perceptions of UGS [92,95–97]. Frequent users emphasized ‘Spiritual value’ and ‘Physical health’, while occasional visitors favored novelty-related services, such as ‘Tourism’ and ‘Recreation’. Perceived vegetation strongly influenced the identification of ‘Inspiration’ and ‘Spiritual value’, supporting psychological and immersive effects associated with abundant vegetation [98–100].

‘Sense of place’ did not vary significantly across sociodemographic groups, as also reported by [101,102]. Yet, the comments provided significant insights into how long-term use, personal memories, and community engagement reinforce emotional attachment to specific parks. Also, older adults tended to mention it more often in residentially embedded UGS, such as Alameda, supporting the literature linking proximity, familiarity, and emotional attachment to stewardship [78].

4.4. Limitations of the Study and Opportunities for Future Research

Among the limitations of the study, restricting the sample to park visitors may underrepresent the perspectives of non-users, whose absence from these spaces may reflect barriers related to accessibility, safety, mobility, or personal preferences. Additionally, although the comments from the qualitative approach enriched the identification and interpretation of CES and CES bundles, the limited number of respondents was insufficient

to support claims of thematic saturation [103,104], as additional responses might have revealed additional CES or provided further insights into those already identified. Future studies incorporating a larger qualitative sample could provide a more comprehensive understanding of how people perceive and describe CES in their own words. Data collection was conducted between September 2023 and January 2024 and, therefore, may not fully capture seasonal variations in park use and CES perception that could occur throughout the year.

Because this research was conducted in a single neotropical Latin American city, caution should be exercised when extrapolating the findings to other urban contexts with different environmental, cultural, or socioeconomic conditions. Nevertheless, its integrated analytical framework, which combines qualitative and quantitative approaches, CES bundles, park identity, and sociodemographic drivers, could be transferable. Applying this framework in different urban contexts could help identify both shared and context-specific patterns of CES perception, thereby supporting locally adapted planning and management of urban green spaces. Future research could extend this approach by conducting comparative studies that assess how changes in park attributes influence the long-term provision of CES and CES bundles across multiple cities.

5. Conclusions

This study confirms that urban parks in Xalapa represent essential socioecological assets that deliver a wide range of CES to their visitors, often as CES bundles. ‘Recreation’, ‘Mental health’, ‘Physical health’, and ‘Contact with nature’ emerged as the most relevant bundle services across the five parks, demonstrating that residents heavily rely on these spaces for recreational and natural purposes that can provide physical and psychological benefits.

Together, the quantitative and qualitative data illustrate that CES do not operate independently. Instead, they constitute a network of co-occurring benefits that shape and reinforce visitors’ motivation to return. Likewise, social and cultural meanings were intertwined with everyday routines, emotional attachment, and creative expression. These interrelationships highlight the vital role of parks as multidimensional public resources for well-being. We also confirmed that CES can differ according to the physical characteristics of the ecosystems that provide them, in this case, urban parks. Sociodemographic variables are also important for identifying CES and may be considered for further investigations, maintenance, and accessibility of parks.

These findings demonstrate the joint importance of physical attributes and social heterogeneity in shaping CES provision. Strategies aimed at enhancing multifunctionality, maintenance, accessibility, and community participation can expand both highly visible CES and those with currently low recognition, increasing social cohesion, environmental awareness, and equitable well-being across the city. Conserving and strengthening urban green spaces is fundamental to sustaining public well-being, reinforcing social bonds, and preserving cultural identity amid ongoing urban development. Recognizing and integrating the multiple CES that citizens value will be key to developing resilient and human-centered urban policies.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/environments13080434/s1>, Table S1: Summary of Generalized Linear Model (GLM) results and model diagnostics for each cultural ecosystem service.

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Institutional Review Board Statement: Ethical review and approval were waived for this study because it involved non-invasive, non-interventional interviews and anonymous questionnaires that collected no personally identifiable information and posed no foreseeable risk to participants. The study was conducted in accordance with the principles of prior, free, and informed consent. Participants were informed of the study’s purpose, data use, and confidentiality measures before participation. Participation was voluntary; respondents could withdraw at any time, and completing the questionnaire was considered to imply informed consent.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Abbreviations

The following abbreviations are used in this manuscript:

CES Cultural Ecosystem Services
UGS Urban Green Spaces
GLM Generalized Linear Model

Appendix A

Table A1. Cultural ecosystem services and their descriptions used in the study.

CES	Description
‘Recreation’	Activities carried out in the green spaces for entertainment or distraction purposes.
‘Cultural diversity’	Green spaces allow the expression of different urban cultures in the city, as well as for them to coexist.
‘Tourism’	Green spaces represent attractive sites for visits by people from other localities and foreigners.
‘Aesthetic value’	Appreciation of the place for its beauty (other than through recreational activities).
‘Spiritual value’	Green spaces can provide spiritual opportunities for people, allowing them to develop peace and tranquility.
‘Educational value’	These sites provide educational opportunities for formal and informal learning and teaching about nature.
‘Sense of place’	Green spaces can represent sites that foster a sense of human attachment and are associated with a sense of being at home. This refers to the influence of green spaces on feelings of belonging to the local environment.

Table A1. Cont.

CES	Description
‘Inspiration’	Green spaces stimulate the creation of new thoughts, ideas, or creative expressions, which lead to inspiration for books, magazines, photographs, and other things when exposed to the elements of the landscape.
‘Heritage and cultural patrimony’	The site has historical or cultural significance for people.
‘Social relations’	Green spaces allow for the flow and creation of different types of social relationships, as well as coexistence between people.
‘Contact with nature’	The site contains nature to which people may be drawn by its mere existence (not for aesthetic value). This service focuses on an emotional awareness of nature based on the senses and the desire to be close to nature and/or be a part of it.
‘Physical health’	Green spaces can promote and maintain people’s physical health through activities such as exercise or sports.
‘Mental health’	The site can promote, improve, and maintain people’s health through relaxation, providing spaces for activities that improve mood and promote rest.

Appendix B

Appendix B.1. Survey of Cultural Ecosystem Services Perceived and Reported by Visitors in Green Areas of Xalapa

- What are your main reasons for visiting this park? (Check as many options as you consider necessary)
 - ☐ I do activities to distract, such as walking my dog, Reading, biking, hiking, or playing
 - ☐ I can visit it regardless of my personal interests, way of thinking, or style of dress
 - ☐ It is part of the city’s tourist attraction
 - ☐ I enjoy the beauty of the place
 - ☐ I find spiritual peace
 - ☐ I learn about nature and/or teach others about it
 - ☐ This place is special to me; it makes me feel at home
 - ☐ I find inspiration that stimulates my creativity
 - ☐ I consider it to be part of the city’s natural and cultural heritage
 - ☐ I spend time with my family, friends, and other visitors to the place
 - ☐ I experience more contact with nature
 - ☐ I do sports and other physical activities for the benefit of my health
 - ☐ I come here to relax, feel calm, and unwind.
- Do you have any more comments to add to the benefits this park brings you?
- What is your main occupation?
 - ☐ Unemployed
 - ☐ Retired or pensioned
 - ☐ Homemaker
 - ☐ High school student
 - ☐ University student
 - ☐ Postgraduate student
 - ☐ Worker/employed
 - ☐ Other: _____
- What is your level of education?
 - ☐ None
 - ☐ Elementary
 - ☐ Middle
 - ☐ High school
 - ☐ University

- ☐ Postgraduate
- 5. If you don't live in the city, where are you visiting us from?
 - ☐ From somewhere else in the state
 - ☐ From somewhere else in the Republic (national)
 - ☐ From another country (international)
 - ☐ Not applicable (I live in the city)
- 6. How many times a month do you visit the park?
 - ☐ Almost daily
 - ☐ Two to four times a week
 - ☐ Once a week
 - ☐ One to three times a month
 - ☐ Less than once a month
 - ☐ This time
- 7. How much vegetation do you think there is in the park? (Check only one option)
 - ☐ No vegetation
 - ☐ Little vegetation
 - ☐ A lot of vegetation
 - ☐ Completely covered by vegetation

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