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Review article

# Historical-dendrological analysis of the tree cover of the *Bosque de Chapultepec* (1st section): 3rd part

# Análisis histórico-dendrológico de la cubierta arbórea del Bosque de Chapultepec (1ª sección): 3ª parte

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**Abstract**

This contribution continues with an analysis of the changes and events that have taken place in the tree cover of the *Bosque de Chapultepec* since the second decade of the 20th century, with the administrations derived from the post-revolutionary governments to the present day. Special emphasis is given to the active but short-lived participation of the Autonomous Department of Forestry, Hunting and Fishing, headed by Miguel A. de Quevedo, which was replaced in 1936 by the Federal District Department, following a verbal instruction by the office of the President of the Republic. Advances in knowledge of the tree population during the 20th century were still limited, although two floristic studies (in the 1930s and 1980s) stood out, as did two reports by forestry specialists from federal government institutions, published in 1951 and 1984, describing the deplorable sanitary conditions of the tree population (mainly *Cupressus* spp.). These reports highlighted accurate comments on the factors that influenced the condition of the trees, among which the lack of irrigation was the most significant —given that the springs had been depleted and the water table had fallen for several decades—, along with the absence of guidelines and technical management for years. Finally, this paper discusses the contributions of the 21st century, notably the first comprehensive study of the entire tree cover of the forest, and mention is made of the great challenge faced by *Bosque de Chapultepec* due to the climate change, global warming, and the increase in the urban heat island effect.

**Keywords:** Urban green areas, Mexico City, Autonomous Department of Forestry, Hunting and Fishing, urban tree species, history of arboriculture in Mexico, Miguel Ángel de Quevedo.

**Resumen**

Esta contribución continúa con el análisis de los cambios y acontecimientos que se dieron en la cubierta arbórea del Bosque de Chapultepec, desde la segunda década del siglo XX, con las administraciones derivadas de los gobiernos posrevolucionarios, hasta la actualidad. Especial énfasis se da la activa pero efímera participación del

Departamento Autónomo Forestal y de Caza y Pesca, a cargo del Ing. Miguel A. de Quevedo, dependencia que fue reemplazada en 1936, por el Departamento del Distrito Federal, en seguimiento a una instrucción verbal de la Presidencia de la República. El avance del conocimiento del arbolado durante el siglo XX aun fue limitado, aunque destacaron dos estudios florísticos (décadas de 1930 y 1980), además de dos informes de especialistas del ámbito forestal, pertenecientes a instituciones del gobierno federal, que intervinieron en 1951 y 1984, debido a las deplorables condiciones sanitarias del arbolado (principalmente *Cupressus* spp.). En dichos reportes destacaron los acertados comentarios sobre los factores que influyeron en la condición del arbolado, de los cuales la falta de riego tuvo mayor relevancia, considerando que desde hacía varias décadas se habían agotado los manantiales y abatido el manto freático, aunado a la ausencia de una directriz y manejo técnico dasonómico por años. Finalmente, se comentan las aportaciones del siglo XXI, entre las que resalta el primer estudio integral de toda la cubierta arbórea del bosque y se comenta el gran reto que enfrenta el Bosque de Chapultepec ante el cambio climático, calentamiento global e incremento de la isla de calor urbana.

**Palabras clave:** Áreas verdes urbanas, Ciudad de México, Departamento Autónomo Forestal y de Caza y Pesca, especies arbóreas urbanas, historia de la arboricultura en México, Miguel Ángel de Quevedo.

# Introduction

This article concludes the analytical review of changes and developments in the tree cover of *Bosque de Chapultepec* (*BCh* in Spanish), specifically in what is now known as 1st section, a strategic site for Mexico City for more than seven centuries. The first part dealt with the pre-Hispanic period, the Viceroyalty of New Spain, and the beginnings of independent Mexico up to the Second Empire (Benavides-Meza, 2023); while the second contribution reviewed the final years of the Empire, up to the beginning of the 20th century (Benavides-Meza, 2025).

The history of the *BCh* forest has been marked by events of great significance, including the depletion the springs of the forest and the lowering of the water table, which led to the decline and death of many trees of the species *Taxodium mucronatum* Ten. (Montezuma cypress, *ahuehuete*, or *sabino*) (Bárcena, 1891; Benavides-Meza, 2025). Another important event was the forest renovation project, carried out by the Forest Improvement Board, which changed the appearance of the forest. Equally notable was the absence of technical guidelines during much of this period, which was partially remedied by the *Bosque de Chapultepec* Higher Board, which operated during the improvement project until 1914 (Archivo Histórico de la Ciudad de México [AHCM], 1914).

Based on the above, it is recommended to consult the publications by Benavides-Meza (2023) and Benavides-Meza (2025) for a more detailed overview of what happened at the *BCh* prior to the period addressed in this contribution.

It is important for readers to bear in mind the environmental, social, cultural, and recreational importance and significance of the *BCh*, which is located in one of the most populated and extensive metropolitan areas in the world, consisting of the city's 16 boroughs, 50 municipalities in the State of Mexico, and one municipality in the state of *Hidalgo*, and covering a total area of 7 866 $km^2$ with a population of over 22 million inhabitants (Instituto Nacional de Estadística y Geografía [Inegi], 2020; Secretaría de Desarrollo Agrario, Territorial y Urbano [Sedatu], 2018).

The objective of this third contribution was to continue analyzing dendrological, hydrological, and environmental issues related to the tree cover in what is now known as 1$^{st}$ section of the *BCh*, taking into account the changes that have occurred in conditions of the forest and in the Mexico Valley Basin, both technically and administratively, from the beginning of the 20$^{th}$ century to the present day.

## Administrations in the Post-Revolutionary Regime

When the *BCh* stopped supplying water to Mexico City, the city government's involvement in the forest became less significant, however, the federal government increased, mainly due to the fact that *Chapultepec* Castle was the presidential residence (Campos, 1922).

There is little information available about the trees of the *BCh* after the fall of Porfirio Díaz’s regime and the government of President Francisco I. Madero. Only one document could be consulted in the General Archive of the Nation (AGN, Spanish acronym): a report from late 1916, without a name or signature, prepared by the head

of the *BCh* during the administration of President Venustiano Carranza, in which he stated that "…following instructions to improve and beautify it..." (received around August 1915), "...it was possible to recover it from the worst conditions of neglect in which it found itself...", as it had "...large dry meadows, [and] almost all the plants [were] destroyed, and the crews of laborers, disbanded…" The manager also mentioned a series of activities and highlighted the "...pruning, watering, and inspection of the groves at *Molino del Rey*, *Rancho de La Hormiga* and *Fábrica Nacional de Cartuchos* (National Cartridge Factory)..., and over 500 trees were transplanted on the hill." (Archivo General de la Nación [AGN], n. d.).

In relation to the above, a few years later, Campos (1922) described that "...over 300 *ahuehuete* trees surround the castle and render the forest in that place even more beautiful." These trees most likely survived the major impact caused by the depletion of springs and groundwater in the 19$^{th}$ century, which decades earlier had led to the death of several individuals (Benavides-Meza, 2025).

An additional document found in the AGN refers to a request made by then-President General Álvaro Obregón to the government of the state of *Sonora* to send *saguaros* (*Carnegiea gigantea* (Engelm.) Britton & Rose) to the forest (AGN, 1923), which most likely did not materialize, or perhaps the individuals did not survive, as these plants have not been recorded thenceforth.

It should be noted that, after these documents, there is no information available in the AGN or the Historical Archive of Mexico City (AHCM) until the beginning of General Lázaro Cárdenas' presidency in 1934.

## Participation of the Autonomous Department of Forestry, Hunting and Fishing

At the beginning of General Cárdenas' presidential term (1935), a significant change took place in the administration of the *BCh*, as it ceased to be under the authority of the Presidency of the Republic and became a national park under the newly created Autonomous Department of Forestry, Hunting, and Fishing (DAF, Spanish acronym), headed by Miguel A. de Quevedo (de Quevedo, 1935a). This situation meant that the country's most important urban green area (AVU) was, for the second time, placed in the hands of a group of professionals with the technical knowledge required to carry out the necessary activities. The first time was when the Governing Board of the *Chapultepec* Forest took charge of it as part of the improvement project at the beginning of the 20th century (Benavides-Meza, 2025).

The DAF's intervention provided accurate information on the condition of the trees and the activities carried out, publishing its reports in the Bulletin of the DAF since the start of its activities.

The first issue mentioned various tree maintenance activities, mainly pruning, and reported that old and diseased trees had been "removed" (*i. e.*, felled) (de Quevedo, 1935b) —an activity that continued to be reported in subsequent issues of the bulletin—, which most likely evidenced the poor condition in which the trees had been found due to a lack of technical attention, most likely since the end of the first decade of the 20th.

Issue No. 2 of the newsletter reported on the extensive reforestation of the hills and ravines located towards the *Desierto de los Leones* (presumably what is now the 3rd section and probably further west), with the aim of "...carrying out the great project of joining these two forest units..." (de Quevedo, 1935c). The advisability of expanding the *BCh* northward was also mentioned, since "...the hamlet of a new subdivision called *Polanco* has grown, with all the major inconveniences that such expansion was to bring to the most beautiful of our parks..." (de Quevedo, 1935c).

In August, the monthly reports section noted the expansion of the forest on "...the land acquired in the extreme Southwest along *Calzada Madereros* (now *Avenida Constituyentes*), where reforestation and planting of sacred firs (*Abies religiosa* (Kunth) Schltdl. & Cham.) and *ahuehuetes* took place" (de Quevedo, 1935d). The choice of the first species could be considered erroneous for the *BCh*, as it was not its proper habitat, since it is naturally found in the ravines of the mountainous part of the Mexico Valley Basin (Calderón de Rzedowski & Rzedowski, 2001), which are more sheltered and humid places.

The October report documented the planting of several thousand pine trees on the former *Rancho de la Hormiga*, following President Cárdenas' request, which is why the site was named *Parque de los Pinos* (Pine Park) (de Quevedo, 1935e) —a predecessor of what would later become the *Los Pinos* presidential residence, now a cultural complex. Notably, the report of this month mentioned "...many thousands of people..." were reported to have visited the *BCh* on the weekends, generating a large amount of trash, a situation that made it difficult to keep the *BCh* clean, given that "...the current budget (did not allow for) an effective cleaning service...". Likewise, efforts were made "...to prevent children's playground equipment from invading the meadows, taking away space for walkers to enjoy themselves... and detracting from the beauty of the landscape...". Eng. de Quevedo also pointed out that he had prevented "...the invasion of various meadows by kiosks selling foodstuffs (*sic*), which spoil the view and litter the ground..." (de Quevedo, 1935e).

It is interesting to note that the social issues referred to by Eng. de Quevedo in 1935 remain relevant almost 100 years later; the litter generated by visitors is a recurring problem, as is the presence of vendors located at the main entrances and along the route to the zoo, which has increased over the years.

In the October newsletter, Eng. de Quevedo reported on the closure of a cabaret located in an old space that was built during the improvement project at the beginning of the century, originally occupied as a restaurant. Over the years, the place was leased before the DAF began its activities. Eng. de Quevedo stated in this regard that "...in agreement with the Technical Conservation Commission, the Ministry of Finance,

and the Federal District Department, they decided to eliminate such an inconvenient locale...” (de Quevedo, 1935e).

In the final pages of issue number two of the aforementioned bulletin, written in December 1935, Eng. de Quevedo included a section entitled “Work program carried out in *Bosque de Chapultepec* during the course of 1935 and which should be continued in 1936,” in which he presented information and ideas of great interest and significance. At the beginning of this document, he mentioned the members of the aforementioned Technical Commission for the Conservation of *Chapultepec* Forest, which included a representative from the Ministry of Education (Department of Conservation of Historical and Colonial Monuments); a representative from the Federal District Department, in this case the Head of the Office of Parks and Gardens; a delegate from the Planning Commission, and citizens knowledgeable on the subject, such as biologist Alfonso Herrera, founder of the zoo, a hygienist (public health), and a Swiss expert on national parks (Mr. Lenz), who “provided the Department with the standards that have been applied for its effective improvement...” (de Quevedo, 1935f).

In this program, Eng. de Quevedo proposed a series of recommendations that can be considered examples of management activities for an AVU, as he recommended undertaking its conservation “...with the utmost care, of the truly indigenous groves, such as the *ahuehuete* that dominated the entire primitive section of the forest with their beauty, great development, and longevity... into whose groves, exotic species like eucalyptus trees (*Eucalyptus* spp.) and privet (*Ligustrum lucidum* W. T. Aiton) were improperly introduced (most likely in the 1920s) as many of the old *ahuehuete* trees disappeared. Such exotic species which must be gradually removed to prevent them, particularly eucalyptus, from dominating over and harming the surviving *ahuehuete* trees…, and the privets within the wooded areas, as well as the *tepozan* trees and other diverse species, which must be replaced by new *ahuehuetes* and sacred firs... renewing the forest while preventing it from becoming excessively dense, so that visitors can walk through these beautiful parts of the forest…" (de Quevedo, 1935f).

Another management measure he proposed was that, because "…the number of people visiting the forest is increasing, particularly at midday on Sundays and public holidays… coming in by the thousands... forestry work must be carried out to cut down defective or unsuitable trees which, due to their density, prevent the use of wooded areas for public recreation..., to allow greater penetration of sunlight..." (de Quevedo, 1935f).

He also recommended (de Quevedo, 1935f) that, in order to accommodate more visitors to the meadows, "...the treeless areas should not be occupied by kiosks, shops, and playgrounds, so that families can enjoy the place…". He also reported that "...the playground equipment had been concentrated near the zoo and the food stalls that were scattered throughout various parts of the forest…". He reiterated the major issue of the trash generated by "...the public on public holidays... because the next day the meadows and other places are littered with all that unhealthy and unsightly waste…" (de Quevedo, 1935f).

Furthermore, Mr. de Quevedo (1935f) pointed out that during 1934, when the Director's Office was under the authority of the President of the Republic, the budget had been $400 000.00 *pesos*, while when it was transferred to the Forestry Department in 1935, the Ministry of Finance allocated only $200 000.00 *pesos*, and, therefore, the number of workers and employees, as well as other expenses, had to be reduced. This meant that the planned improvements could not be carried out, nor could various services be properly provided, so he recommended a minimum budget of $250 000.00 *pesos*. Finally, he addressed certain suggestions regarding the botanical garden, the zoo, and the need for parking spaces, the expansion of the *BCh* to land that had been acquired near *Molino del Rey* (located in what is now the 2$^{nd}$ section), and that the exhibition area be located to the North (facing *Polanco*).

Finally, he referred to a matter of great importance, namely the provision of irrigation water for the *BCh*; given that this "...was one of the greatest difficulties encountered by the Department in improving the conditions of the Forest and even in conserving it properly... it is therefore necessary for the Central Department (Department of the Federal District or DDF) to address this issue as a matter of priority, for the proper conservation of the Forest..." (de Quevedo, 1935f).

The work program written by Eng. de Quevedo and outlined in the preceding paragraphs appears to have been drawn up on the assumption that the DAF would not continue its participation in the *BCh*, which became effective at the beginning of the following year (1936), through a verbal instruction from President Lázaro Cárdenas (Departamento del Distrito Federal [DDF], 1942) and, therefore, the technical actions of the DAF in the most important urban green area (AVU) in the country were unfortunately short-lived (lasting only one year).

It is very likely that the actions of Eng. de Quevedo and the professionals and technicians of the DAF caused friction with officials and individuals with interests inside and outside the *BCh*, as may be inferred from the actions recorded in the bulletin, mainly those related to the defense of the forest boundaries and his proposal to President Cárdenas to expand the forest to the North and West (AGN, 1935), which surely contravened the intentions of real estate developers and officials who were interested in the land located in the neighborhoods surrounding the forest (*Polanco*, *Anzures* and *Lomas de Chapultepec*). In this regard, it was possible to locate and consult in the AGN certain documents on the concerns of individuals regarding the expansion of the forest —such as AGN (1937a) and AGN (1937b)— in which the intervention of President Cárdenas was requested.

Moreover, the attempt to regulate commercial activities in the forest (playground equipment and food stalls) and even the closure of the cabaret located inside it, presumably generated a hostile environment, since, as stated in the final report presenting the actions in favor of the forest, "...the criticism made by those expelled regarding the Department's work in that forest is unjustified..." (de Quevedo, 1935e).

What is beyond doubt is the selfless work of Eng. de Quevedo to preserve and improve the *BCh* and expand it, particularly towards the West, with the intention of connecting the forest areas of *Chapultepec* with *Santa Fe* and the *Desierto de los Leones* and thereby protecting the slopes of the *Sierra de las Cruces* foothills, an area of great importance for water resources as it is a recharge zone for Mexico City's aquifer. Unfortunately, these areas are now densely urbanized, with considerable surface runoff (Santos-Cerquera & Rodríguez-Caamaño, 2020).

## Change of administration to the Department of the Federal District

In January and March 1936, the administration of the BCh was transferred from the DAF to the DDF, based on a verbal instruction from President Cárdenas. This procedure was referred to in a decree issued several years later (June 15, 1942) by President Manuel Ávila Camacho, who finally formalized the transfer (DDF, 1942). The decree mentions the boundaries of the forest, including the *Madereros* road (*Constituyentes* Avenue), the *Jalisco*, *Mariano Escobedo*, and *Campos Elíseos* avenues; the boundaries of the *Paredón* (*Arquímedes* street) and *Fundición* (*Newton* street) roads, which are located further North of the current location; as well as the wall of the *Dolores* Civil Cemetery, which currently forms the Western boundary of the 2nd section. Also mentioned are the properties that belonged to the federal and Federal District governments, the National Autonomous University of Mexico, military facilities, schools, sports facilities, and the presidential residence of *Los Pinos* (DDF, 1942).

In relation with the new administration and the vendors, it was possible to consult a memorandum from the office of markets of the Treasury of the Federal District, which states that the DAF, "...upon taking office (at the *BCh*) ...prohibited the installation of stalls and street vendors, removing most of them..."; however, when the Federal District Government took over the management at a later time, they increased in number (AGN, 1937c). The person who wrote the memo clearly showed an affinity for the merchants and even commented that the tax they were paying at the time was excessive, proposing that it be reduced, considering that "they are humble people". He recommended that more stalls be set up, even though the Mexico City Parks and Gardens Office had prohibited it, as they would affect the trees, a situation that the signatory believes will not happen (AGN, 1937c).

Concomitantly with the change in the management, a year and a half later, President Cárdenas received a complaint about excessive logging in the *BCh*, under the pretext of opening roads. The president ordered a review of the DAF, and the report prepared

by the inspector from the Central Forestry Delegation indicated that the damage recorded could not be considered indiscriminate logging. However, at the end of the document, he mentioned that most of the Forest was neglected and unguarded, "...so that outsiders enter it to collect firewood...". He added that it was "...essential to create a new mass formed by native species... to replace the current tree mass that has already fallen into decay and which for many years was admired by thousands of people... and, if studied in depth, [this endeavor] will be observed to require broad participation by the Autonomous Department of Forestry, Hunting and Fishing to provide it with a technical basis and prevent criticism…" (AGN, 1937d).

Since the *BCh* came under the control of the DDF in 1936, the actions carried out were described in its annual activity reports, such as DDF (1937), DDF (1945), and DDF (1967), to name just a few, and which usually mention among other activities the repair of buildings, gardening work and reforestation (numbers, but not species), which are available mainly at the Mexico City Historical Archive (AHCM).

Over the years, the administrative structure of the DDF underwent changes, and as a result, the *BCh* even came to depend on the *Miguel Hidalgo* borough. However, given the proximity in time that facilitates the consultation of information, no mention is made therein of the changes or events surrounding the forest, highlighting only the declaration of the forest as an area of environmental value (Gobierno del Distrito Federal [GDF], 2003) and the subsequent publication of a management program (GDF, 2006) that fails to establish clear specifications regarding the trees and the issue of the *BCh*.

In this final stage of the administrative changes to this important AVU, it is important to mention the formation of a Citizen Governing Council for the *Chapultepec* Forest (2002) and the creation of the *Chapultepec ProBosque* Trust (2004) —two private organizations that, through the review, opinion, and advice of the former and the financing and operation of projects of the latter (with resources obtained from donors and from the city government), contribute to improve the forest through various research, infrastructure, and maintenance projects.

### *Los Pinos*

After the fall of the Second Empire, the *Chapultepec* Palace became the official residence of the presidents of Mexico until the six-year term of President Lázaro Cárdenas, who in 1937 transferred the residence to the former *La Hormiga* ranch, located next to the *BCh* and which at one time formed part of it and was reforested with pine trees, as described by de Quevedo (1935c).

As soon as this space became the presidential residence, it ceased to be the responsibility of the *BCh* and in 2018, the place became a cultural complex with the same name, under the responsibility of the Federal Ministry of Culture. It is paradoxical that the site now has almost no specimens of the *Pinus* L. genus, as the vast majority of the trees are ash trees (*Fraxinus uhdei* (Wenz.) Lingelsh.) and privets.

## Subsequent contributions on tree cover in the 20th century

Engineer de Quevedo (1933) commented early on that the *ahuehuete* trees of the *BCh* "...suffer and do not thrive with the same strength and vigor, and even become diseased and dry out due to lack of moisture and the urban atmosphere that now surrounds them and undoubtedly damages them...". This remark by such an eminent figure in the field of forestry and urban forestry in Mexico was a warning about the future that awaited the *ahuehuete* trees in the *BCh* and even in Mexico City, as they were not compensated in subsequent decades with sufficient irrigation and maintenance, and the thinning of privet and eucalyptus trees that he recommended in 1935, as mentioned above, was never carried out —a situation that persists even today.

In 1934, the first accurate contribution on the tree species of what is now 1st section of the *BCh* was made, thanks to Biologist Agustina Batalla Zepeda, a researcher at the *UNAM* Institute of Biology, which was then located in what is now *Casa del Lago*. This pioneering contribution, which is purely floristic in nature, includes no record of the number of individuals or the condition of the trees, as its purpose was to promote knowledge of the species in the forest (Batalla-Zepeda, 1934).

In the mid-20th century, a new contribution was made to the *BCh*'s tree population, stemming from a request by the Secretary of Agriculture and Livestock to the General Directorate of Forestry and Hunting (perhaps prompted by the Presidency of the Republic) to enable the staff of that directorate to carry out a study on the precarious health situation of the trees (Ortega-Cattaneo et al., 1951). This situation was resulting in obvious tree mortality, a condition that, it should be noted, had already been anticipated by Eng. de Quevedo in 1933 (de Quevedo, 1933).

In the introductory section of the report, the Director General of Forestry and Hunting, Eng. Eulogio de la Garza, stated that, since 1935, "…an intense attack by bark beetles on white cedar" had been detected in the forest (most likely on *Cupresus benthamii* Endl. [synonym of *Hesperocyparis benthamii* (Endl.) Bartel]), which had been widely planted decades earlier, or also *Cupressus lusitanica* Mill. (synonym of *Hesperocyparis lusitanica* (Mill.) Bartel). Eng. de la Garza noted that "...the sanitary protection of the site had been neglected, and there had been no technical intervention whatsoever..." and emphasized "...that the work...was experimental and investigational..." (Ortega-Cattaneo et al., 1951), which highlighted the lack of personnel with experience in managing urban trees in Mexico at that time.

Ortega-Cattaneo et al. (1951) reported that the forest was a mixture of species (mixed forest), although they only recorded individuals of the most affected taxa (*C. lusitanica* and *C. benthamii*, *Pinus* spp. and *Platanus occidentalis* L.), categorizing them as healthy, damaged, and dead. They recommended applying a series of chemical treatments to control the detected pests and commented on the factors that could have led to the infestation, such as "...vehicles passing along roads adjacent to the *BCh*, carrying (forestry) products from damaged areas". Another cause may have

been "...the alteration of the thickness in which these species live when established in the *BCh*...". Furthermore, the "...tamping, paving, and construction of the site have compacted the soil surrounding the roots, hindering or preventing the air they need to function normally from entering, in many cases causing the tree to die of suffocation", coupled with decreased precipitation, which they documented with a table containing data from the Mexican Meteorological Service (Ortega-Cattaneo et al., 1951).

The water issues affecting the trees persisted during those decades, according to a comment referred to in a publication by the DDF (1956) titled *Noticia de Chapultepec*, which reported: "…its *ahuehuete* tree forest...has been thirsty. Just two years ago, the authorities in the capital ordered...four tanker trucks, each with a capacity of 1 700 liters, to dump their contents...on the *ahuehuete* trees every day…". The author of the document goes on to say that the water supply issue had been solved by using water from the *Hondo* River and the then "...upcoming installation of a sewage treatment plant…" (DDF, 1956). However, the solution proved insufficient over the years and the plant ceased to operate. Currently, the irrigation problem remains and is an environmental factor of great importance for the trees.

For almost five decades, there were no further contributions on the tree cover of the *BCh*, and it was not until the completion of a professional thesis by Biologist Lorenza Tovar y de Teresa in 1982 that knowledge on this subject was renewed. It should be noted that the findings of this study were not published in any journal or other publication.

A couple of years later, most likely as a result of the health issues that had affected the trees in the past, two researchers from the National Forest Research Institute (INIF) conducted a survey of the trees located in the area surrounding *Constituyentes* avenue, using data from a partial inventory carried out in 1978 by the Forest Coordination Agency (Gutiérrez & Muñiz, 1984). The authors recorded 428 trees with some damage, of which 207 were damaged or severely damaged. The species *Platanus orientalis* L. (sic), previously cited as *P. occidentalis* by Batalla-Zepeda

(1934) and in the 1982 thesis, was predominant, along with *Cupressus lindleyi* Klotzsch *ex* Endl. (now *Hesperocyparis lusitanica*) and *Eucalyptus* sp.

These authors described the pest organisms affecting the trees and commented that "...the deterioration of the trees in the *BCh* continues with the same intensity, showing no signs of slowing down..., and it is easy to imagine the imminent disappearance of these species and, consequently, of the forest…". Finally, they stated that "...the damage caused by pests is very severe...", being a consequence of the planting of species without considering their requirements, the construction of buildings and roads; they also highlighted that individuals of *T. mucronatum* "...are a very clear example of the effect of water shortage and that [the water] they obtain from irrigation is not enough…". Therefore, among other aspects, they recommended an in-depth study of plant species for establishment, as well as of irrigation systems and techniques for protecting the trees against pests and diseases.

The comments made by engineers de Quevedo and de la Garza engineers as well as the forest professionals who drafted the 1951 document, indicate that the *BCh* did not have effective technical guidelines before or after the DAF. It is also interesting to note that, sometime later (30 years) after the work carried out by Ortega-Cattaneo et al. (1951), the same problem arose in the *BCh*, which suggests that the personnel in charge of the forest during that period lacked the technical knowledge to manage it and that, unfortunately, with few exceptions, this situation has persisted.

## Studies of tree vegetation in the 21st century

No studies on the tree population were carried out during the rest of the 20th century, and it was not until the beginning of the 21st century that the City Studies Program of the National Autonomous University of Mexico prepared a diagnosis requested by the

Federal District Environment Secretariat, with the aim of supporting a Comprehensive Management Program for the *BCh* (Programa Universitario de Estudios de la Ciudad-Universidad Nacional Autónoma de México [PUEC-UNAM], 2002). Although the work is very extensive, the information gathered in relation to the trees was limited. However, one relevant piece of data provided by this contribution was the number of annual visitors, which was determined for the first time in a more reliable manner and amounted to 14 423 257 per year. Of these, 38 % came from the Mexico City Metropolitan Area and were distributed differentially among the three sections, with the first section being the most visited, with 9 173 257. Although this information does not relate to trees *per se*, it is one of the disturbance factors that can affect tree cover and, therefore, is an aspect to be considered in urban green space management programs (Benavides-Meza, 2015). Another factor was the informal trade in the *BCh*, which they classified as the "privatization of public space" and which was estimated to generate sales for 150 million pesos per year (PUEC-UNAM, 2002).

Schjetnan and de la Rosa (2005) proposed a Comprehensive Rehabilitation Master Plan for *Chapultepec*, sponsored by the Citizen Governing Council, and noted that in recent decades the forest had suffered environmental and landscape deterioration, among other issues, "…with numerous well-intentioned reforestation and gardening campaigns, but without technical criteria...", which had "...caused an oversaturation of plant species in many areas..." and highlighted "...the loss of open spaces, necessary (both) for the environment and for recreation…". Several actions were carried out as part of this plan, including tree pruning (Schjetnan & de la Rosa, 2005).

A more detailed study of the forest's trees was carried out by Benavides in 2013 (thanks to financial support from the *Chapultepec ProBosque* Trust), using a network of sampling stations in 26 of the more than 45 operational subzones into which the 1$^{st}$ section was divided. The results of the project were not published beyond the report submitted to the *Chapultepec* Forest Management, as it was hoped that funding would be obtained to complete the diagnostic work on the entire tree cover. However, this was not possible due to a change in the forests and, consequently, in its areas of interest. These results, however, served as a basis for a subsequent project carried

out in several stages with financial support from the Ministry of the Environment, through the Directorate of Urban Forests and Environmental Education (2012-2018), the *Chapultepec ProBosque* Trust, and later the National Council for Science and Technology (Conacyt) in the period 2019-2021. This made it possible to complete the diagnosis of the trees in the 1st section, record their characteristics and conditions, and, most innovatively, quantify the environmental services they provide and their economic value, which will be the subject of a subsequent publication.

## Final remarks

The lack of accurate information on the characteristics and conditions of the *BCh*'s trees was a constant for several centuries, as only the majestic *ahuehuetes* were highlighted in the chronicles of the Viceroyalty and the early 19th century. In the 20th century, although more information was generated, contributions were of a floristic nature or addressed large-scale health problems in the tree population; therefore, these latter studies only emphasize the affected species, without going into greater detail about the conditions of the other individuals present at the site.

It is important to highlight the brief intervention of the Autonomous Department of Forestry, Hunting, and Fishing, headed by Eng. de Quevedo, who took care to record the activities carried out in the department's bulletin, including proposals for the management of what is now the 1st section that were not addressed by subsequent administrations within the structure of the Department of the Federal District. Among these recommendations, the lack of attention to the shortage of water supply for tree irrigation stands out, as the documents consulted frequently mentioned or recorded its impact, a situation that persists today, since the irrigation network built during the

2012-2018 term has not functioned due to technical issues, which is known to the author and has even been published in national newspapers.

Likewise, the health crises that have affected the trees at different times during the 20th century and up to the present day, demonstrate this impact on the tree population, as exemplified by the number of dead standing trees recorded in the latest diagnosis of the 1st section, which was carried out by the author of this document and reported to the forest director's office (738, equivalent to 2.91 % of the total), as well as the news articles published with some frequency. The lack of technical guidelines continues to be a constant in the *BCh* to date, with some exceptional periods that fail to resolve the accumulated problems.

*Bosque de Chapultepec* is a delighted place for all Mexicans, and therefore, deserves specialized attention to its tree cover to enable its protection, conservation, and improvement, particularly under the adverse environmental conditions resulting from global warming and the increase in the urban heat island effect, which are likely to have the same significance as the decline in the water table and the depletion of aquifers that occurred at the end of the 19th century (Benavides-Meza, 2025).

# Conclusions

The *Bosque de Chapultepec* has been a strategic location for Mexico City since pre-Hispanic times and a place of recreation for the city's inhabitants since the 16th century.

The water situation at the site and in the basin significantly affected and continues to affect the development and survival of the tree cover.

The recurrence of phytosanitary problems and tree mortality since the late 19th century, shows that *Bosque de Chapultepec* has regularly been affected by

environmental factors that were not addressed by the staff in charge of it in a timely and appropriate manner.

It is essential that the management and technical staff of the *Bosque de Chapultepec* have extensive knowledge in the areas of urban arboriculture, dendrology, and urban forestry, in order to promote its development in the best possible conditions.

Priority attention must be given to *Bosque de Chapultepec* by the City and Federal Government Agencies related to this matter, with the participation of research and teaching institutions in urban arboriculture and forestry, as well as citizens and civil organizations such as the *Chapultepec ProBosque* Trust and the Citizen Governing Council, which contribute to addressing the challenges facing the forest, global warming and the increase in the urban heat island effect.

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## Conflict of interest

The author declares that there is no conflict of interest with any company or institution related to this work.

## Contributions by author

The author is responsible for all components of this work.

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