

Article

The Identification of Historic Plant Landscape Characteristics and Conservation Strategies for Longevity Hill Based on the WSL Monoplotting Tool

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Abstract: The surrounding environment of architectural heritage sites is integral to cultural heritage protection; plant landscapes play crucial roles in them. Controlling plant spaces and appearances is essential for preserving plant landscapes. A World Cultural Heritage Site, the Summer Palace has undergone multiple changes since the 1860s; restoring and protecting plant landscapes has been an ongoing research focus. However, data accuracy limitations have hindered analyses of the overall spatial characteristics of historical gardens. Here, the historical dynamics and unique landscape features of plants on the front hill of Longevity Hill (FLH) are explored, and conservation and renewal strategies are proposed. Geographic information system (GIS) and WSL Monoplotting Tool are used to identify historical plant spaces. Plant space types are classified, and their landscape characteristics are analyzed. On the basis of historical events, the historical plant spaces on the FLH can be divided into two major categories and six subcategories. The vegetation retention area (south side) was less affected, and the plant landscape along Kunming Lake was the most well-preserved. However, the vegetation-damaged area (north side) was impacted more in the western part than in the eastern part, with notable changes in spatial landscape characteristics, particularly regarding forest function, morphology, and structure. Strategies are proposed for reducing human intervention and adjusting retention areas; furthermore, historical images and spatial grading in damaged areas can be used to suggest landscape adjustment and restoration strategies. This study introduces a method for analyzing the historical characteristics of plant landscapes over time that can be used to protect cultural heritage sites worldwide.

Keywords: world heritage site; plant landscape change; multitemporal; historical photographs; monophotogrammetry; georeferencing



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1. Introduction

Historical gardens, as distinctive cultural heritage sites, are protected by their architectural surroundings; they play a pivotal role in urban historical landscapes [1]. Plant landscapes constitute a vital component of these environments. Article 2 of the Florence Charter explicitly underscores the importance of plants [2]: “The historic garden is an architectural composition whose constituents are primarily vegetal and therefore living, which means that they are perishable and renewable”. In the context of the Chinese cultural emphasis on garden design, composition, and artistic conception, the preservation of historical gardens addresses the issue of “authenticity”, aiming to maintain their original state amid natural changes through human intervention [3]. The spatial relationship of plant landscapes with literati aesthetics, landscape settings, and architecture is a critical aspect of Chinese historical garden design and artistic conception. Globally, historical research serves as the foundation for the conservation and development of historical garden plantings. Historical documentation and comparative analysis are essential in determining the conservation, restoration, and maintenance levels required for plant landscapes [4]. However,

unlike historical buildings, many Chinese historical gardens lack detailed drawings similar to those for architectural structures [5]. Plant studies often rely heavily on classical paintings [6–8] and literary works (primarily poetry and essays) [9,10]. The poetic and abstract representations in these sources contrast with modern design blueprints. Furthermore, owing to scale issues in classical maps and the expressive techniques of Chinese classical paintings, the accuracy of image data is challenging to ascertain, resulting in substantial inaccuracies [11]. Therefore, research often focuses on qualitative assessments of the nature of historical plant landscapes rather than on more precise quantitative studies.

With technological advancement, digital techniques have gradually been applied to the study of historical gardens in recent years [12]. Some studies have attempted to simulate and recreate the historical spatial characteristics of gardens via mathematical models based on parameter systems [13]. However, such methods are not universally applicable to all historical gardens. This is because natural elements, particularly plants, exhibit changing dynamics, and many features have been altered over time. As dynamic data, historical photographs enable analysis of the dynamics and complexity of plant landscapes in historical gardens [14]. When combined with auxiliary digital models, historical photographs assist in documenting changes in plant landscapes [15]. Nevertheless, extracting quantitative information from photographs remains challenging. Compared with satellite and aerial imagery, historical photographs with tilted perspectives lack geographic references. The usefulness of photographs is affected by variations in lighting, vegetation, and other obstructions. Consequently, comparative analyses based on the integration of similar photographs from different historical periods are challenging [16,17]. Such approaches are typically limited to studies of relative changes and cannot be used to estimate actual coverage precisely due to data and technical constraints [14,18]. This situation complicates analyses of plant landscape characteristics in historical gardens. To address these challenges, researchers employ monoplotted techniques to process historical photographs, aligning them with geographical coordinates. The WSL Monoplotted Tool (WSL-MPT), developed by the Swiss Federal Institute, currently permits the geo-alignment of individual oblique aerial images without the necessity for multiple overlapping images, which are typically required by traditional photogrammetric geo-alignment practices. The tool is capable of integrating photographs taken at different angles at different times into a single spatial coordinate, thereby enhancing the accuracy of the analysis [19]. To date, WSL-MPT has been utilized in quantitative analyses of natural disasters [20], glacial processes [21,22], land cover changes, and other fields [23–27]. Nevertheless, the application of the monoplotted tool in conjunction with historical heritage conservation is a relatively uncommon practice. The tool, however, has the potential to serve as a reliable research foundation for the analysis of the spatial configuration and attributes of plants in historical gardens through the utilization of the spatial overlay technique, which combines image data and multitemporal data.

Landscape characteristic assessment (LCA) is increasingly employed in numerous studies to discuss historic garden conservation as a perceptible entity [28]. It comprehensively assesses the geographical, physical, and social perceptions of historical gardens, establishing standards and conceptual frameworks to document their spatial uniqueness [29,30]. The dynamic development of historical gardens necessitates multitemporal analyses of heritage elements, placing them within a coherent framework of spatial and temporal continuity. Analyzing changes in plant heritage through dynamic landscape approaches facilitates the introduction of more precise conservation and development guidelines, as well as policy actions [31,32], thus enhancing the locality of historical gardens.

The Summer Palace, also known as the Garden of Clear Ripples, was inscribed on the UNESCO World Heritage List in 1998. It is an outstanding embodiment of Chinese garden design and artistic creativity, epitomizing the principles and practices of Chinese garden design. It is also renowned as China's most illustrious and well-preserved imperial garden palace [33]. The Garden of Clear Ripples, Jingming Garden, Jingyi Garden, Yuanmingyuan, Changchun Garden, Longevity Hill (LH), Fragrance Hill, and Jade Spring Hill, along with various temple gardens, private gardens, and surrounding environment,

collectively form a vast cluster of gardens in the northwestern suburbs of Beijing known as the “Three Hills and Five Gardens”. The Three Hills and Five Gardens represent one of the focal areas within Beijing’s historical and cultural city protection system. This cluster has important cultural resource enrichment areas where the cultural belts of Xishan and the Yongding River intersect with the Grand Canal cultural belt, intricately blending traditional historical culture with emerging culture. The central features of the Summer Palace, LH, and Kunming Lake play crucial roles in the organic integration and overall environmental formation of the Three Hills and Five Gardens [34]. LH was rebuilt by bulldozing the foundation hill of Weng, and the artificial cultivation of plants on LH was recorded in the royal regulations of the Qing Dynasty. The design of the plant landscape on LH began in 1750. Over many years, a multitude of tree species were introduced, resulting in the gradual formation of a luxuriant expanse comprising coniferous pines, cypresses, and a diverse array of forests, including deciduous and broad-leaved arborvitae species. Pines and cypresses have always been regarded as a symbol of “high morality and longevity”, favored by ancient Chinese royalty and literati, and their design and layout reflect the will and aesthetics of the emperors, emphasizing the creation of an atmosphere of high cultural value [35]. The front mountain of Longevity Hill (FLH) serves as the central focal point and primary viewing interface of the entire garden, representing the pinnacle of national garden artistry with its meticulous layout. The central courtyard and plaza feature a structured planting pattern, with cypress trees interspersed with pine trees. Furthermore, the temple is embellished with symmetrically arranged shrubbery on its flanks. Elsewhere on the FLH, a more naturalistic approach is taken with scattered plantings of pine and cypress trees. The dense greenery of these trees harmonizes with the vibrant hues of the palaces and pavilions, creating a vivid color scheme that epitomizes the grandeur of imperial gardens [35]. Since 1860, the plant landscape of LH has experienced varying degrees of damage due to successive events, including the Second Opium War, the Boxer Rebellion, the invasion of the Eight-Nation Alliance, and World War II. The destruction of the plant landscape of LH has had a significant impact on the cultural value and connotations associated with this natural environment. Subsequent efforts in restoration and preservation have been hindered by economic and political constraints, and a comprehensive restoration approach based on historical landscape studies is lacking. Therefore, there is an urgent need to analyze the changes in the plant landscape of the FLH and study appropriate policies for its conservation [36,37]. The focus of this study is on researching the evolving characteristics of the plant landscape in the Summer Palace, specifically examining different historical periods of the FLH plant landscape via historical photographs. This study aims to identify and analyze these characteristics from the perspectives of plant landscape spatial organization and aesthetic control and provide scientific recommendations for the future management and conservation of the Summer Palace plant landscape. Two research questions are considered:

1. How has the spatial configuration of vegetation changed during the restoration process of the FLH since severe damage occurred in 1860?
2. Compared with the 1860s (late Qing dynasty), what changes have occurred in the botanical landscape and appearance of the FLH?

This study makes several contributions to the field. First, it introduces a novel approach to studying landscape features by combining the identification and analysis of historical garden spatial characteristics with the analysis of extra-garden landscape features. Second, the study employs photographs, which are more precise than traditional literary works and paintings, ensuring data authenticity. The focus is on quantitative analysis, as photographs taken from different angles and periods are integrated into a unified spatial coordinate system, thereby providing more accurate assessments of changes in plant landscape features. Third, the Summer Palace is employed as a case study to provide insights into the conservation of plant heritage from a landscape feature perspective, thereby enhancing our comprehensive understanding of landscape spatiality, plant aesthetics, and cultural heritage preservation. The research findings provide references for

the protection of historical plants at various levels and in different areas within the Summer Palace, a UNESCO World Heritage site, and offer methods for identifying, analyzing, and conserving various heritage elements that have undergone significant historical changes at other cultural heritage sites.

2. Materials and Methods

2.1. Study Area

This study focuses on the FLH in the Summer Palace. The research scope of this paper was delineated by overlaying panoramic photographs of the FLH from 1860 to 2024 within the visible area (method detailed in Section 2.2.1). The geographical coordinates spanned from 116.264° E to 116.272° E longitude and 39.999° N to 39.996° N latitude, covering an area of 7.66 hectares (Figure 1) [35]. The architectural alignment relationships of the FLH are illustrated in Figure 2. A series of isosceles triangles were employed to control the architectural complex, creating an invisible network that bound the entire facade into a stable whole. This facade was akin to a pyramid, enhancing the solemnity of the imagery. Simultaneously, garden designers devised five axial lines as the main visual corridors of the FLH, effectively fulfilling both scenic highlighting and viewing needs and thereby achieving a harmonious blend of variability within rigorous architectural forms.

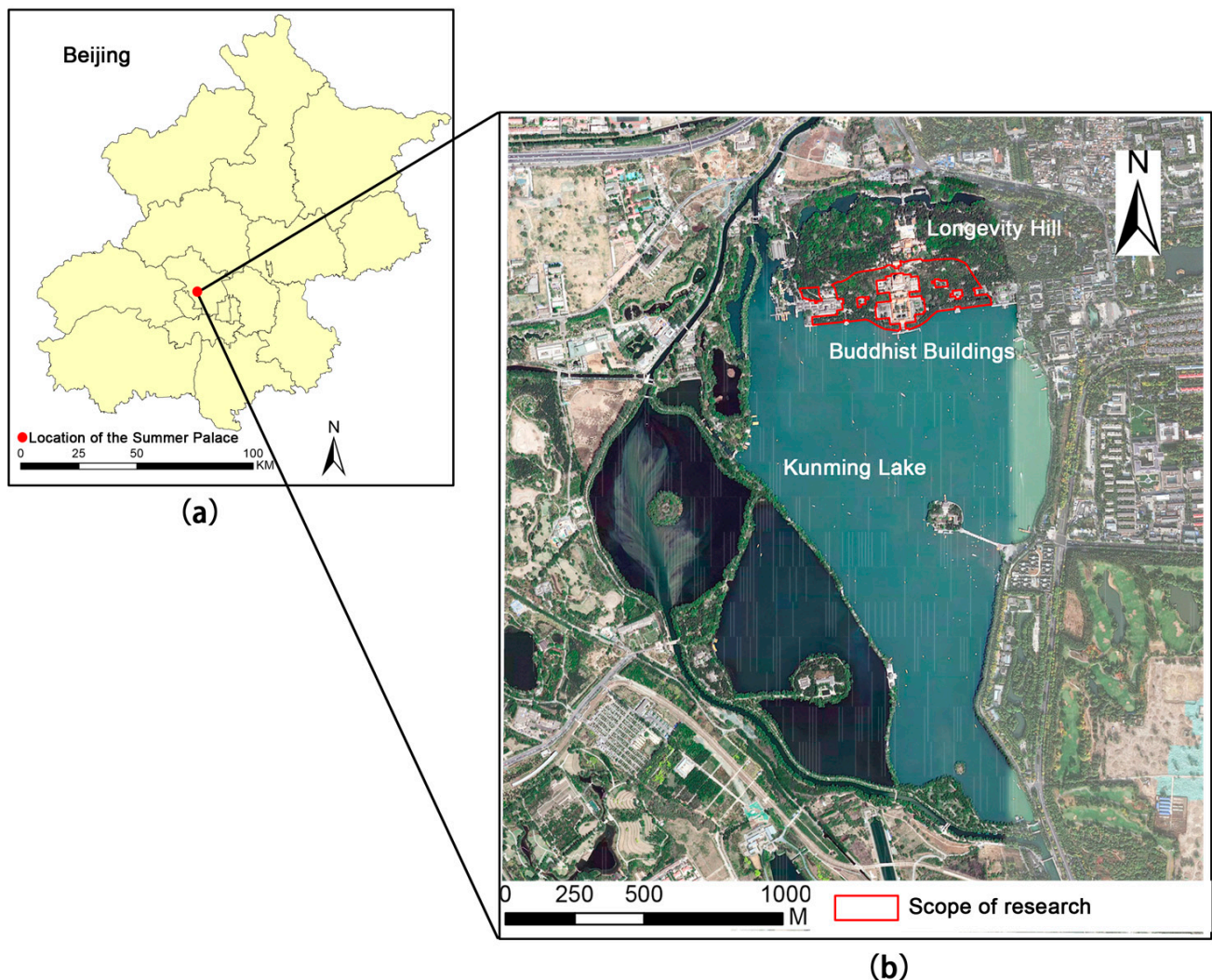


Figure 1. (a) Location of the Summer Palace; (b) map of the Summer Palace (courtesy of Big Map) with specific study areas indicated by the red line.



Figure 2. Analysis of the basic architecture and structure of Longevity Hill.

2.2. Data Collection and Preprocessing

2.2.1. Data Collection

The study utilized three types of data: historical literature, historical photographs, and geographic information data.

Historical literature data were sourced from local chronicles of the Summer Palace and government official documents, totaling 145 entries, primarily including “*Records of the Summer Palace*” and “*A Series of Examinations on the Historical Events and Characters of the Summer Palace*”. These data are officially recognized by the government and the Summer Palace authorities, ensuring their authority and authenticity. Researchers have used these data to delineate periods of change in the FLH.

Historical photograph data were sourced from government official media, news reports, and public digital libraries with copyright permissions for photographs. These data provided foundational information for historical plant spatial classification and were also used to analyze the botanical landscape characteristics of the FLH during different periods.

The geographic information data included digital elevation model (DEM) data from the Resource-3 satellite launched by China, which is accessible at <http://sjfw.sasmac.cn/> (accessed on 15 January 2024). DEM data were extracted via ENVI 5.6 software with a spatial resolution of 5 m. The vector boundary data of the Summer Palace were obtained from “Mapping Essential Urban Land Use Categories in China (EULUC-China): Preliminary Results for 2018 [38]” and satellite images from BIGEMAP (<http://www.bigemap.com/>, accessed on 23 December 2023). These data significantly enhanced the accuracy of using the WSL single-plot technique for analysis.

This approach integrated diverse data sources to comprehensively analyze the dynamics of the FLH in the Summer Palace, providing a robust foundation for understanding its historical and botanical landscape changes.

2.2.2. Data Preprocessing

According to the collected historical literature data, researchers screened and compiled events influencing the botanical landscape of the FLH (Table A1). Concerning photograph data, researchers selected historical photographs that focused on the main scenery of the FLH, documenting the sources and dates of the photographs (Table A2). Using the WSL single-plot method (Section 2.3), researchers have conducted field surveys to confirm the coordinates and elevations of the photograph capture points (Figure 3). Simultaneously, measurements of the geographic coordinates and elevations of various architectural platforms, which were used to refine the DEM data, were taken.

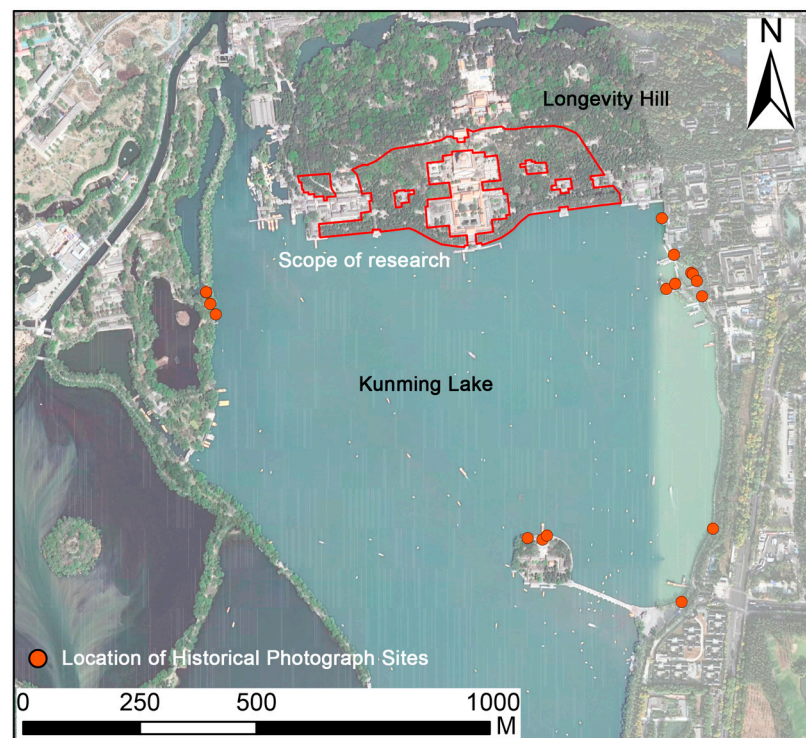


Figure 3. Locations of historical photographs (identified through field research).

2.3. Identification and Classification of Historical Plant Spatial Features

Researchers have utilized the WSL Monoplotting Tool to georeference historical landscape images of the FLH. The fundamental concept involves overlaying raster images onto a digital terrain model (DTM), linking each pixel to attribute coordinates (latitude and longitude) and elevation heights. This allows rays from the camera center through selected points in the photograph to intersect with the corresponding terrain DEM at landscape points (Figure 4) [39]. Through this tool, landscape elements represented in individual terrain photographs can be vectorized in the form of points, lines, and polygons (Figure 5) [40].

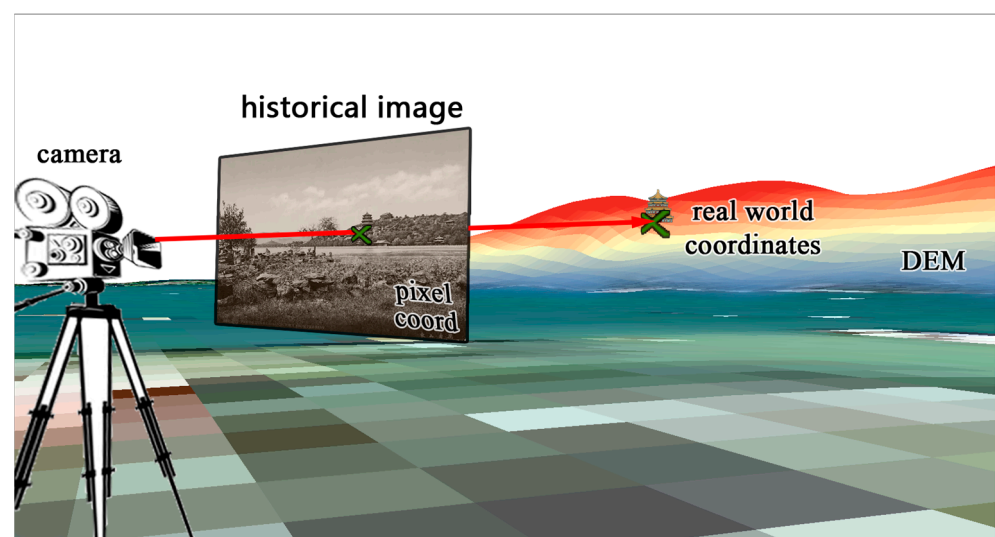


Figure 4. Schematic diagram of the WSL Monoplotting Tool.

MPT 2.0 was employed as the analytical software tool; it requires the following input data: (1) digital images, which are captured by digital cameras or obtained through

scanning historical photographs; (2) DTM; (3) aerial photographs or geographic reference topographic maps depicting the outlined areas in the photographs; and (4) control points (CPs), which are precisely and distinctly identifiable positions in both the image (pixel coordinates) and the landscape (real-world coordinates—latitude, longitude, and elevation height), such as road and sidewalk intersections, rock outcrops, and building corners [20].

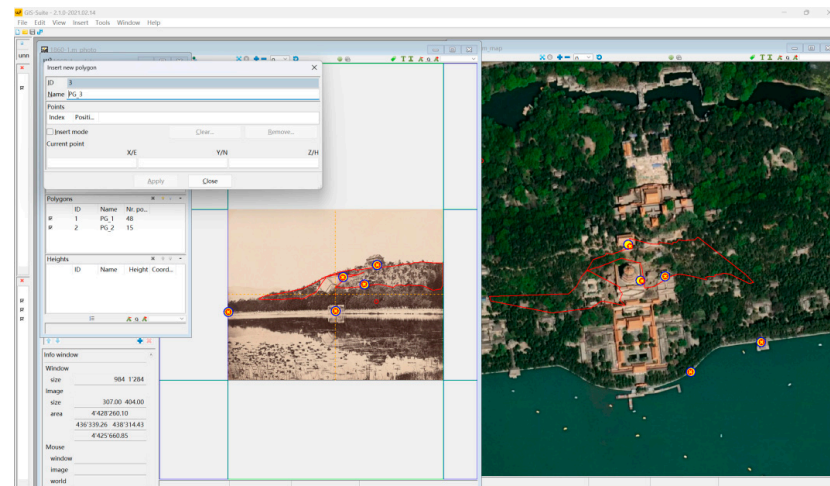


Figure 5. Geo-aligning and adding vectorization to photos via MPT 2.0 software.

Researchers identified historical plant spaces and classified them via the following procedure:

- (1) Historical events influencing the plant landscape of the FLH were extracted from historical literature data and sorted chronologically by the occurrence of events.
- (2) All historical photographs were georeferenced, and the areas where changes in the plant landscape of the FLH occurred during the first event period were vectorized (Figure 6). The MPT 2.0 tool was used to import vectorization information from the first event period into subsequent historical photographs. Differences in plant landscape areas were further vectorized during each subsequent event period, continuing in chronological order. Changes for each event period in the plant landscape of the FLH were vectorized.
- (3) All vectorization information from each period was imported into ArcGIS as shapefiles. The plant landscape space of the FLH was delineated by overlaying the ranges of plant spatial changes across multiple periods.
- (4) All spaces were divided into two main categories based on whether each space experienced destruction events. Logical judgment was used to further classify spaces on the basis of the results of each historical event and their impact on each space. This process facilitated the analysis of the historical dynamics of plant landscapes at the FLH and provided spatial references for comparing extraneous landscape features.

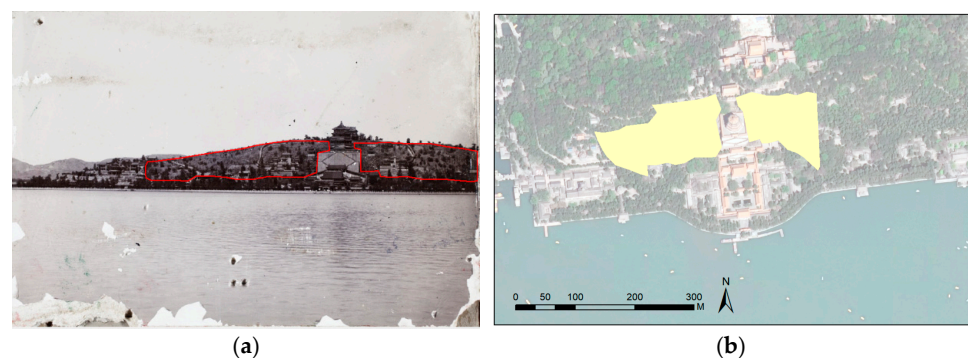


Figure 6. Mapping of vectorized information: (a) areas of altered botanical landscapes in the 1900 photographs and (b) areas of altered botanical landscapes in the plane mapped 1900. Red line: identification

of the spatial extent of plant damage in MPT2.0 for the 1890 photograph; yellow area: the extent of the red line in the photograph that corresponds to the extent of the red line in the plane after geo-calibration.

2.4. Dynamic Analysis of Off-Forest Landscapes

To comprehensively understand the changes in the FLH botanical landscape from the late Qing Dynasty (1860) to the present, a dynamic analysis of off-forest landscapes is essential [41,42]. Geographic spatial data and remote sensing technology have been effectively used in such landscape quality assessments. These scientific evaluations guide scenic forest management and construction. Researchers have examined the characteristics of the FLH botanical landscape across different periods via the following steps:

First, researchers identified landscape indicators and categorized the scenic forest of the FLH as a near-forest landscape (within a 500 m observation distance) based on historical photographs. They selected morphology, linearity, and structure as key elements for analyzing its near-forest landscape [43–45]. Field surveys tailored to the conditions of the FLH further divided these factors into ten indicators: canopy texture, free-standing trees, patch detectability, shape, distribution, forest canopy contour, patch boundary line, canopy layer, stand type, and life-type composition (Table 1). These indicators classify changes in the characteristics of the FLH botanical landscape.

Table 1. Composition elements of the near-forest landscape of the FLH.

Basic Compositional Elements	Project Description Factor	Class			
Morphology	Canopy texture	Rigid	Soft	Mixed	
	Free-standing trees	Several	Multiple	None	
	Patch detectability	Clear	Identifiable	Indiscernible	
	Patch shape	Regular	Irregular	Indiscernible	
	Patch distribution	Congregate	Well-distributed	Randomization	Indiscernible
Linearity	Forest canopy Contour	No undulations	Slight undulations	Moderate undulations	Significant undulations
	patch Boundary line	Straight	Eclectic	Curve	
	Canopy layer	1	2	3	4
Structure	Stand type	Coniferous forest	Broad-leaved forest	Mixed conifer-broad forest	
	Life-type composition	Trees and shrubs	Trees	Trees and grasses	Trees, shrubs, and grasses

Second, researchers mapped various plant spaces onto historical photographs from periods when plants were present, thus contrasting botanical landscape features.

Finally, by integrating historical contexts from each period, researchers analyzed spatial changes in plant spaces, evaluating differences in current botanical landscape characteristics compared with those in 1860. This analysis provides critical insights into the overall changes in the FLH botanical landscape, supporting enhancements in existing conservation policies.

3. Results

3.1. Key Events Influencing the Plant Landscape of the FLH

The researchers identified eight significant events that impacted the FLH vegetation landscape. These events resulted in three main outcomes: vegetation destruction, vegetation landscape restoration, and changes in vegetation landscape function (Table 2). Events one and three significantly damaged the vegetation landscape of the FLH, as a substantial portion of plants were destroyed by fire during them. Events two and four involved royal-led efforts to restore the vegetation landscape, hindered by financial constraints that slowed the restoration progress. Empress Dowager Cixi emulated the landscaping methods used in the construction of Qingyi Garden in 1750, and her influence impacted the restoration of the vegetation landscape to some extent. Events five and seven transformed the vegetation landscape of the FLH, altering the functional roles of the woodland. During event five,

the transformation of the Summer Palace into a public space shifted its purpose from serving the royal family to serving the public, which also led to changes in the strategies for restoring the botanical landscape. The military presence during World War II also affected the vegetation landscape. In event seven, many fast-growing tree species and fruit trees were planted on LH, shifting the landscape's focus from public service to production and disrupting the original botanical landscape pattern. The subsequent neglect during the three years of natural disasters and the Cultural Revolution led to inadequate management of the botanical landscape in Summer Palace, resulting in the decline and death of numerous trees due to high-density planting. Event six involved replanting 500 trees according to the original configuration style. In event eight, the government focused on the community structure of vegetation, utilizing the distinctive attributes of diverse plant species to enhance the overall aesthetic appeal. This entailed the removal of a multitude of incongruous, miscellaneous trees that had previously been planted and the implementation of extensive, stylistically diverse botanical landscaping initiatives [35–37].

Table 2. Influential events on the botanical landscape of the FLH.

Event	Time	Description	Impact
Event one	1860	The Anglo-French Allied Forces set fire to the Garden of Clear Ripples.	Vegetation destruction
Event two	1886–1895	Empress Dowager Cixi restores the Summer Palace.	Restoration of plant landscape
Event three	1900	The Boxer Rebellion and the invasion by the Eight-Nation Alliance, with Russian and Italian troops occupying the Summer Palace.	Vegetation destruction
Event four	1902–1912	Empress Dowager Cixi restores the Summer Palace.	Restoration of plant Landscape
Event five	1928–1945	The Summer Palace transitions to a public space, with large-scale replanting of trees. The stationing of military troops also causes damage.	Landscape Transformation, functional changes
Event six	1949–1952	Implementation of the “Widespread Greening, Gradual Improvement” policy, involving the restoration and repair of vegetation throughout the garden.	Restoration of plant configuration
Event seven	1958–1972	Following the “Greening Combined with Production” policy, the area saw extensive planting of fast-growing trees and fruit trees, with dense planting of species such as black locust, tree of heaven, and paulownia.	Landscape transformation, functional changes
Event eight	1991–1994	Initiation of a three-year greening adjustment program to gradually restore the historical landscape pattern, restoring the FLH to its original state with lush cypress trees.	Restoration of plant configuration

3.2. Identification and Classification of Plant Spaces on the FLH

The changes in plant landscapes after each of the eight historical events are analyzed and explored by dividing the plant landscape spaces of the FLH into 25 blocks (Figure 7) on the basis of the areas affected by these events. The southern area of the FLH is notably larger and evenly distributed along the east–west sides of the lake. In the northern part of the FLH, especially around Foxiang Ge (Tower of Buddhist Incense), the spatial distribution of the plants is dense, as they are concentrated on both the east and west sides, indicating significant differences in the plant restoration events experienced in this area. These events may have been the source of its varied landscape characteristics. In the southern part of the FLH, the west side of Foxiang Ge, and the northern areas, the distribution of plant spaces mostly formed east–west bands. The northeast side of Foxiang Ge exhibits a greater abundance of plant spaces than the west side. These spaces display distinctive patterns and variations in spatial distribution when compared to other regions. Of particular note are the numerous clustered and enclosed spaces, including zones 15, 16, 18, 19, 20, and 25. Differences in area and morphology are evident, with some spaces showing discontinuities, such as zones 15 and 18.

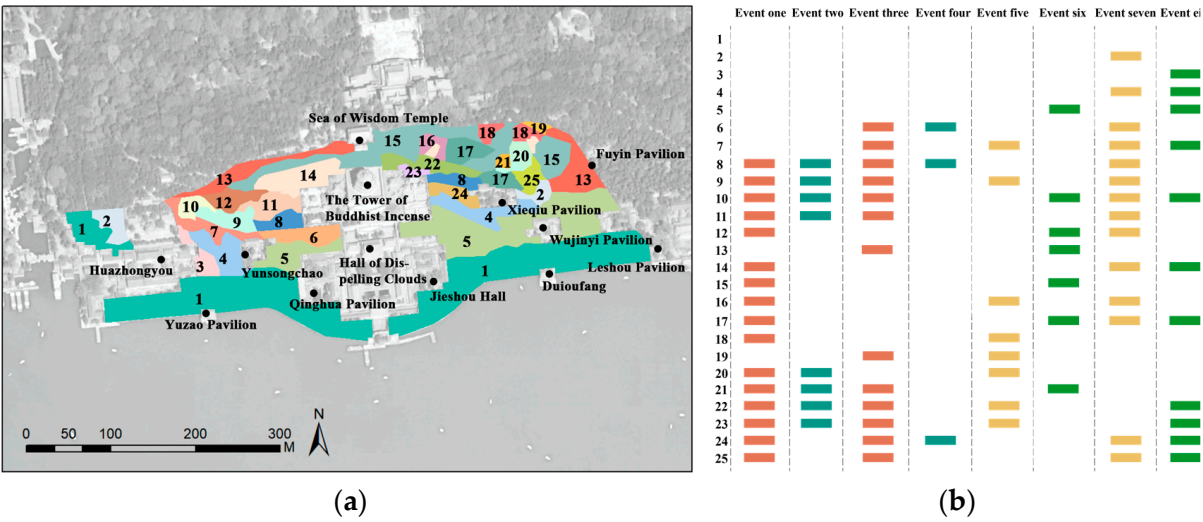


Figure 7. (a) Spatial division of the FLH planted landscapes and (b) the FLH partition event correspondence chart. Different colors represent the impacts of different events, as detailed in Table 2.

Researchers further classify the 25 spaces on the basis of the content and outcomes of the eight events and their impacts on the FLH. They categorize these spaces into vegetation retention areas (Type I) and vegetation damaged areas (Type II) based on whether they have experienced destruction. Areas that have undergone multiple restorations exhibit more stable ecological structures and historical value than those that have been restored only once. Moreover, spaces experiencing Events Six or Eight tend to exhibit greater historical fidelity in terms of plant landscape restoration than those impacted by Events Five and Seven. Consequently, according to these findings, researchers classify vegetation retention areas into two types and vegetation damaged areas into four types (Figure 8).

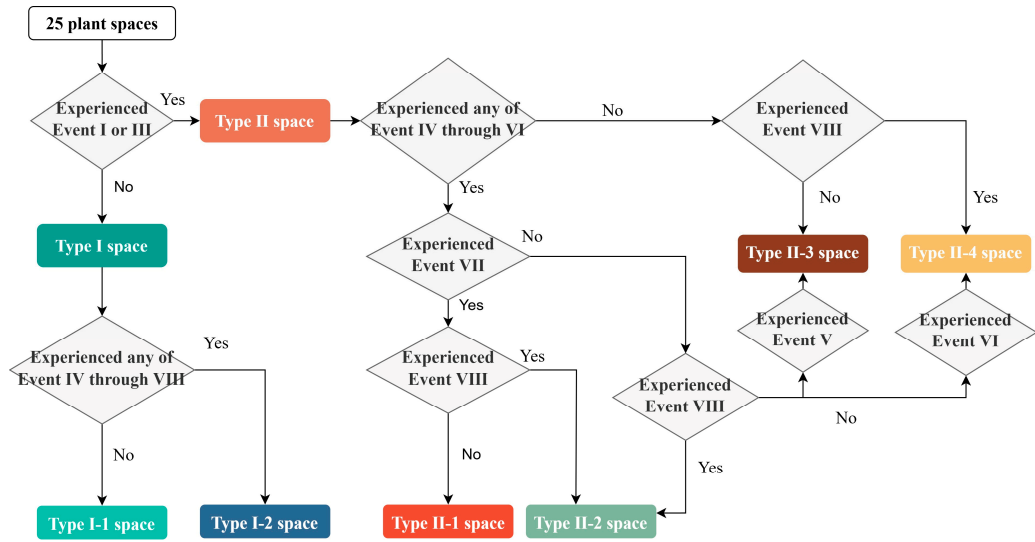


Figure 8. Spatial delineation process of historical plants on the FLH.

The locations of the vegetation destruction area and the vegetation preservation area in the FLH are shown in Figure 9, and the specific locations of the 2 major categories and 6 spatial subcategories are listed in Table 3.

Type I vegetation retention area: This area is located in the central-southern part of the study area, south of Yunsong Pavilion and Wujinyi Pavilion, and covers approximately 4.25 hectares (Figure 10).

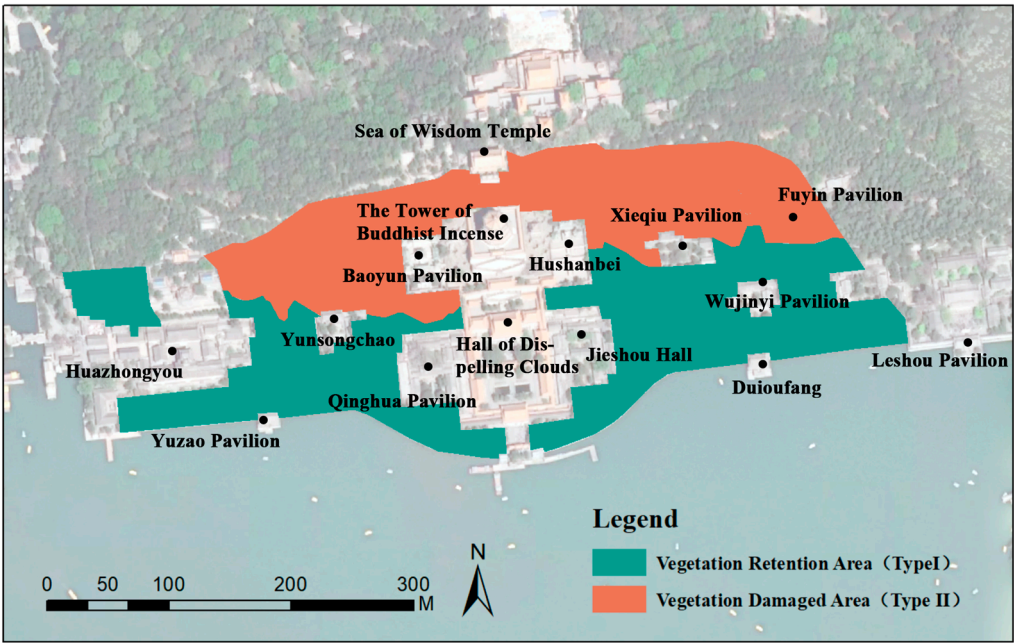


Figure 9. Spatial classification of plants in the FLH.

Table 3. Historical botanical spatial regions of the FLH.

Category	Subcategory	Area (ha)	Location
Type I	Type I-1	2.46	116.264° E—116.272° E, 39.997° N—39.996° N
	Type I-2	1.79	116.268° E—116.272° E, 39.998° N—39.997° N
Type II	Type II-1	0.70	116.265° E—116.267° E, 39.998° N—39.997° N
	Type II-2	0.71	116.266° E—116.270° E, 39.998° N—39.997° N
	Type II-3	0.40	116.265° E—116.271° E, 39.999° N—39.998° N
	Type II-4	1.63	116.267° E—116.270° E, 39.999° N—39.998° N

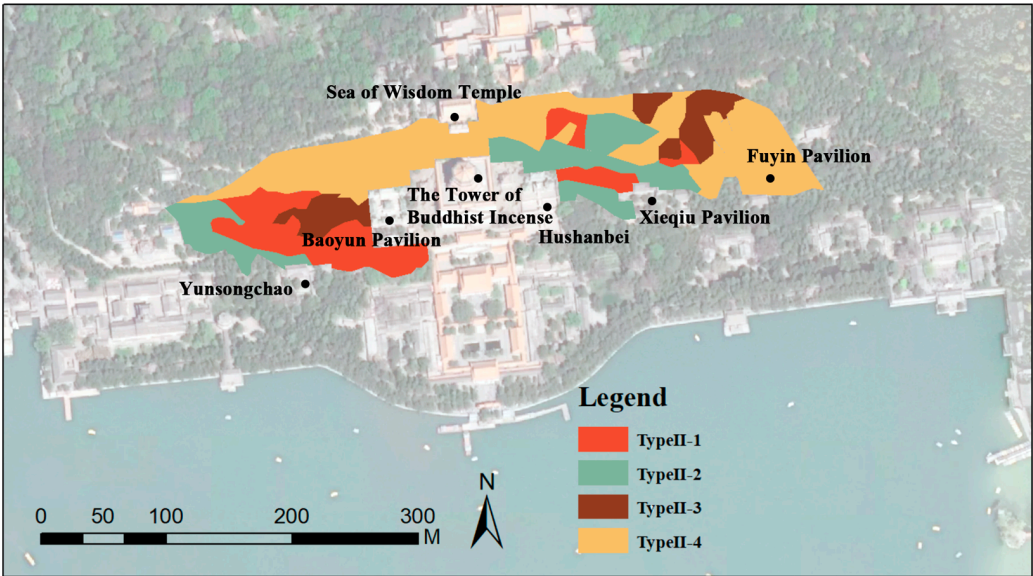


Figure 10. Spatial classification of plants in the vegetation retention area.

Type I-1 space: This space is located in the southern part of the vegetation retention area and covers approximately 2.46 hectares. Along the Kunming lakeshore, it forms a belt-shaped distribution on both sides of the Long Corridor, extending approximately 600 m east–

west from Huazhongyou to Leshou Pavilion. This area has a gentle terrain with extensive recreational platforms and serves as the primary activity zone for tourists. Historical changes in this area have been minimal, predominantly featuring Chinese junipers, with new shrub plantings on the eastern side introduced in the 1980s.

Type I-2 space: This space is located in the northern part of the vegetation retention area and covers approximately 1.79 hectares. Concentrated on the east side of Paiyundian (the Hall of Dispelling Clouds), the south side of Xieqiu Pavilion, and both the east and west sides of Yunsong Pavilion. The spatial boundaries of this area are more irregular than those of Type I-1 areas. Between 1860 and 1950, tree species in this area showed little change. In the 1960s, broad-leaved trees were added to the eastern area, which remains today. By the 1970s, cypress trees had decreased westward, transitioning from the original monoculture of cypress trees around buildings to mixed coniferous and broad-leaved plantings.

Type II vegetation damaged area: This area is located in the central-northern part of the study area, north of Yunsong Pavilion and Wujinyi Pavilion, and covers approximately 3.44 hectares (Figure 11).

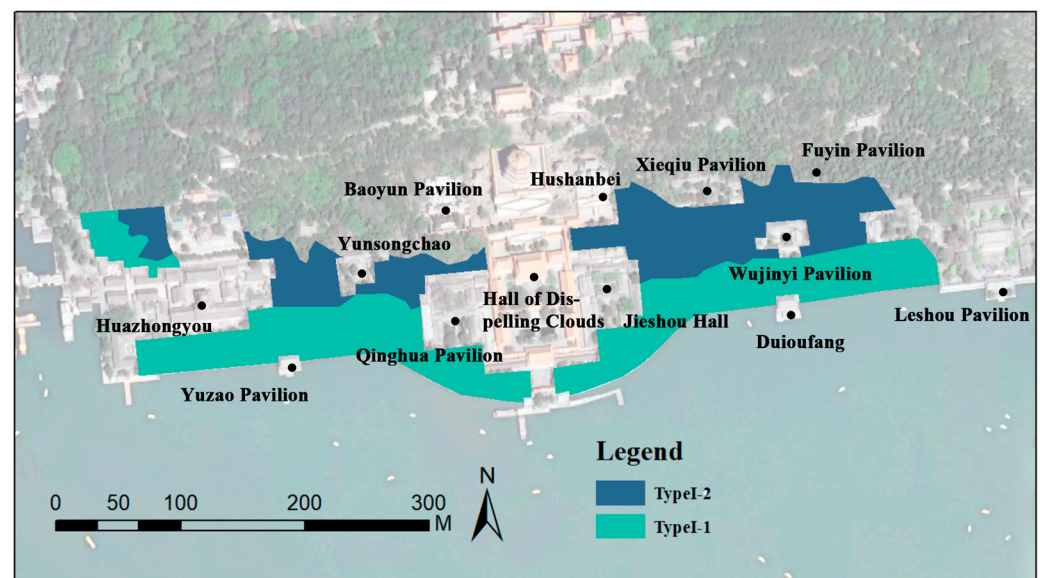


Figure 11. Spatial classification of plants in the vegetation damage area.

Type II-1 space: This space covers approximately 0.7 hectares and is situated primarily west of the Foxiang Ge and Baoyun Pavilion buildings, distributed in an east–west direction. Following the destruction from Events One and Three, this area remained predominantly bare until the 1950s. During Event Five, pine and cypress were replanted; however, the trees were young and did not fully restore the original physiognomy of the area. In the 1970s, during the restoration efforts of Event Seven, broad-leaved tree species were planted for the first time, increasing the planting density. This led to a transformation into a mixed coniferous and broad-leaved forest. Owing to poor planting practices, some trees decayed and died. Currently, the area is mainly populated with cypress trees, but small patches of broad-leaved species remain; these patches are particularly concentrated on the east and north sides of Xieqiu Pavilion.

Type II-2 space: This space covers approximately 0.71 hectares, is irregularly shaped, and is found primarily in two areas. The eastern side of Huazhongyou has a serpentine shape, whereas the western side of Xieqiu Pavilion extends in an east–west belt along the main mountain paths. Following the damage from Events Four and Six, extensive planting of Chinese juniper occurred during restoration, transforming the vegetation cover from wasteland to young coniferous forest. By the 1990s, after Event Eight, struggling cypress and newly grown broad-leaved trees were cleared and transplanted, reintroducing pine

and cypress. However, recent surveys indicate that several broad-leaved trees remain planted in some eastern areas, affecting sightline transparency to some extent.

Type II-3: This type covers an area of approximately 0.4 hectares and is located predominantly on the northeast side of the study area, adjacent to Baoyun Pavilion. It has an irregular, patchy distribution. Along the west side of Baoyun Pavilion, the area extends in an east–west orientation. It is characterized by steep terrain in the southern part, limiting accessibility for visitors. In the northeastern part of the study area, this zone follows a north–south orientation. Following Events One and Three, this area remained largely barren until 1958. Subsequently, there was extensive replanting with broad-leaved tree species such as *Forsythia suspensa*, *Koelreuteria paniculata*, and *Morus alba*. However, Event Eight, which occurred in the 1990s, did not involve significant restoration efforts in this region.

Type II-4: This type covers an area of approximately 1.63 hectares and is widely distributed, located west of Fuyin Pavilion, north and northwest of Foxiang Ge, and east of Zhihui Hai (Sea of Wisdom Temple). It forms an east–west-oriented band. The eastern part is divided into two separate areas by other spaces, whereas the western part extends in a north–south orientation. The eastern section is characterized by a clustered distribution, whereas the western section has a strip-like pattern, flanking both sides of the main walking paths. Like Type II-3, this area was bare land until Event Seven in 1958, when extensive planting of broad-leaved tree species occurred. In the 1990s, efforts were made to adjust the forest structure by removing a substantial number of mismatched trees and planting new, 4 m tall pine and cypress trees. Currently, the western side of this area near the Huazhongyou area still features patches of broad-leaved tree species. In contrast, other parts are dominated by cypress forests, albeit with scattered broad-leaved trees that obstruct the primary scenic views.

3.3. Near-Landscape Features of Vegetation Spaces in Vegetation Retention Areas

Researchers compared the extra-forest landscape characteristics of the vegetation preservation area between the 1860s and the present day, yielding the following results:

In the Type I-1 space (Table 4), there have been minimal changes in the near-forest landscape characteristics, with no significant alterations in morphology. With respect to linear elements, the current canopy contour is less undulating than it was in the 1860s, with increased canopy layers. The planted form of Chinese juniper remains in rows, although overall heights are taller than they were in the 1860s. In terms of structural elements, new shrub plantings are observed on the eastern side, altering the composition of the near-forest landscape from predominantly trees to a mix of trees and shrubs.

Table 4. Type I-1 comparison of near-landscape characteristics outside the spatial forests.

Basic Compositional Elements	Project Description Factor	Time	
		1860s	Present
Morphology	Canopy texture	Rigid	Rigid
	Free-standing trees	None	None
	Patch detectability	Identifiable	Identifiable
	Patch shape	Regular	Regular
	Patch distribution	Congregate	Congregate
Linearity	Forest canopy contour	Significant undulations	Slight undulations
	Patch boundary line	Eclectic	Eclectic
	Canopy layer	1	2
Structure	Stand type	Coniferous forest	Coniferous forest
	Life-type composition	Trees	Trees and shrubs

In the Type I-2 space (Table 5), significant changes are evident in the near-forest landscape characteristics. In terms of morphological elements, many broad-leaved trees have been added, resulting in a mixed texture in the current canopy. Adjacent to the

main buildings, the low-density cypress plantation of the 1860s featured scattered trees and distinct plant patches, particularly clustered around the buildings in row formations. Presently, the increased density due to broad-leaved forest additions has resulted in a more even distribution of patches. There are inconsistencies in tree planting among different species communities, leading to irregular patch boundaries. With respect to linear elements, the canopy structure in the 1860s was uniform, with similar tree ages and lower average tree heights. Currently, the forest type in the area has transitioned to mixed coniferous and broad-leaved forests, with abundant broad-leaved plantations on the western side enriching the canopy structure. Structurally, the predominant cypress planting form has been largely maintained overall, but there has been a significant increase in broad-leaved tree planting on the eastern side. This has resulted in a shift from a coniferous forest type to one that is mixed coniferous and broad-leaved. Overall, the Type I-2 space has enriched plant configurations, retaining the original dominance of Chinese juniper as the primary tree species base. However, the addition of broad-leaved trees in certain areas has somewhat disrupted the original characteristics of the near-forest landscape. This change, particularly noticeable in the eastern area near Wujinyi Pavilion, has enriched the landscape but also diminished its former solemn features to some extent.

Table 5. Type I-2 comparison of near-landscape characteristics outside the spatial forests.

Basic Compositional Elements	Project Description Factor	Time	
		1860s	Present
Morphology	Canopy texture	Rigid	Rigid
	Free-standing trees	None	None
	Patch detectability	Identifiable	Identifiable
	Patch shape	Regular	Regular
	Patch distribution	Congregate	Congregate
Linearity	Forest canopy contour	Significant undulations	Slight undulations
	Patch boundary line	Eclectic	Eclectic
	Canopy layer	1	2
Structure	Stand type	Coniferous forest	Coniferous forest
	Life-type composition	Trees	Trees and shrubs

4. Discussion

4.1. Plant Zoning and Grading Protection Strategy in the FLH

Currently, the plant conservation strategy in the Summer Palace focuses on the maintenance of ancient and famous trees and the nurturing of characteristic flowers [35]. However, there is no specific regional strategy or plant landscape management strategy for the protection of the FLH plants. During this study, it was discovered that the plant landscape of the FLH has undergone numerous changes since the 1860s, with significant differences in plant configuration and community structure. Previous vegetation adjustment and renewal strategies were based exclusively on historical data for the restoration of plants on the FLH. There was a dearth of comprehensive management strategies for the overall vegetation landscape of the FLH, and the implementation of graded management plans for different regions was also lacking. Under the premise of adhering to the authenticity of historical heritage and natural laws, managers should fully consider the dynamic succession and development of plant communities. They should also reconcile the conflicts between short-term landscape aesthetics and long-term ecological benefits to preserve the authenticity of the plant landscape of the FLH. Researchers have proposed different conservation strategies for vegetation retention areas and vegetation damaged areas from the perspectives of plant configuration, ecological protection, planting structure, and landscape adjustment. This approach allows for the delineation of distinct conservation approaches for different plant spaces (Table 6).

Table 6. Spatial conservation strategies for historic plants in.

Category	Protection Strategy	Subcategory	Protection Level	Protection Method
Type I	Reduce human intervention and adopt a slow adjustment approach for landscape conservation management.	Type I-1	Level I priority protection	Continue existing ancient tree protection policies, regularly prune trees, and enrich the canopy contour.
		Type I-2	Level II priority protection	Slow adjustment: reduce planting density, reference 1860s historical photos, and coordinate plant landscape with major architectural elements.
Type II	Implement landscape adjustment and restoration based on historical images and spatial classification.	Type II-1	Level I protection	Slow restoration: prioritize ecology, and remove poorly growing broad-leaved trees.
		Type II-3	Level II protection	Further restoration: replant dominant tree species and adjust life form composition.
		Type II-2	Level III protection	Enhance artificial intervention: transplant broad-leaved trees that impact the overall plant landscape, adjust areas with overly dense growth and pay special attention to the design of view corridors.
		Type II-4		

4.1.1. Vegetation Retention Area: Reduced Human Intervention, Slow Adjustment for Character Protection Management

In vegetation retention areas, the overall structure and species composition of plant communities show minimal changes. These areas hold significant historical and cultural value, warranting the highest protection levels. They are categorized into two protection types: Level I priority protection (Type I-1) and Level II priority protection (Type I-2), with Level I protection having greater intensity than Level II protection.

In Type I-1 spaces unaffected by major historical events, the crown contours of cypress forests have gradually stabilized over a century of historical changes. Existing policies for ancient tree protection lack control over tree morphology. To enhance authenticity while preserving ecological conditions, managers should periodically prune trees to adjust and enrich crown contours. Emphasis should be placed on protecting cypress forests and minimizing visitor impacts on ancient trees. Adjustments to newly planted shrubs on the west side should involve replacing them with shorter, sparsely branched species to increase transparency (Figure 12).

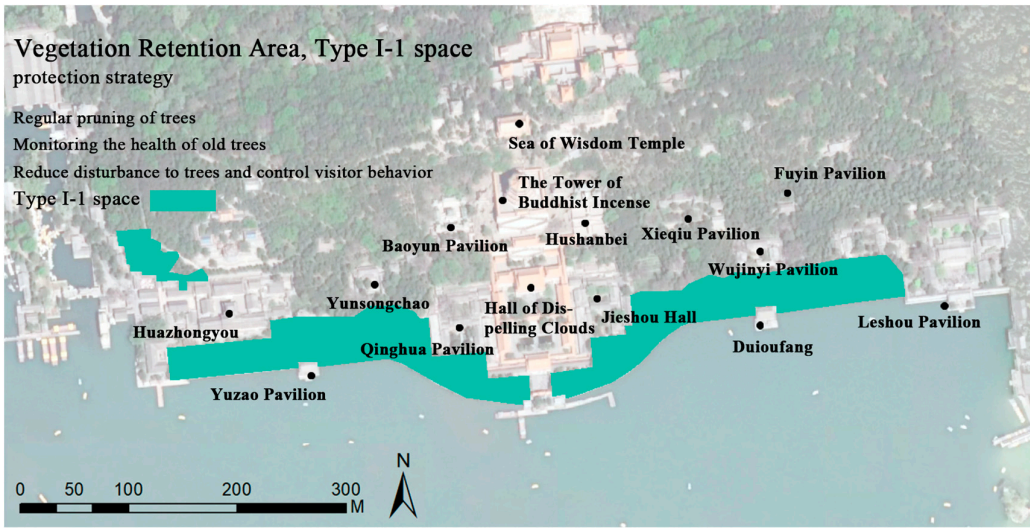


Figure 12. Type I-1 planted spatial landscape conservation strategies.

Type I-2 spaces have undergone significant changes influenced by Events Seven and Eight, differing notably from Type I-1 areas. Management should focus on gradual adjustments, including appropriate clearing of the eastern area near Foxiang Ge and the western area depicted in paintings, to reduce broad-leaved forest obstruction of key sightlines. Compared with the 1860s, the area presents more evenly distributed patches of forest with increased planting density, transitioning from neatly arranged cypress forests to mixed coniferous forests with seasonal variation, which lack the former solemn landscape features. These changes may result from alterations in forest structure in the northern region and shifts in the target audience of the forest service from imperial to public use. In managing this area, historical images from the 1860s to the 1890s can serve as references, guiding natural plant growth patterns with appropriate human intervention. Priority should be given to ensuring the health of ancient trees, controlling the planting density of other species, and removing miscellaneous trees and poorly growing species to enhance openness and preserve key sightlines. East of Foxiang Ge, the selective clearing of inappropriate broad-leaved forests and the dense planting of cypress forests are recommended. For areas surrounding the main building of Foxiang Ge, adjustments in the planting structure should favor cypress trees, harmonizing with the architectural environment (Figure 13).

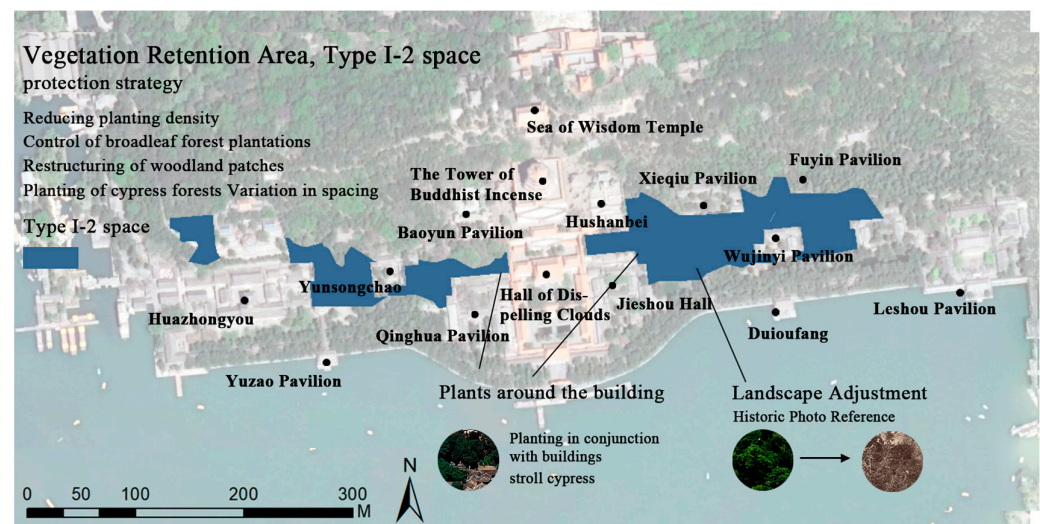


Figure 13. Type I-2 planted spatial landscape conservation strategies.

4.1.2. Vegetation Damaged Area: Historical Image-Based and Spatial Grading Vegetation Character Restoration

Compared with vegetation retention areas, vegetation-damaged areas, which have been heavily impacted by historical events, exhibit lower stability. Consequently, the level of protection intensity needed in this area is lower, and a graded protection strategy can be employed: Level I protection for Type II-2 spaces; Level II protection for Type II-4 spaces; and Level III protection for Type II-1 and Type II-3 spaces. In terms of protection intensity, Level I protection > Level II protection > Level III protection. Existing photographic records do not fully reflect the area's original design concept, complicating assessments of restoration appropriateness. Historical accounts typically describe the vegetation landscape of the FLH as a unified entity, suggesting the restoration of Level I vegetation. Damaged areas could reference the plant landscape of vegetation retention areas depicted in 1860s photos.

Level I protection: Type II-2 space. Following Events One and Three, Type II-2 spaces received the highest frequency of protection and restoration efforts, with minimal alterations to site functionality. Through long-term and repeated restoration, these areas have developed a strong ecological foundation and landscape structure. Previous studies have identified western areas featuring extensive cypress forests similar to those in 1860s photographs, warranting continued preservation efforts and measures to control visitor

damage. Pruning activities should target areas that are potentially obstructing sightlines. On the eastern side, two areas feature broad-leaved forest plantings, which minimally impact sightlines and forest continuity, allowing preservation of existing planting methods. The removal of declining or potentially decaying broad-leaved trees is recommended (Figure 14).

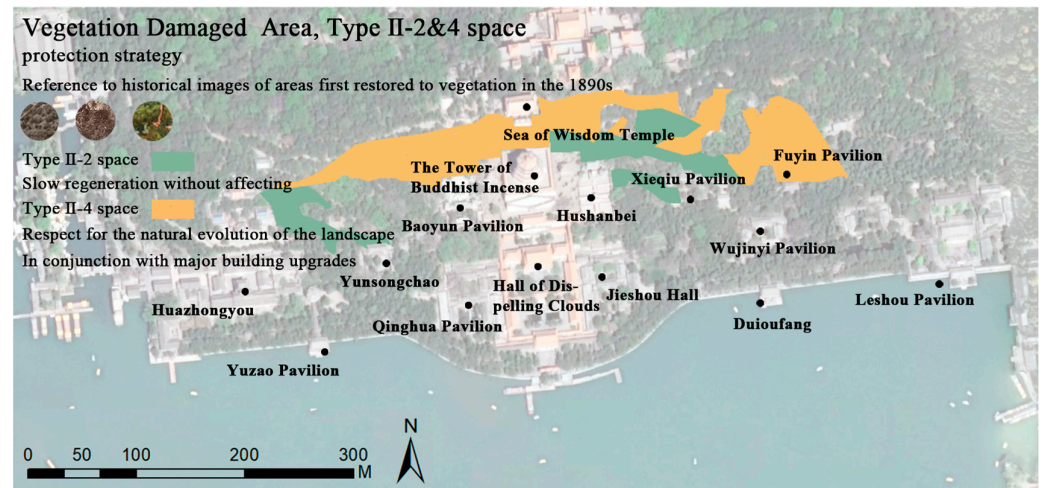


Figure 14. Type II-2 and 4 planted spatial landscape conservation strategies.

Level II protection: Type II-4 space. Located north of the Great Bao'en Longevity Temple complex, the Type II-4 space serves as the background forest for Foxiang Ge and marks the termination of the main architectural axis, thus significantly influencing the overall vegetation landscape of the FLH. Compared with the southern side of Foxiang Ge, the cypress forest in this area has a lower height and planting density and thus fails to fully exhibit the solemn characteristics typical of cypress forests. Restoration efforts may involve transplanting tall coniferous species to the north side of Foxiang Ge to increase the planting density. In the eastern area, farther from the main buildings, adjustments to the current life form composition could involve naturally interspersing pine and cypress trees. Daily management should strictly regulate visitor behavior to minimize tree damage, with periodic pruning to maintain optimal ventilation and light conditions (Figure 14).

Level III protection: Type II-1 and Type II-3 spaces. Through multiple restoration efforts, the vegetation landscapes of Type II-1 and Type II-3 spaces have undergone significant transformations in terms of functionality and appearance. Historical descriptions of planting designs around Foxiang Ge and southern architectural plantings from the 1860s can guide landscape adjustments. On the west side, around Foxiang Ge, phased adjustments can begin by transplanting existing broad-leaved species near the main buildings and planting cypress forests exceeding 4 m in height. Strict control over the aesthetics of the surrounding vegetation should be maintained. In addition to the main buildings, existing planting forms should be initially preserved, with pruning in densely vegetated areas. Once a well-formed landscape aesthetic is achieved around the main buildings, further adjustments can be made. On the higher eastern terrain, which includes major footpaths where visitors view Kunming Lake, the selective pruning of low branches of broad-leaved trees meets scenic viewing needs. Transplanting trees that significantly affect sightlines is recommended (Figure 15).

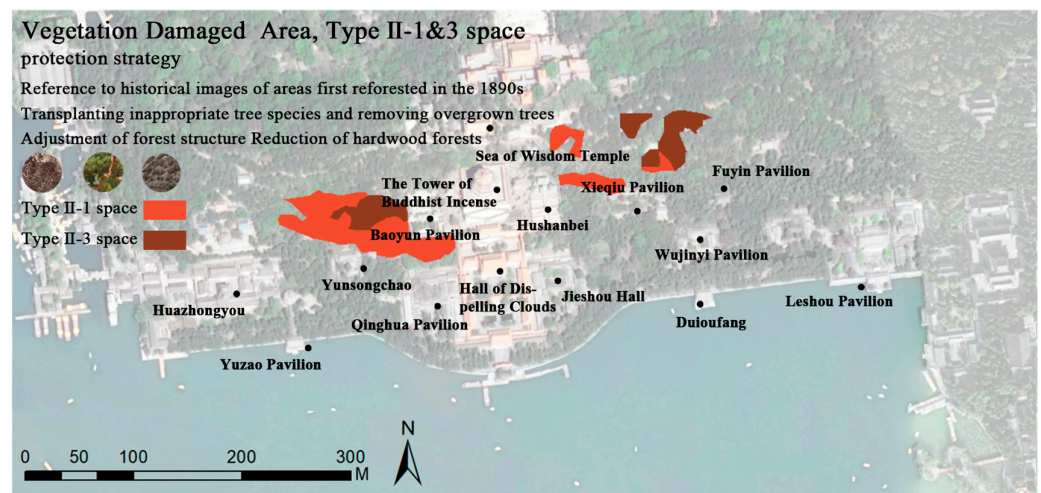


Figure 15. Type II-1 and 3 planted spatial landscape conservation strategies.

4.2. Innovations and Shortcomings of the WSL Monoplotting Tool for the Study of Historical Heritage

The geographic registration of historical photos via WSL monoplotting enables multi-temporal overlay analysis and the identification of spatial characteristics in plant landscapes. Compared with traditional literature analyses and single-image recognition methods, monoplotting offers significant advantages. First, it addresses challenges associated with spatial referencing of oblique terrestrial images, providing geographic information data for comparative analysis across multiple periods. Second, it extracts vector data from historical photos and integrates seamlessly with ArcGIS functionalities to facilitate spatial data comparisons. This approach visualizes the temporal and spatial dimensions of vegetation space in the FLH, aiding researchers in identifying and analyzing changes in plant spatial characteristics across different periods. The spatial data digitization of historical photos extends research timelines and broadens the potential for comprehensive spatial analysis of plant landscapes via photos. It resolves the challenges of multidimensional and multispatial analysis limitations, thereby enabling the analysis of heritage site plant landscape changes via historical landscape photos.

However, errors inevitably exist. First, the accuracy of the input DEM affects the calibration precision, which is a concern [46]. Due to data confidentiality, 5 m DEM data, compared with 1 m precision, lack some accuracy, potentially affecting area calculations. Second, historical photos from the late 19th to early 20th centuries were less common than those of other periods, and they often had lower pixel resolution and limited color information, hindering the analysis of plant phenology. Furthermore, variations in photograph angles over time, changes in terrain morphology, and different lighting angles during photography may have introduced errors in the calibration process. Additionally, clear positioning points are necessary for calibration; however, vegetation obscures buildings in photos from the 1970s, posing challenges in calibration and data vectorization. These errors may significantly impact analyses requiring finer granularity and smaller study scales.

Overall, monoplotting provides a flexible and convenient way to study changes in historic landscapes, allowing us to compare different information in photographs taken at different times and locations, bypassing differences in viewpoint and location. This provides a new approach to studying changes in historic landscapes at other heritage sites around the world, which is particularly important for sites that have been damaged and are currently difficult to restore due to a lack of accurate historical information.

5. Conclusions

In this study, the WSL Monoplotting Tool was utilized to georeference historical photographs for multitemporal identification and analysis of botanical landscape spaces.

Researchers have investigated the zoning and off-forest landscape characteristics of the FLH and offer two main conclusions. (1) Spatially, the southern part of the FLH (the vegetation preservation area) retains a more intact botanical landscape than does the northern part. The area along Kunming Lake has experienced minimal historical impacts, preserving vegetation most effectively. The western side of the northern part (vegetation destruction area), particularly near Foxiang Ge, exhibited more significant changes in botanical landscape functionality and aesthetics, with notable alterations in landscape features. (2) Regarding off-forest landscape characteristics, the vegetation adjustment strategies of the 1990s did not fully restore the botanical landscape appearance of the 1860s. The northern part of the vegetation preservation area shows substantial changes, characterized by more uniformly distributed forest patches without distinct landscape zoning features. The increase in broad-leaved forests has diminished the individual characteristics of the original coniferous forest image. Compared with the northern area, the southern area presents more pronounced changes in canopy contour lines, as its overall landscape transformations are less pronounced. Proposed zoning and grading protection strategies have been proposed. With respect to zoning protection strategies, the preservation of plant retention areas is of primary importance. Furthermore, the continuation of existing policies for the protection of ancient and non-native trees is a priority. Another objective is to enrich the forest canopy outline through pruning, gradually adjust the vegetation landscape characteristics, and implement landscape adjustment strategies for vegetation destruction areas based on historical imagery. With respect to grading protection strategies, vegetation retention areas are classified into Level I and Level II priority protection categories, while vegetation protection areas are categorized into three levels. Type II-1 areas undergo gradual restoration with the removal of poorly growing broad-leaved trees under Level I protection. Type II-3 areas are replanted with dominant species trees, adjusting the life form composition under Level II protection. Type II-2 and Type II-4 areas receive increased human intervention, transplanting poorly affecting broad-leaved trees under Level III protection to improve the overall vegetation characteristics.

Our research provides substantial evidence in favor of the conservation of the botanical space of the Summer Palace, a site of historical and cultural significance. Our findings offer a framework for the plant space restoration and management of Longevity Hill. Additionally, our research is instrumental in advancing the restoration, preservation, and management of historical gardens and other heritage sites by providing novel methodologies. In particular, the new scientific methodology of using historical data (maps and photographs) in conjunction with the evaluation of gardens, facilitated by emerging technologies, enhances the in-situ nature and authenticity of the study. This represents a significant advancement in the study of historical photographs and maps in historical gardens. It offers a means of preserving and enhancing the reality of the past. At the same time, the methodological tools of this study underscore historical, cultural, and perceptual values, thereby raising awareness of historical resources.

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Appendix A

Table A1. Historical events affecting the botanical landscape of LH.

Time	Events	Sources
1860	“British and French allied forces” fire burned Qingyi Garden, the trees in the middle of the FLH were destroyed, and the trees around the whole mountain building were seriously destroyed.	<i>Records of the Summer Palace</i>
1886–1895	After the Summer Palace burned down, Cixi diverted naval funds to restore the Summer Palace, which was completed in 1894.	<i>A Series of Examinations on the Historical Events and Characters of the Summer Palace</i>
1900	In May 1900, the Boxer Rebellion broke out, and in August, the Eight-Power Allied Forces marched into Beijing, and the Russian and Italian armies entered the Summer Palace, destroying it for the second time.	<i>A Series of Examinations on the Historical Events and Characters of the Summer Palace</i>
1902	After the signing of the unequal treaty, Cixi returned to Beijing from Xi’an. In the twenty-eighth year of the reign of Emperor Guangxu (1902), Cixi used a large sum of money to restore the dilapidated Summer Palace.	<i>A Series of Examinations on the Historical Events and Characters of the Summer Palace</i>
1912–1924	The Qing dynasty ended in 1912, the Summer Palace was opened as Puyi’s private property in 1914 and opened to the public in 1924 after Puyi was expelled from the Forbidden City.	<i>A Series of Examinations on the Historical Events and Characters of the Summer Palace</i>
1928	In June 1928, the Republican government established the Summer Palace Management Office. The government of the Republic of China established the “Summer Palace Management Office of the Ministry of the Interior”, and the Summer Palace was officially transformed into a public space managed by the central government.	Summer Palace Cultural Relics Management Section
1928–1945	The Summer Palace spent 25 years under the rule of the Beiyang warlords, Japanese imperialists, and Kuomintang reactionaries. Some of the courtyards of the Summer Palace were taken as private apartments by warlords, bureaucrats, traitors, and politicians. Warlords and Kuomintang troops entered and left the gates of the garden at will, damaged cruise ships, cut down trees, and stole cultural relics.	<i>Records of the Summer Palace</i>
1949–1952	To carry out the greening policy of “universal greening, repeated improvement” and “popularization first, improvement later”, the Ministry of Finance of the Central People’s Government allocated construction costs for the restoration of the Summer Palace to give a strong guarantee in March 1950. In 1952, the ancient buildings, cultural relics and vegetation in the garden were repaired and restored.	Summer Palace Cultural Relics Management Section; Beijing Information Archives Network
1958–1967	In 1958, the Beijing Municipal Bureau of Landscape Architecture put forward the “greening combined with production” policy, the Summer Palace planted a large number of fast-growing trees and fruit trees, densely planted acacia, stinking toon, paulownia, and other fast-growing trees. A large number of fast-growing trees and fruit trees, high-density planting, and garden trees decayed and died.	Beijing Information Archives Network
1984	It is clear that “gardening should not be used in conjunction with production” as a guideline, and that the main focus should be on plant landscaping and garden construction.	Qing Dynasty Royal Garden Research Center
1991	The concept of landscaping has changed, focusing not only on quantitative improvement but also on qualitative growth. Summer Palace in line with the trend, opened a three-year greening adjustment, gradually restore the historical landscape pattern, from “greening” to “beautification” change. LH restored the landscape pattern of cypresses planted all over the former mountain.	China News Service (CNA)

Table A1. Cont.

Time	Events	Sources
2006	Main buildings on the FLH: repair of the Buddha's Fragrance Pavilion, Paiyun Hall, the promenade and its surroundings	China News Service (CNA)
2010	The drainage system from the Guangxu period has also been re-dredged, utilizing a concealed drainage system that discharges rainwater downhill through culverts and pipes.	Qing Dynasty Royal Garden Research Center
2020	Restoration of the painting tour "The painting tour complex is located in the Summer Palace LH southwest slope, overlooking Kunming Lake. The repair mainly includes the building body, courtyard ground, wall, stone repair and cultural relics components, and ancient tree protection".	Peking Gazette (official government website)

Table A2. FLH's panorama photo information.

Serial No.	Shooting Time	Photographers/Collectors/Books	Accessed Date	Source
1	1860	Felice Bitto	10 December 2023	https://philamuseum.org/collection/object/131164
2	1890	-	10 December 2023	https://www.loc.gov/photos/?q=41215v&st=slideshow#slide-3
3	1898	-	10 December 2023	https://www.bild.bundesarchiv.de/dba/en/search/?yearfrom=&yearto=&query=116-127-102
4	1900	Bayley, Arthur	12 January 2024	https://hpcbristol.net/visual/AB01-01
5	1900	Bayley, Arthur	12 January 2024	https://hpcbristol.net/visual/AB01-02
6	1902	Alfons von Mumm	10 December 2023	https://commons.wikimedia.org/wiki/File:Der_Haiserliche_Sommerpalast_Wan_shou_shan._%E2%85%A0_Gesamtansicht.jpg
7	1905	Firmin Laribe	10 December 2023	https://www.shuge.org/view/firmin_laribe_photographs_of_china/
8	1910	-	10 December 2023	https://www.prints-online.com/summer-palace-beijing-china-general-view-lake-11584379.html
9	1920	Donald Mennie	12 January 2024	https://hpcbristol.net/visual/Bk04-46
10	1920	<i>Collection of photographs of China</i>	12 January 2024	https://www.prints-online.com/summer-palace-beijing-china-panoramic-view-11584371.html
11	1920	<i>The most interesting views of Peking</i>	-	-
12	1930	-	12 January 2024	https://www.douban.com/photos/album/1629594496/
13	1930	J.P.Koster		<i>Ground and Aerial Views of China</i>
14	1930	<i>Beijing Famous Places</i>	12 January 2024	https://old.shuge.org/ebook/photos-of-peking/
15	1940	Dmitri Kessel		<i>American Life Magazine</i>
16	1940	<i>Temple and Altar of Heaven</i>	12 January 2024	-
17	1952	-		Personal Collections
18	1971	Pickowicz, Paul	12 January 2024	https://library.ucsd.edu/dc/object/bb5566521j
19	1974	Albertson, Maury	12 January 2024	https://digitallibrary.usc.edu/CS.aspx?VP3=DamView&VBID=2A3BXZ8RBULM8&SMLS=1&RW=1659&RH=945&FR_=1&W=1194&H=938
20	1986	-		Personal Collections

Table A2. Cont.

Serial No.	Shooting Time	Photographers/Collectors/Books	Accessed Date	Source
21	1986	-		Personal Collections
22	2020	-	12 January 2024	https://www.vcg.com/creative/802456362.html
23	2024	Author		Personal Collections

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