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# Implications for Cultural Landscape in a Chinese Context: Geo-analysis of Spatial Distribution of Historic Sites

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**Abstract:** The protection of historic sites, especially their relationship with urban development, has become a worldwide issue, both in developed and developing countries. In the context of rapid urbanization in China, the realistic compatibility between urban construction and the protection of historic sites is always a key research topic. In this study, first, to comprehend their spatial distribution patterns, 828 historic sites throughout the country are selected based on certain criteria. Then, we conduct quantitative research using GIS software, adopting indicators that include Nearest Neighbor Index, Gini Coefficient, and Geographic Concentration Index to analyze the spatial characteristics of historic sites on the three levels of city, province and nation. The results indicate that the spatial distribution of the different types of historic sites is an agglomeration on the nationwide scale, most of which is located in the regions of the Pearl (Zhujiang) River Delta, Yangtze (Changjiang) River Delta and Beijing-Tianjin Region. Because the majority of historic sites are located within approximately 10 km of the downtown area, a certain pattern has emerged, showing that the larger cities own more historic areas, which are in a more incomplete state of preservation, indicating the fragmentation of heritage spaces. The formation mechanism of the historic sites' distribution pattern is based on the conditions of the cities/towns as well as the bid-rent theory.

**Keywords:** historic site; cultural landscape; spatial distribution; Geo-analysis; ancient city/town; past heritage block; recent industrial heritage district

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## 1 Introduction

In the reconstruction process of urban material and spiritual space, the conservation and renovation of historic sites is an indispensable and essential part (Serageldin et al., 2001). The international interpretation of the 'historic sites' concept has undergone a long period of exploration. As evidence of social and cultural development, the scope of historic sites has been extended from cultural relic buildings that are single and scattered to historic buildings and their surrounding environments, and then to historic areas or even an entire city that is closely entwined with people's present life (Ahmad, 2006). Historic sites in Chinese cities were formed in the context of a certain space-time and evolved with the development and construction of cities, exhibiting particular spatial distribution features. If we only focus on historic sites themselves, they are just an isolated point. However, observing them from the perspective of the whole nation, their spatial distribution

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and mutual relationships form the strategic nodes and corridors of a cultural landscape pattern (Wang, 2011).

This article assumes that 'historic sites' must contain two dimensions of information: 1) 'time' (historic), which means they should embody characteristic styles of a certain stage or special period in the development of a city or town (Timothy, 1997); and 2) 'space' (sites), which indicates they should combine the space distribution, inherent correlation, culture sequence and system function of the entire area. Research of this paper is aimed at the important dimension 'space', but it is not only in the aspect of 'space', but also in the dimension of 'time', in other words, 'history and construction', which is behind 'space' and crucial. Based on the current situation in China, historic sites referred to in this article include ancient cities/towns, past heritage blocks and recent industrial heritage districts.

Currently, the development of a city/town faces not only the physical aging process but also the change of structure and function, as well as the loss and extinction of historical traditions and humanistic circumstances. This long process is expressed in conflicts between the old and the new, between the traditional and the alien, and between developmental change and heritage. Challenges between urban development and heritage conservation are more critical in developing countries because new construction threatens historic areas (Najd et al., 2015). In particular, lots of districts in historic city cores encompass areas of mixed class and ethnicity, as well as mixed land use (Hamer, 1998). In many historic cities, a bipolar approach has occurred, including conservation of limited listed heritage buildings and massive redevelopment of traditional quarters (Zhai and Ng, 2013), exposing many historic sites to the inescapable misfortune of 'protective development' or 'destructive construction.'

The methodologies for researching historic sites include a stated preference non-market valuation technique (Rolfe and Windle, 2003), a structural model that can reflect visitors' perceptions and valuation of authenticity (Bryce et al., 2015), hedonic modeling aimed to 'test the effects of age, both actual and effective' (Winson-Geideman et al., 2011), a strength, weakness, opportunity and threat (SWOT) analysis to identify and assess the key criteria of historic city quarters (Doratli et al., 2004), a panel data approach to assess the value of historic buildings (Cyrenne et al., 2006), and the tourist trail analysis to develop an interactive domain that combines place, tourists, and local people (Al-hagla, 2010). Thanks to the development of remote sensing and geographic information systems, scholars are conducting a lot of quantitative research on the spatial distribution of historic sites. Chen et al. (2011) proposes a spatial-temporal framework to conduct historical and cultural research. A thorough GIS analysis of 375 historical maps contributes to a better understanding of colonial developments, as well as landscape and settlement processes, the sedentarization of the Bedouin population (Levin et al., 2010), the spatial relationship between the new district and old town in Historical Cultural City (Peng et al., 2004), the influence of the city environment of historic sites upon traditional architecture (Al-Kheder et al., 2009), and the restoration of significant buildings that, for different dynasties, were in the strategic position of being a historically nomadic route and an important source of water (Alhasanat et al., 2012). As for the actual operation, based on GIS, information gathering and code processing of existing historic sites has been conducted according to the different types, along with the development of protective utilization and tourism (Cano et al., 2013).

Generally speaking, the present research on historic sites covers many aspects, including space transformation (Elsorady, 2012), aborigines and tourists, authenticity (Ragab, 2011), urban renewal (Pendlebury, 1999), and the utilization of industrial heritage (Conesa et al., 2008; Florentina-Cristina et al., 2014). Most of these studies take a single historic site or city/town as the research object. Scholars analyze historic cities with the concept of spatial scale and regional difference in human geography. Different principles of scale division are used, including economic belts (Li and Bao, 1996), as well as administration partition with micro, medium and macro scale (Hu et al., 2012). Some other researches with greater scale usually choose several cities/towns in particular regions for comparison (Yu, 2013).

In fact, for a long time, the study of spatial regularity and spatial patterns has been mentioned as they relate to the spatial distribution of economic geography (Axenov et al., 1997), city space (Lee and Jou, 2010) and tourist areas (Xie et al., 2007; Xie and Wu, 2008; Huang et al., 2010). As for the study of spatial distribution, we are able to master the distribution pattern from a macroscopic view and then discern the holistic spatial distribution and key node.

This article focuses on the spatial distribution and characteristics of historic sites on three scales of city, province and nation, which is the key to discerning the security pattern of China's cultural landscape at the micro, medium and macro levels. With the technical support of a GIS spatial analysis tool, incorporating the mathematical methods of geography as the spatial analysis measure, this article describes the spatial characteristics of historic sites, explores the distribution pattern and preservation state of historic sites in cities/ towns, discusses the reason for the current spatial distribution of historic sites and the relationship between their formation and the city/town's construction. As a result, these studies will lay the foundation for creating an integrated conservation and development strategy, restoring the city/town context that should be inherited and developed, and realizing the continuation and reconstruction of traditional space texture, hoping to provide reference for the preservation and renewal of historic sites.

In this paper, the spatial distribution pattern of historic sites of China is studied at three levels: city, province and nation. Firstly, the paper analyzes the distance between historic sites and the downtown area where they are located. Particular emphasis is placed on the differences in quantity, pattern and distribution of historic sites in cities/towns of various grades. Next, with criteria such as geographic concentration index, imbalance index and the Lorenz curve, this paper examines the characteristics and equilibrium of the spatial distribution of historic sites on a provincial scale and conducts a contrastive analysis between the number of historic sites per unit area of a province and that of the whole country, providing a more visual reflection of the unbalanced distribution of historic sites in different provinces. Finally, 828 historic sites are selected as study samples according to a certain standard, and their spatial distribution is described quantitatively on a nationwide scale.

## 2 Data and Methods

The paper conducts comprehensive research on the spatial distribution of historic sites at three levels, with intensive study and analysis at each level. It breaks through the limitations of former studies that only focused on a single historic building and fully masters the spatial and temporal distribution patterns of historic sites, thus conducting an in-depth exploration of their distribution mechanism and approaches to preservation.

As for the ancient cities/towns and past heritage blocks, this thesis concentrates on the 117 China National Historical Cultural Cities (by the end of 2013) published on the China Cultural Heritage Website[①]. Extracting information to define the historic sites (including historic areas and historical and cultural blocks) from related materials, such as City Master Planning and Conservation and Planning of Historical Cultural City, 736 eligible historic sites are selected. As for the recent industrial heritage districts, according to the carding and identification of China's contemporary industrial development phase and potential industrial heritage (Yu and Fang, 2006), 92 eligible industrial cultural relics are selected from all of the potential industrial heritage, and the city samples added up to 141. Finally, all of the historic sites amount to 828 after removing duplicates. The historic sites are located in 33 provincial-level administrative units except Macao.

Accurate geographic coordinates of 828 historic sites and the administrative center of the cities/towns where they are located are ascertained by means of Google Earth (Fig. 1). At the nationwide and provincial levels, historic sites are approximately regarded as point elements. They are marked with their longitude and latitude data on a map of China, which is rectified with geographic coordinates. Properties such as the name and type of each element are given clear indication in an attribute table to digitize operations and the spatial analysis in the setting of ArcGIS 9.3.

By means of the mathematical method of geography, quantitative analysis of historic sites is made with tools such as Point Distance, Near and Density in ArcGIS 9.3, including the quantitative measure of the spatial distribution type of historic sites with the Nearest Neighbor Index and evaluation of the degree to which the historic sites are evenly distributed in provinces and regions all over the country with Geographic Concentration Index and Lorenz curve.

① China Cultural Heritage Website (www.cchmi.com), a commonweal transmission network platform of cultural heritage, was built up by the China Cultural Heritage Information Consultation Center (State Administration of Cultural Heritage Data Center) under the leadership of the State Administration of Cultural Heritage. All Chinese world heritages, national culture relic protection sites at all levels, historical cultural cities, historical villages and towns, and digital book reservations are gathered here, with all national cultural relic treasures being displayed by means of a network. This paper was written based on 117 Chinese historical cultural cities published in the China Cultural Heritage Network (up to the end of 2013).

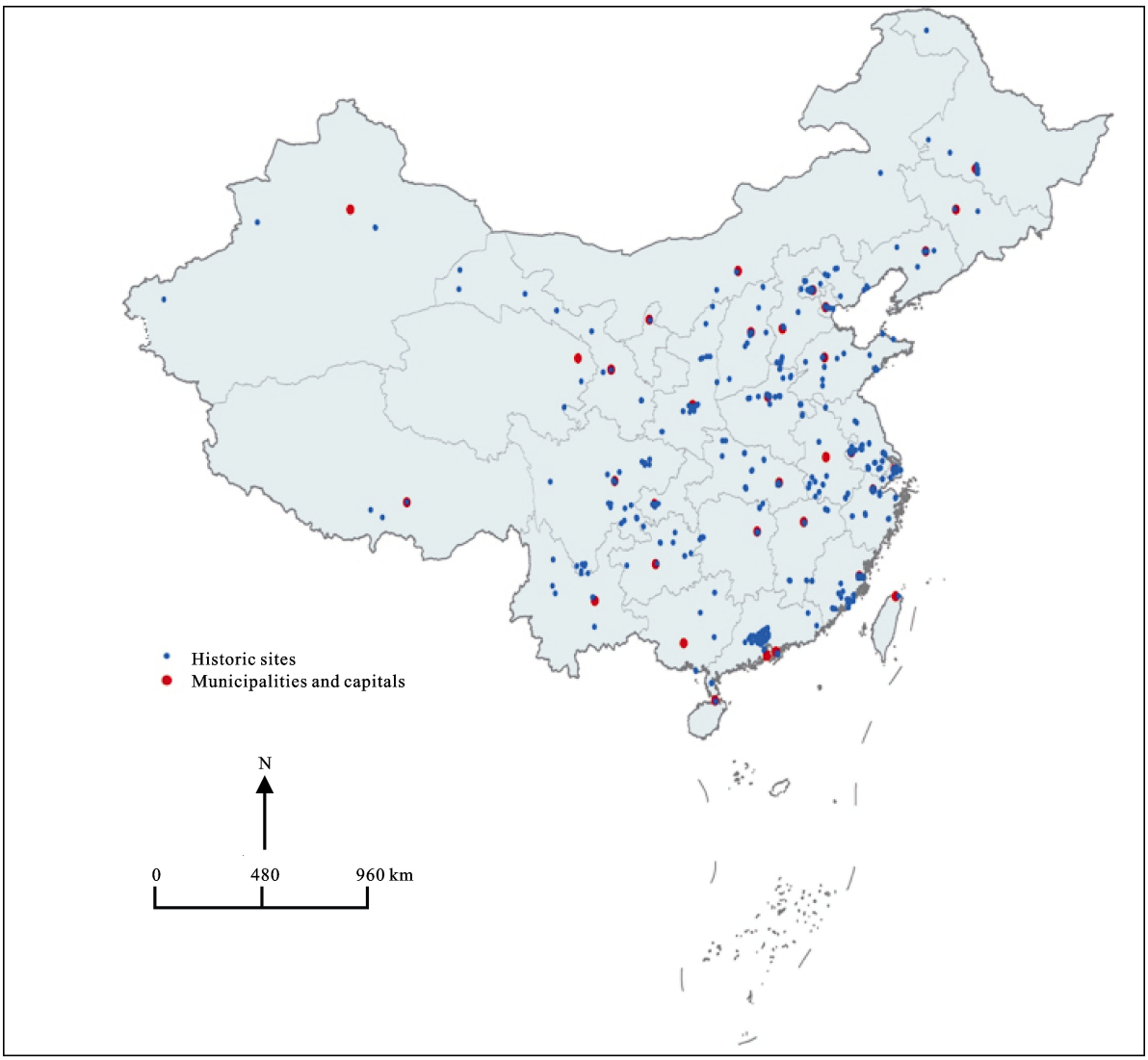


**Fig. 1** Distribution of historic sites in China

## 3 Spatial Distribution Regularity of Historic Sites at the City Level

From the perspective of morphology, we can always find similar structural features in different cities/towns. So, there comes a question that if historic sites in different cities/towns show similar features in spatial distribution. And after a long-term development, which kind of cities/towns can reserve more historic sites till now?

### 3.1 Similar features in spatial distribution of historic sites

According to the results measured by ArcGIS 9.3, the distance between historic sites and the downtown area of the province where they are located is sorted in ascending order.

Within the distance of 55 km from the downtown area, there are 66 ancient cities/towns, accounting for 97.06% of this type; there are 632 past heritage blocks, accounting for 94.61% of this type; and there are 80 recent industrial heritage districts, accounting for 86.96% of this type. All three types of historic sites add up to 778, occupying 93.96% of the entire population.

To further measure the distribution pattern of historic sites away from the downtown area, we choose 5 km within the range of 55 km as the calculative unit to screen out the number of different types of historic sites that are distributed in each concentric ring with Excel software (Fig. 2).

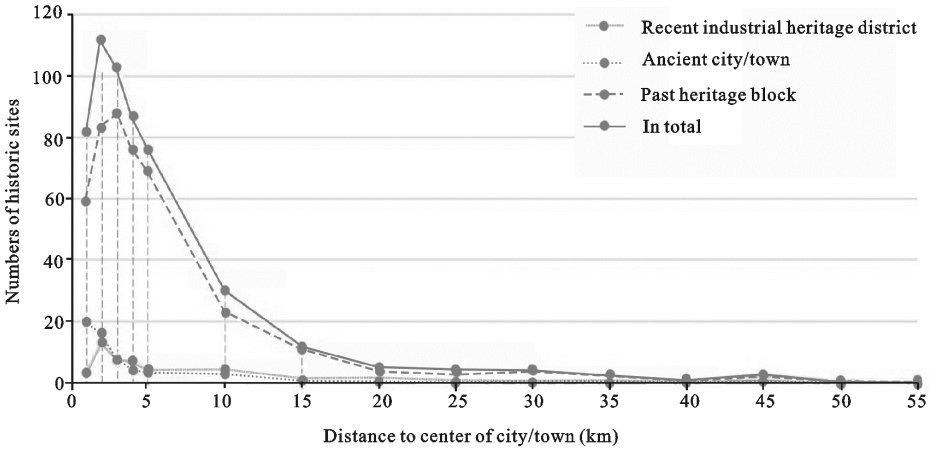


**Fig. 2** Spatial distribution of different types of historic sites in cities/towns

It can be easily observed from Fig. 2 that most historic sites are concentrated downtown and in suburban areas within the range of 10 km of the city/town or county center. As for different types of historic sites, the number of ancient cities/towns obviously decreases as the distance from the downtown area increases, mainly occurring within the range of 0 to 2 km from the center, such as Zhenyuan Ancient City (in Guizhou Province), Jiangzi Ancient City (in Tibet Autonomous Region) and Zhengding Ancient City (in Hebei Province). The number of past heritage blocks and recent industrial heritage districts have both gradually gone down after increasing the distance from the downtown area, and the majority are distributed within the range of 2 to 5 km to the center. From a distance of 5 km from the downtown area, the number of three types of historic sites is apparently reduced.

The relationship between historic sites and the downtown areas on a microscale is exactly the same as the spatial distribution of the bid-rent curve in cities/towns. In terms of an empirical study on the spatial distribution of city land prices, Alonso (1964) has proven the bid-rent theory, explaining that the city land price decreases outward, from the center to the peripheral area. Economic activities of all types tend to be carried out in the central town. Thus, the ancient city/town, past heritage blocks and recent industrial heritage districts are nothing but the material results produced by commercial activities, official business, recreation, and the industrial activities that take place under the guidance of bid-rent theory. Therefore, the coupling between the spatial distribution of historic sites and the spatial structural model of the city's land prices is never a coincidence but an inevitable consequence.

### 3.2 Distribution of historic sites in different graded cities/towns

To research the types, scales and spatial distribution of historic sites on the scale of a city/town, consideration of the Historical Cultural City's development pattern, which bears its own unique characteristics, is required. Protection of the Historical Cultural City is tightly bound to the development of the city/town. Together, the integrity of historical heritage sites and the city/town scale determine how ancient cities/towns are developed. Based on the scientific classification of the Chinese Historical Cultural City by Liu (2005), according to the different city/town scales and the remaining amount of historical relics in the city/town, we can create generalizations of nine types of cities/towns, depending on the two dimensions discussed above and after ruling out the three types of cities/towns that do not exist in the real world (Table 1).

The principal criterion to describe a city/town's scale is its population (Zhou, 1995). Based on previous studies (Zhang and Deng, 1999; Zhou et al., 2001), this paper classifies 141 city samples into four types (Table 2), taking population, economic development, land area, primary function and regional influence into account. This approach enables discussion about the relationship between the quantity and types of historic sites and the cities/towns in which they are located, which are graded in accordance with the variables mentioned above, including 1) the first-graded cities/towns: cities/towns that

are self-sufficient, fully internationalized, economically concentrated, innovatively equipped, and have a remarkable influence on the surrounding area; 2) the second-graded cities/towns: central towns with comparatively strong influences in a province, such as provincial capitals, municipalities with independent planning, and prefecture cities that hold prominent positions in provincial domains; 3) the third-graded cities/towns: cities/towns that include other unlisted prefecture cities; and 4) the fourth-graded cities/towns: cities/towns that include all county-level cities, counties, districts, and autonomous prefectures.

Then, we count up the types and quantities of historic sites that belong to different graded cities/towns (Table 3).

Next, the relationship between the total number and average of different types of historic sites and cities/towns' grades are further investigated (Fig. 3a).

Fig. 3a demonstrates that when the total number of recent industrial heritage districts declines, the cities/towns' grades also descend. The majority of ancient cities/towns are in third-graded and fourth-graded cities/towns, while past heritage blocks is located mainly in third-graded cities/towns, with a slight decrease in second-graded and first-graded cities/towns, and the lowest quantity is in fourth-graded cities/towns. These allocations indicate that the first-graded cities/towns assume the city/town's past heritage blocks and recent industrial heritage districts as their domain; the fourth-graded cities/towns have an abundance of ancient cities/towns and past heritage blocks; and the second and third-graded cities/towns cover all three types of historic sites.

**Table 1** Examples of Chinese Historical Cultural City classified according to city scale and integrity of historical heritages (partial)

| Type | Megapolis | Large-sized city/town | Medium-sized city/town | Small-sized city/town |
|---|---|---|---|---|
| Very intact type | Non-existent | Non-existent | Non-existent | Pingyao, Lijiang |
| Comparatively intact type | Beijing, Xi'an, Nanjing | Suzhou, Quanzhou | Kaifeng, Yangzhou, Shaoxing | Qufu, Shexian |
| Ordinarily preserved type | Tianjin, Shenyang, Jinan | Baoding, Anyang, Xiangfan | Datong, Linzi, Chaozhou | Xinjiang, Shouxian, Hancheng |

**Table 2** Examples and numbers of all of graded cities/towns

| Graded cities/towns | Examples | Number |
|---|---|---|
| First-graded cities/towns | Beijing, Guangzhou, Shanghai, Hong Kong | 4 |
| Second-graded cities/towns | Chengdu, Fuzhou, Guiyang, Harbin, Haikou, Hangzhou, Hohhot, Jinan, Kunming, Lhasa, Lanzhou, Nanchang, Nanjing, Ningbo, Qingdao, Shenyang, Suzhou, Taiyuan, Tangshan, Tianjin, Wuxi, Wuhan, Xi'an, Yantai, Changchun, Changsha, Zhengzhou, Chongqing | 28 |
| Third-graded cities/towns | Anqing, Anyang, Anshan, Baoding, Beihai, Changshu, Chaozhou, Chengde, Dali, Daqing, Datong, Deyang, Dujiangyan, Dunhuang, Foshan, Fushun, Fuxin, Ganzhou, Guilin, Leizhou, Handan, Hancheng, Hanzhong, Haozhou, Huai'an, Huainan, Keelung, Jilin, Jiaxing, Jinhua, Jingdezhen, Jiuquan, Kashi, Kaifeng, Lanzhong, Leshan, Lijiang, Liaocheng, Linhai, Liuzhou, Liupanshui, Luzhou, Luoyang, Meizhou, Nantong, Neijiang, Panzhihua, Penglai, Puyang, Qiqihar, Qinhuangdao, Quzhou, Qufu, Quanzhou, Shangqiu, Shaoxing, Shiyan, Suizhou, Tai'an, Taizhou, Tianshui, Turpan, Wuwei, Xianyang, Xiangfan, Xuzhou, Yanan, Yangquan, Yibin, Yixing, Yinchuan, Yulin, Yueyang, Zhangye, Zhangzhou, Zhaoqing, Zhenjiang, Zhongshan, Zhongxiang, Zibo, Zigong, Zoucheng, Zunyi | 83 |
| Fourth-graded cities/towns | Da Hinggan Ling Prefecture, Daixian, Fenghuang, Huili, Jixi, Jianshui, Jiangling, Jiangzi, Junxian, Linxia Hui Autonomous Prefecture, Linzi District, Pingyao, Qi County, Miao-Dong Autonomous Prefecture of Qiandongnan, Qiongshan, Xigazê Prefecture, Shanhaiguan, Shouxian, Tekes, Tongren, Weishan, Shexian, Xinjiang, Changting, Zhenyuan, Zhengding | 26 |

**Table 3** Total number and average number of different types of historic sites in different graded towns

| Graded cities/towns | Recent industrial heritage districts | | Ancient cities/towns | | Past heritage blocks | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Sum | Average* | Sum | Average* | Sum | Average* | Sum | Average* |
| First-graded cities/towns | 39 | 9.75 | 0 | 0.00 | 102 | 25.50 | 141 | 35.25 |
| Second-graded cities/towns | 25 | 0.89 | 7 | 0.25 | 263 | 9.39 | 295 | 10.54 |
| Third-graded cities/towns | 25 | 0.30 | 40 | 0.48 | 259 | 3.12 | 324 | 3.90 |
| Fourth-graded cities/towns | 3 | 0.12 | 21 | 0.81 | 44 | 1.69 | 68 | 2.62 |
| Total | 92 | | 68 | | 668 | | 828 | |

Note: * The average is the sum of historic sites of those graded towns/the number of towns

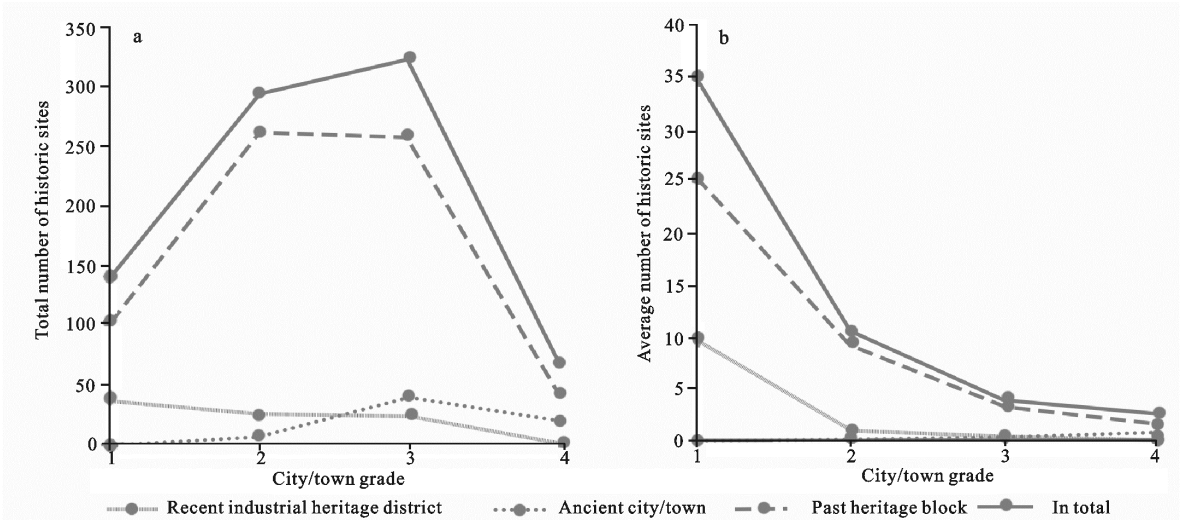


**Fig. 3** Relationship between total and average of historic sites and different graded cities/towns

Because each grade of cities/towns differs in numbers, further investigation is needed to measure the regularity of the different types of historic sites in each graded cities/towns. By calculating the average number of historic sites in each graded cities/towns, which can be done by dividing the number of each type of historic site by the number of corresponding graded cities/towns (Fig. 3b), the distraction of the number of cities/towns is eliminated. We can see that both the average numbers of recent industrial heritage districts and past heritage blocks follow the following distribution principle: first-graded cities/towns > second-graded cities/towns > third-graded cities/towns > fourth-graded cities/towns; however, the average number of ancient cities/towns follows a different distribution principle: fourth-graded cities/towns > third-graded cities/towns > second-graded cities/towns > first-graded cities/towns. If we add up all of the average values of these three types of historic sites, the curve shows that the higher the cities/towns' grade, the more historic sites it will have, with more historic site types (including both past heritage blocks and recent industrial heritage districts) than ancient cities/towns. Therefore, as a city/town's grade rises, the preserved condition of its heritage tends to become increasingly incomplete, and the preservation pattern tends to include more fragmented pieces of historic relics.

Another regularity from Fig. 3a lies in that for the first-graded and second-graded cities/towns, the number of each historic site types follows the order: past heritage blocks > recent industrial heritage districts > ancient cities/towns. Notably, the type of ancient city/town is lacking in the first-graded cities/towns, which means the megapolis and large-sized cities barely own any historic cultural heritages that are in intact condition; for the third-graded and fourth-graded cities/towns, the quantitative relationship between each type of historic site is different: past heritage blocks > ancient cities/towns > recent industrial heritage districts, indicating that, until now, it has been the cities/towns with small-scale, less advanced economies and lower grades that create more opportunities for the safe preservation of ancient cities/towns, which can be attributed to the fact that they are less affected by modern industrialization.

With the respect of structure and properties, analyzing the distribution of historic sites in cities/towns dates back to the growth of the city/town construction in ancient time and the recent development of renewal. This analysis not only makes sense in study of the structure and function for the growing cities/towns, but also has more important meaning in the protection of historic sites themselves.

## 4 Spatial Distribution Regularity of Historic Sites at Provincial Level

With vast territory, complex terrain, long histories and multiple cultures, historic sites in China are found in all provinces, autonomous regions and direct-controlled municipalities. The quantity difference of historic sites at the provincial level could reflect the disparity of province's cultural foundation. At the same time, the

provincial level as a separate and important part forms the multi-level Chinese history cultural heritage protection system. By emphasizing the provincial administrative unit, the analysis at the provincial level counts for analyzing spatial distribution difference of historic sites in the whole nation, as well as provides the reference to protection and development positioning of the provinces on the basis of historical and cultural foundation. Three aspects of the general distribution characteristics, as well as the balance degree of distribution and distribution density of historic sites at the provincial level will be expounded upon in the following paragraphs.

### 4.1 General distribution characteristics of historic sites

The Geographic Concentration Index is an important indicator to measure the degree of concentration. The formula is as follows (Xu, 1996):

$$G = 100 \times \sqrt{\sum_{i=1}^{n} \left( \frac{x_i}{T} \right)^2} \tag{1}$$

where $G$ denotes the Geographic Concentration Index of research objects, ranging between 0 and 100. A higher value of $G$ indicates a more concentrated distribution, while a lower value means a more decentralized distribution. $x_i$ represents the number of historic sites in the $i$th province or region. With the number of all historic sites, $T$ = 828, and the number of provincial-level administrative units, $n$ = 33, we have:

$$G = 100 \times \sqrt{\sum_{i=1}^{33} \left( \frac{x_i}{828} \right)^2} \approx 24.26 \tag{2}$$

If historic sites are distributed evenly, then the number of historic sites in every province and region should be $x_i$ = 828/33 ≈ 25.09. However, the Geographic Concentration Index $G_0 \approx 17.41 < 24.26$, indicating that the historic sites in every province vary in number. Their distribution at the provincial level is also uneven, indicating a generally concentrated distribution.

### 4.2 Balance degree of historic site distribution

To better focus on the specific provinces in which historic sites are gathered, the Unbalance Index is introduced as a variable, reflecting the degree of distribution range or distribution equilibrium of the research object at different levels or in different regions, and it can be represented by the formula for the Concentration Index in the Lorenz curve (Zhou, 1995).

$$S = \frac{\sum_{i=1}^{n} Y_i - 50(n+1)}{100n - 50(n+1)} \tag{3}$$

where $n$ denotes the number of provinces; $Y_i$ denotes the cumulative percentage of the number of historic sites in the $i$th province, accounting for the number of sites in the entire country and sequenced according to the number of historic sites they own in descending order. The Unbalance Index ranges from 0 to 1, with 1 indicating that research objects are gathered in the same province, and 0 indicating that research objects are distributed evenly in each province. The number of historic sites in a province-scale is shown in Table 4.

The Unbalance Index $S \approx 0.46$, indicating historic sites are distributed unevenly in 33 provincial-level administrative units all over the country (excluding Macao). Observing the Lorenz curve of the distribution of historic sites in each province (Fig. 4), it can be found that historic sites are owned by seven provinces, Guangdong, Jiangsu, Zhejiang, Fujian, Beijing, Shanghai and Shandong, amounting to more than half of the total number in China. The location of all seven provinces extends across the eastern coastal area from south to north. In addition, their city/town types include not only the ancient capital cities, such as Beijing and Nanjing, but also scenic cities/towns such as Suzhou and Yangzhou.

### 4.3 Density analysis of historic sites

As all provincial-level administrative units greatly differ from each other in size, mere calculation of the number of historic sites lacks comparability. Therefore, similar to the concept of 'location quotient' in regional economics and economic geography, we can define the density quotient, which is the ratio of the number of historic sites in every province and the provincial area divided by the ratio of the number of historic sites all over the country and national territorial area (Table 5).

Taking national statistics as standard data, the distribution density of historic sites is 828/960 = 0.86 per ten thousand square kilometers. Among all of the provinces, those with a distribution density of historic sites that is higher than the national level, meaning the density quotient is higher than 1, amount to 21, accounting for 61.76% of 33 administrative units at the provincial level.

**Table 4** Distribution of historic sites in different provincial-level administrative units

| Provincial-level administrative unit | Number of historic sites | Proportion | Cumulative percentage (%) |
|---|---|---|---|
| Guangdong | 103 | 0.1244 | 12.44 |
| Jiangsu | 95 | 0.1147 | 23.91 |
| Zhejiang | 56 | 0.0676 | 30.68 |
| Fujian | 51 | 0.0616 | 36.84 |
| Beijing | 44 | 0.0531 | 42.15 |
| Shanghai | 43 | 0.0519 | 47.34 |
| Shandong | 41 | 0.0495 | 52.29 |
| Sichuan | 40 | 0.0483 | 57.13 |
| Hubei | 38 | 0.0459 | 61.71 |
| Henan | 35 | 0.0423 | 65.94 |
| Shaanxi | 31 | 0.0374 | 69.69 |
| Anhui | 26 | 0.0314 | 72.83 |
| Hebei | 25 | 0.0302 | 75.85 |
| Heilongjiang | 22 | 0.0266 | 78.50 |
| Hunan | 20 | 0.0242 | 80.92 |
| Tianjin | 19 | 0.0229 | 83.21 |
| Jiangxi | 19 | 0.0229 | 85.51 |
| Shanxi | 17 | 0.0205 | 87.56 |
| Gansu | 17 | 0.0205 | 89.61 |
| Ningxia | 16 | 0.0193 | 91.55 |
| Guizhou | 12 | 0.0145 | 93.00 |
| Chongqing | 11 | 0.0133 | 94.32 |
| Liaoning | 9 | 0.0109 | 95.41 |
| Yunnan | 7 | 0.0085 | 96.26 |
| Guangxi | 6 | 0.0072 | 96.98 |
| Xinjiang | 6 | 0.0072 | 97.71 |
| Inner Mongolia | 4 | 0.0048 | 98.19 |
| Hainan | 4 | 0.0048 | 98.67 |
| Tibet | 4 | 0.0048 | 99.15 |
| Hong Kong | 3 | 0.0036 | 99.52 |
| Jilin | 2 | 0.0024 | 99.76 |
| Taiwan | 1 | 0.0012 | 99.88 |
| Qinghai | 1 | 0.0012 | 12.44 |

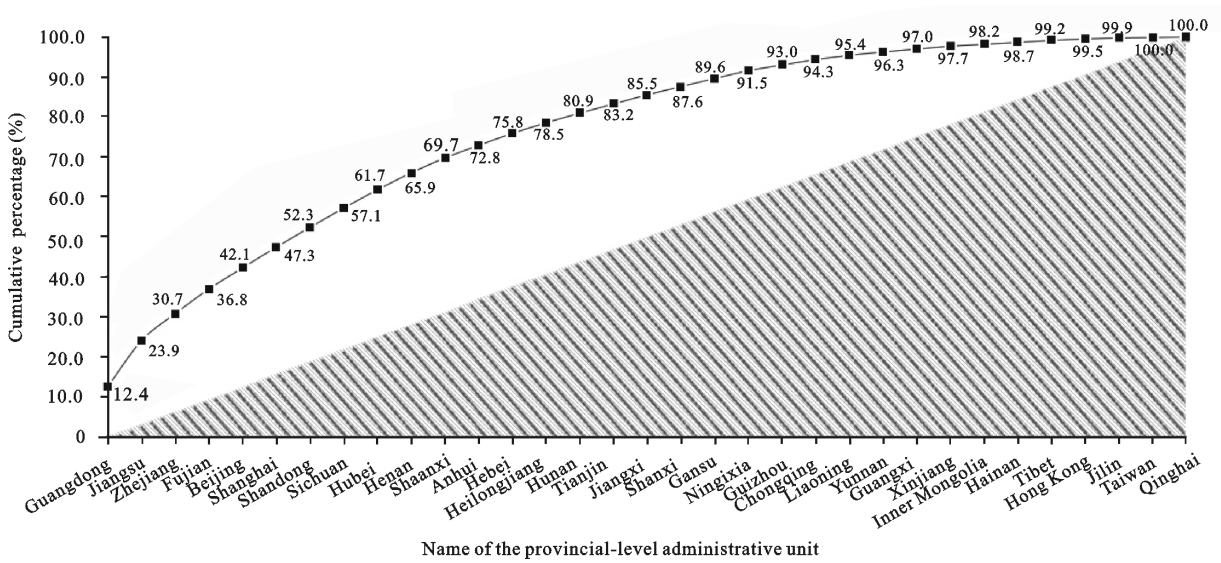


**Fig. 4** Lorenz curve of number of historic sites distributed in each provincial-level administrative unit in China

**Table 5** Comparison between area ratio and number ratio of historic sites held by each provincial-level administrative unit

| Provincial-level administrative unit | Ratio of area | Ratio of number | Density quotient |
|---|---|---|---|
| Guangdong | 0.018666 | 0.124396 | 6.66 |
| Jiangsu | 0.010641 | 0.114734 | 10.78 |
| Zhejiang | 0.010756 | 0.067633 | 6.29 |
| Fujian | 0.012848 | 0.061594 | 4.79 |
| Beijing | 0.001725 | 0.053140 | 30.80 |
| Shanghai | 0.000665 | 0.051932 | 78.13 |
| Shandong | 0.016171 | 0.049517 | 3.06 |
| Sichuan | 0.051049 | 0.048309 | 0.95 |
| Hubei | 0.019623 | 0.045894 | 2.34 |
| Henan | 0.017455 | 0.042271 | 2.42 |
| Shaanxi | 0.021703 | 0.037440 | 1.73 |
| Anhui | 0.014799 | 0.031401 | 2.12 |
| Hebei | 0.019716 | 0.030193 | 1.53 |
| Heilongjiang | 0.047440 | 0.026570 | 0.56 |
| Hunan | 0.022390 | 0.024155 | 1.08 |
| Tianjin | 0.001223 | 0.022947 | 18.76 |
| Jiangxi | 0.017634 | 0.022947 | 1.30 |
| Shanxi | 0.016483 | 0.020531 | 1.25 |
| Gansu | 0.042684 | 0.020531 | 0.48 |
| Ningxia | 0.005466 | 0.019324 | 3.54 |
| Guizhou | 0.018578 | 0.014493 | 0.78 |
| Chongqing | 0.008700 | 0.013285 | 1.53 |
| Liaoning | 0.015311 | 0.010870 | 0.71 |
| Yunnan | 0.040473 | 0.008454 | 0.21 |
| Guangxi | 0.024961 | 0.007246 | 0.29 |
| Xinjiang | 0.172156 | 0.007246 | 0.04 |
| Inner Mongolia | 0.120705 | 0.004831 | 0.04 |
| Hainan | 0.003582 | 0.004831 | 1.35 |
| Tibet | 0.126961 | 0.004831 | 0.04 |
| Hong Kong | 0.000116 | 0.003623 | 31.22 |
| Jilin | 0.020084 | 0.002415 | 0.12 |
| Taiwan | 0.003809 | 0.001208 | 0.32 |
| Qinghai | 0.075427 | 0.001208 | 0.02 |

Provinces with the highest distribution density of historic sites are Beijing, Tianjin, Shanghai and Jiangsu. In addition, the distribution density of historic sites in eastern coastal provinces such as Zhejiang and Guangdong is much higher than that of the middle-west inland provinces (Fig. 5).

Comparing the ratio of the number of historic sites in every provincial-level administrative unit to the total number in the whole country with the ratio of the area of the corresponding province to the national territorial area, we can reach a similar conclusion that the number of historic sites per unit area in provincial-level administrative units such as Beijing, Shanghai, Jiangsu and Guangdong is more than that of the whole country. The opposite turns out to be true for Inner Mongolia, Tibet and Xinjiang (Fig. 6).

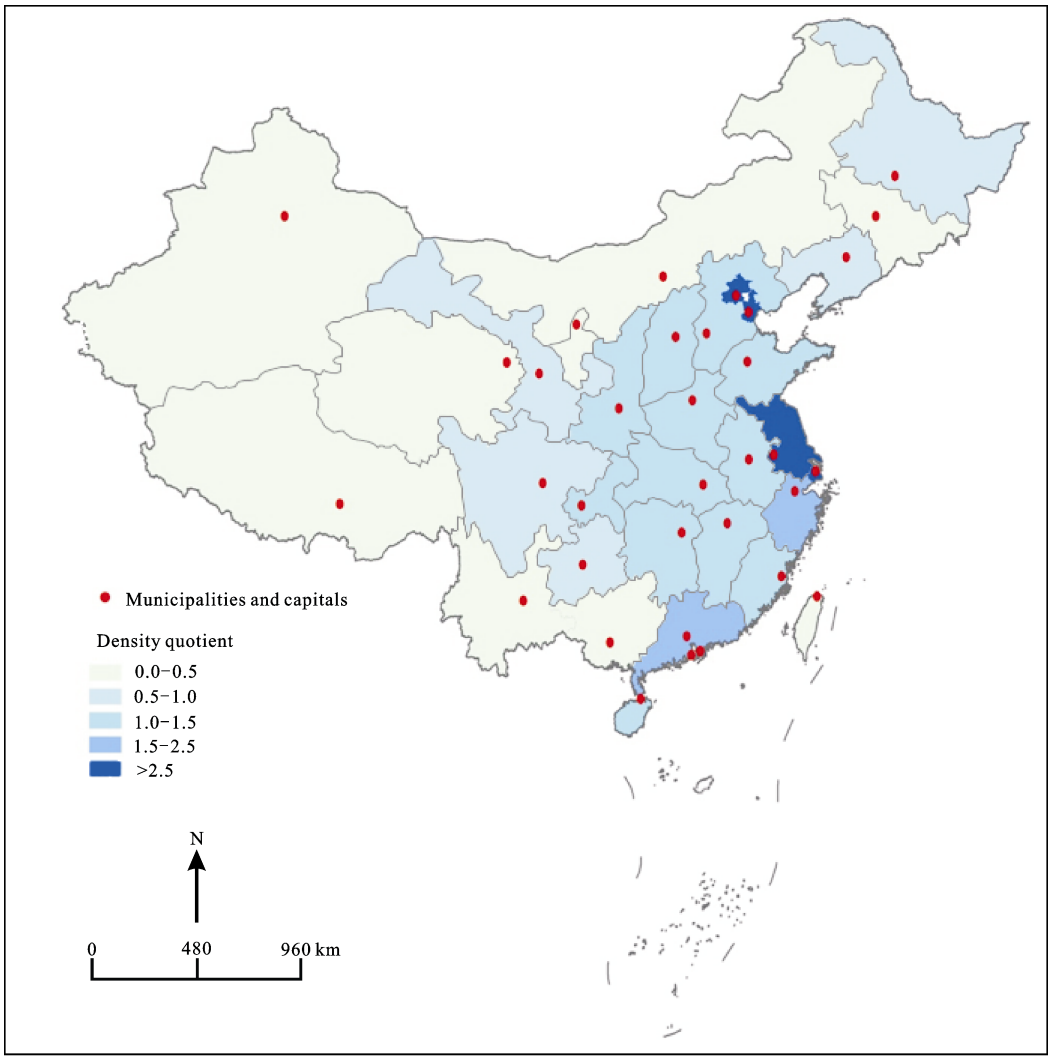


**Fig. 5** Distribution density of historic sites at provincial level

Thus, it can be seen that under the influence of nature, culture and economic activities, historic sites in China are mainly distributed in two areas. The first area is the Central Plains area, represented by Beijing, Shanxi, and so on. The construction of the city is an agglomeration of the imperial capitals of successive feudal dynasties, gathering substantial historic buildings, such as palaces for emperors to work, dwell and have some recreational activities, as well as temples, gardens and mausoleums to rest in peace. No wonder they are scattered with numerous past heritage blocks. The other area is the border region of Jiangsu, Shanghai and Zhejiang, with cities such as Shanghai, Nanjing, Suzhou and Hangzhou as the principal components.

If we trace the formative mechanism of historic sites, they can be divided roughly into the following three categories: 1) Modern capital blocks. Nanjing and Hangzhou had been established as a provisional capital for a long time. They are characterized by historic relics and are referred to as an ancient city or a scenic spot of the capital era. They are featured mainly in past heritage blocks, with a single type but a large quantity and various types of locations, including historical and cultural blocks, historic scenic areas, and general historic sites. 2) Scenic spot and garden blocks. Suzhou leaves us with a strong impression. The world-renowned Suzhou garden represents the highest level of Chinese private garden architecture, embodying excellent fusion of artificial art and the natural environment. Undoubtedly, the combination of architecture and landscape makes the city/town's personality more prominent. 3) Colonial concession blocks. Shanghai is one of the largest

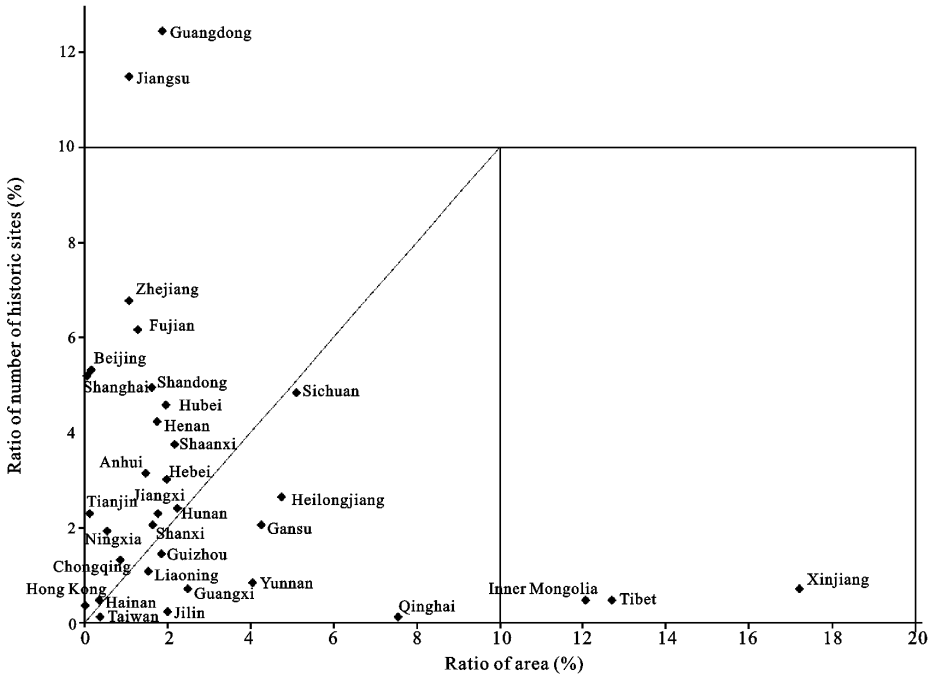


**Fig. 6** Comparison between ratio of number of historic sites in every provincial-level administrative unit to total number in whole country and ratio of area of corresponding province to national territorial area

metropolis in modern China. However, for 500 years, it was just a nameless county in the southeastern coastal region before its opening as a commercial center. Foreseeing that the location of Shanghai would undergo a qualitative leap from a strategic international perspective, Western colonists turned the region between Suzhou River and Old Town Area into a business hub. Therefore, the animated, magnificent and diversified subculture of Shanghai was formed under the dual influences of Chinese and Western culture, as well as the complicated interactions of politics, economy and commerce. Thus, demonstrating the recent heritage of the concession period, historic sites in Shanghai are mainly in recent industrial heritage districts. Most of them are the remaining representative buildings or building groups in the historic area.

## 5 Spatial Distribution Regularity of Historic Sites at the Nationwide Level

Considering the vast territory and the various geography features, these different environments in China have various effects on the spatial distribution of historical cities/towns. At the same time, taking the provincial boundary changes in the history into consideration, the study on medium scale will also be constrained. Breaking the provincial administrative boundaries, this paper goes further to discuss the spatial distribution, as well as the corridor and patch, revealing the spatial distribution of historic sites at a deeper level. At the nationwide level, historic sites are approximately regarded as point elements, whose mutual proximity can be investigated according to the Nearest Neighbor Index, and their distribution density is calculated to understand the spatial distribution of historic sites at the macro level.

### 5.1 Spatial distribution types of historic sites

There are three types of spatial distributions for point elements in geographic space: even distribution, random distribution and agglomerate distribution (Zhang and Yang, 1991). When the distribution of point elements is random (Poisson distribution), theoretically, its Nearest Neighbor Distance can be represented as (Zhang and Yang, 1991):

$$\overline{r_E} = \frac{1}{2\sqrt{n/A}} = \frac{1}{2\sqrt{D}} \tag{4}$$

where $\overline{r_E}$ is the theoretical Nearest Neighbor Distance;

$A$ is region area; $n$ is the number of points; and $D$ is point density. The ratio between the actual Nearest Neighbor Distance and the theoretical one is the Nearest Neighbor Index (Zhang and Yang, 1991):

$$R = \frac{\overline{r_l}}{\overline{r_E}} = 2\sqrt{D}\overline{r_l} \tag{5}$$

where $r_l$ is the actual Nearest Neighbor Distance. When the Nearest Neighbor Index $R < 1$ ($\overline{r_l} < \overline{r_E}$), the points are agglomerate-distributed; when $R = 1$($\overline{r_l} = \overline{r_E}$), the points are random-distributed; and when $R > 1$ ($\overline{r_l} > \overline{r_E}$), the points are even-distributed.

China's territory area is $9.6 \times 10^6$ km$^2$. According to the formula, the Nearest Neighbor Distance of the 828 historic sites with theoretically random distribution is:

$$\overline{r_E} = \frac{1}{2\sqrt{n/A}} = \frac{1}{2\sqrt{828/9600000}} \approx 53.84\,(\text{km}) \tag{6}$$

With the help of Point Distance in the Toolbox of ArcGIS 9.3, the Euclidean Distance between any two historic site elements can be measured, as well as the actual nearest linear distance $r_{l,i}$ ($i$ = 1, 2, 3, …, 828), between the historic sites and their nearest counterparts. The actual average of Nearest Neighbor Distance is:

$$\overline{r_l} = \frac{1}{828}\sum_{i=1}^{828} r_{L,i} = 11.401272 \approx 11.40\,(\text{km}) \tag{7}$$

Based on the calculation, $\overline{r_l} < \overline{r_E}$, which means the actual Nearest Neighbor Distance is smaller than the theoretical Nearest Neighbor Distance of random distribution. As the Nearest Neighbor Index $R$ = 11.40/53.84≈ 0.21 < 1, the 828 historic sites are distributed close together at the nationwide level, presenting a pattern of agglomerative distribution. Therefore, the nationwide distribution of historic sites is not even or random, and their existing form shows some regularity in space.

### 5.2 Spatial distribution density of historic sites

Further study on the density analysis of 828 historic sites is conducted with the help of Density in the Toolbox of ArcGIS 9.3. After selecting kernel, employing the default of both search radius and output cell size, and adopting 'square kilometers' as area units, we can get the degree of distribution density of historic sites at the national level (Fig. 7).

At the national level, historic sites in China are distributed densely in areas such as the Pearl (Zhujiang) River Delta region, Yangtze (Changjiang) River Delta region and Beijing-Tianjin region. Within these areas, the highest distribution densities are in Guangzhou, Foshan and Hong Kong. In particular, Guangdong's regional characteristics originated from its long history and cultural diversity that has left numerous and various types of historic sites behind.

In addition to those three areas above, areas with a comparatively higher distribution density of historic sites also include 1) the Guanzhong area, with Xi'an at the center; 2) the Central Plain ancient capital area, with Luoyang at the center; 3) the Hui people's concentrated communities, with Yinchuan at the center, all of which present regional characteristics and unique landscapes; and 4) the old industrial base area in northeast China, with Harbin at the center, which was influenced by Japan and former Soviet Russia and prospered during the socialist economic period of heavy industry construction.

## 6 Discussion and Conclusions

This paper dives deep into the distribution pattern and spatial distribution of 828 historic sites in China, on the scales of city, province and nation. At the macro and medium levels, the distribution pattern of historic sites has an inner formation mechanism, which is thought to be closely related to the development process of cities/towns. On the provincial scale, historic sites also appear in several specific provinces, with a relatively low degree of equilibrium, among which the number of historic sites held by Guangdong, Jiangsu, Zhejiang, Fujian, Beijing, Shanghai, and Shandong account for more than half of the total, suggesting a substantially higher quantity than the combined result of the provinces in the central and western regions. On the national scale, historic sites tend to be concentrated mainly in the Pearl River Delta region, Yangtze River Delta region, and the Beijing-Tianjin region. Historic sites are gradually formed along with the rise and construction of cities/towns, which is entwined with the natural environment and cultural traditions, as well as economic and social activities. Those regions where historic sites tend to be concentrated have a preference for fertilized soil,

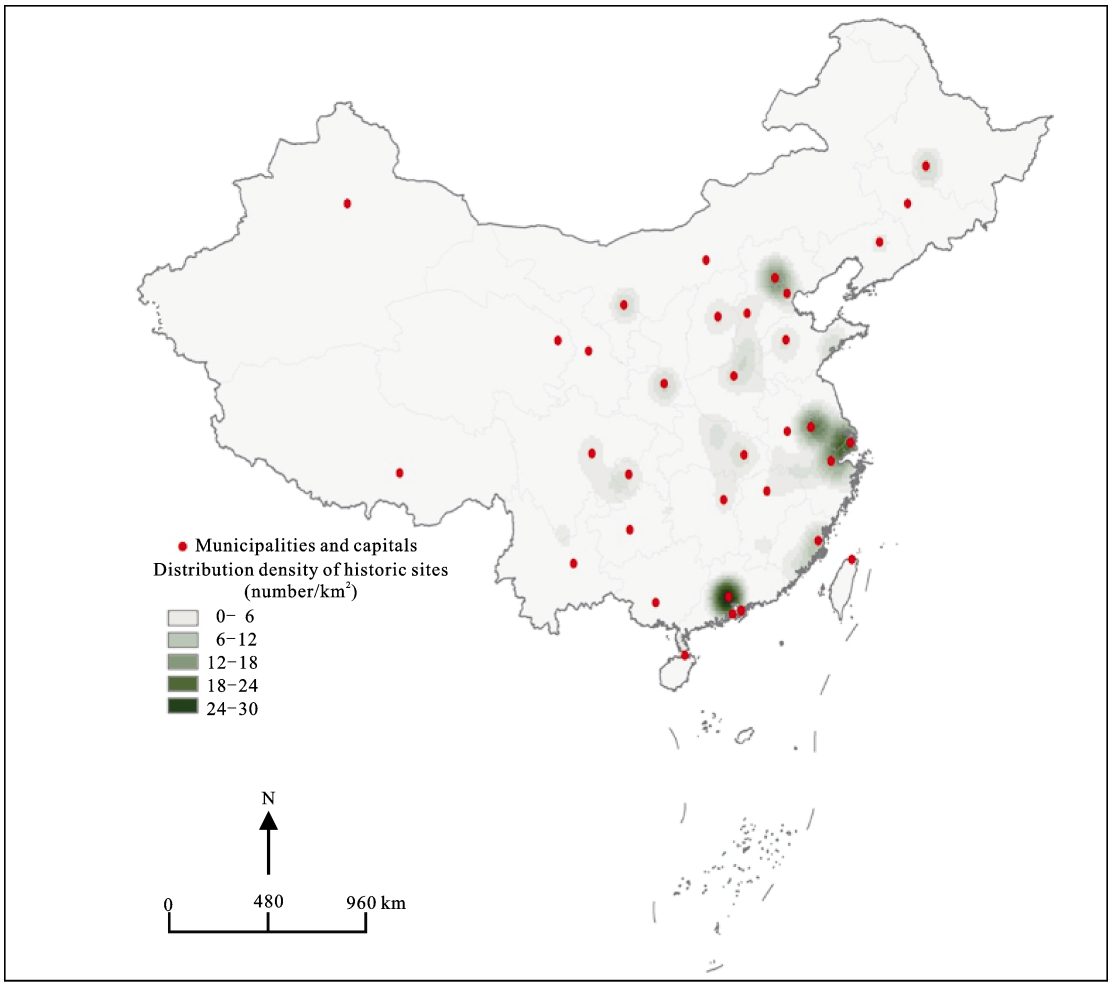


**Fig. 7** Distribution density of historic sites at the national level

mild climate and accessible transportation. These factors make it easy to develop into a residential area, with an enormous agglomeration of people and resources, which is the basis for forming cities/towns and provides pre-conditions for the appearance of potential historic sites, such as Guangzhou, Hangzhou, Suzhou and Beijing. Conversely, the regions with scarce historic sites, such as Anqing and Lanzhou, are normally environmentally disadvantaged for breeding new life. Both regions were rapidly constructed by virtue of exploitation of mineral resources or national policies, transcending the inherent law of the cities/towns' development. As a consequence, few historic and cultural heritages are left in these areas. In this sense, the external environment has determined the driving force of the cities/towns' evolution and, to a large extent, the theoretical value of historic sites. On the city scale, the majority of historic sites are located within the range of 10 km from the downtown area, including downtown, suburb or county center. Specifically, most ancient cities/towns are located 0–2 km away from the downtown area. Both past heritage blocks and recent industrial heritage districts are mainly distributed within the range of 2–5 km from the downtown area, with a distribution pattern that is exactly the same as the bid-rent curve in city/town spaces. Nevertheless, such space coupling is not a coincidence but an inevitable outcome of human activities over a long period of development. Currently, at the mercy of bid-rent theory, the rapidly developing economy, the extremely scarce land, and the fiercely soaring price of central land exert great pressures on the protection of historic sites that are located in the core area of cities/towns. Meanwhile, problems such as the transformation of historic areas, construction of new areas, and the protection of ancient cities/towns have also emerged.

When keeping a watchful eye on the state of preservation of historic sites, we can find that the higher the city/town's grade, the more historic sites it has, including more types of past heritage blocks and recent industrial heritage districts, as opposed to ancient cities/towns, whose preservation status tends to be more fragmented. Generally speaking, no matter the total or average distribution of sites, the number of past heritage blocks is comparatively the largest, which was determined by the long history of city/town development. All of the sampling cities/towns include a number of historical districts, whether more or less, but not all of them have ancient cities/towns. Those without ancient cities/towns may not have a long history of development, but, on the one hand, they were later generated by industry, such as Shanghai. On the other hand, more cities/towns were 'constructively destroyed' in the name of 'protective exploitation.' For example, Wenfeng Tower, which was built in the ancient city Anyang, descended to be the fixture of a central traffic island after losing its reliant environment in the construction of the new area. Similar to recent heritage, recent industrial heritage district tends to be distributed in large and medium-sized cities, a situation in which mutual sides are likely to interact from the beginning as both the cause and effect of the site selection. Some unknown mountain villages have turned into developed cities/towns overnight due to the exploitation of mineral resources, for example Tangshan. Some remote cities/towns with scarce resources are forced to undertake industries that have been transferred from other places, making them more vulnerable to be attacked out of national security. Some cities such as Hong Kong possess favorable economic foundations and are thus forced to host the factories of foreign countries, due to their advantageous resources, locations and transportation.

In conclusion, the differences between the quantity and preservation state of historic sites among different spatial scales are influenced by social, economic, political and cultural factors, which are particularly related to the process of city/town development. Therefore, the protection of historic sites calls for the coordination and cooperation of all social circles. It is undeniable that the prosperity of historic areas is composed of two inevitably mutual yet contradictory processes: renewal and restoration. The former strives to adapt itself to the change in a city/town economic structure, while the latter attempts to restrict these changes to protect the original characteristics of the historical architecture and blocks. Nevertheless, 'protection' is not merely to preserve the past for the sake of keeping authentic memories but to respect the past to improve the present situation. The essence of protection is not to duplicate old times, or to reproduce past styles and features, but to refine the beneficial historical information of the existing environment, subtly accommodating various forces for the purpose of adjusting the directions of development in the present and in the future. Since 'Urban renovation and ecological restoration' has become an important approach in China, it is significant to understand the spatial distribution features of historic sites in a single city/town, especially in comparison with others in China. These features help to position historic sites correctly and find their own characteristics. Instead of the traditional preservation focusing on individual or group, spatial distribution features help make a breakthrough in terms of integral cultural landscape preservation. Such kind of protection and renovation is better for the sustainable development of cultural landscape.

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