

# Temporal-spatial distribution of archaeological sites in the Nihewan-Huliu Basin during the Paleolithic-Neolithic and Iron Age in northern China

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**Abstract.** The Nihewan-Huliu Basin is one of the great regions of human evolution, located in geographical transition zone. This study reveals the temporal-spatial distribution of archaeological sites based on the DEM (Digital Elevation Model) data, and analyses the changes for four periods (Paleolithic-Neolithic transition, Neolithic Age, Bronze Age and Iron Age). These sites expanded from the Sanggan River to the Huliu River and from the central and lower Huliu River to its upper reaches. The population and cultural development in the Nihewan Basin gradually lagged behind the Huliu River Basin after the Paleolithic-Neolithic transition Age, because of the environmental impacts. The results may aid the understanding and study of the cultural heritage and civilization evolution in northern China.

## 1. Introduction

It is well known that there are a large number of Paleolithic sites in the famous Nihewan Basin [1][2][3], but many important Neolithic cultural sites are not well known, especially the sites in the adjacent Huliu River Basin. The Huliu River is a major tributary of the Sanggan River; it flows through Guangling County of Datong City in the northeast of Shanxi Province, Yu County and Yangyuan County (core area of the Nihewan Basin) of Zhangjiakou City in the northwest of Hebei Province, and into the Sanggan River in Yangyuan County. The study area will be called the Nihewan-Huliu Basin in this paper.

From the 1920s[4], archaeologists worldwide have investigated the northern parts of Hebei Province many times, especially the Paleolithic archaeology in the Nihewan Basin, resulting in great achievements and world-renowned discoveries[1][2][3][5][6][7]. From the 1970s, detailed Neolithic archaeological surveys have been carried out in Yu County[8][9][10], resulting in important achievements and proof of prehistory cultural exchanges. However, the temporal-spatial evolution study is not enough, and is not consistent with the significant archaeological status of the Nihewan Basin and the Huliu River Basin. The Nihewan-Huliu Basin holds almost successive human evolution relics from the Paleolithic Age to the Han Dynasty (approximately 21 cal ka BP ago to AD 220 in this paper), extending even to the present, so they should be studied as a whole to reveal the significance of man-land relationships.

With the gradual increased investigation, it is time to reveal the temporal and spatial distribution of archaeological sites based on the DEM (Digital Elevation Model) data, and their relationship with the environments. The results may provide valuable results for the study of ancient human activities,



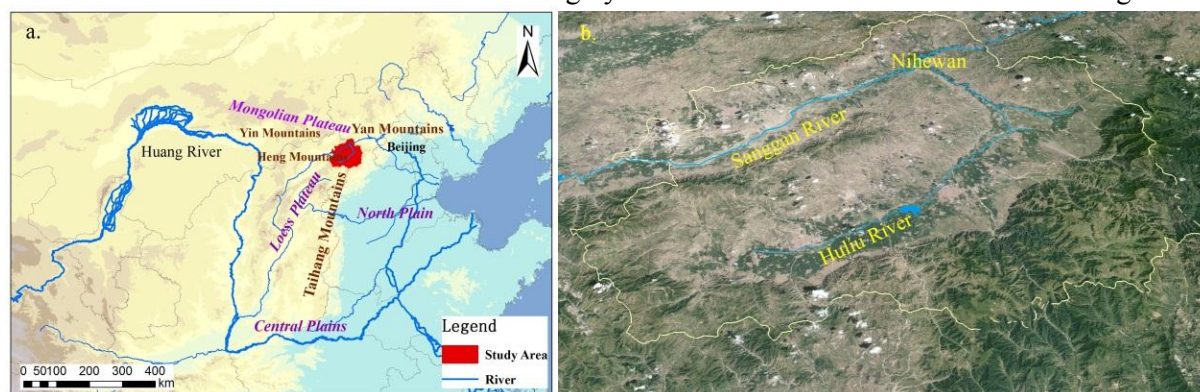
cultural heritage, prehistoric civilization in northern China [10] and so on. This topic is attracting more and more attention.

In this paper, firstly, the regional setting and archaeological sites will be introduced; then, the spatial distribution of published sites will be mapped for four periods and will be analyzed in detail; finally the relationship between the temporal-spatial distribution and the environments will be simply explained.

## 2. Regional setting and data

### 2.1. Regional setting

The Nihewan-Huliu Basin is located in the southeast of the Inner Mongolian Plateau, the northeastern part of the Loess Plateau, and the northwest of the North China Plain. The basin is surrounded by hills and mountains, whose altitude varies from approximately 0.9 to 2.8 km a.s.l. The geographic scope is approximately 39.56-40.38N, 113.85-115.06E, an area of approximately 6,300 km<sup>2</sup>. The position of the basin in northern China and the satellite imagery of the intermontane basin are shown as Figure 1.



**Figure 1.** The position mapping of the Nihewan-Huliu Basin. (a) The position in northern China with the background DEM dataset from the CHGIS (China Historical GIS, <http://www.fas.harvard.edu/~chgis>); (b) the satellite imagery of the Nihewan-Huliu Basin from RSCM (Remote Sensing Cloud Mart, <http://www.rscloudmart.com>) with elevation supported by the ASTER GDEM 30 m

### 2.2. Archaeological data

In this paper, 175 archaeological sites are collected from the “Atlas of Chinese Cultural Relics” edited by the State Administration of Cultural Heritage in China (Chinese: Guojia Wenwuju, abbreviated: GWJ) [11][12] and the published data [3][2][7][13][14], including 61 sites (including the Small Stone and Microlithic sites) in Yangyuan County, 101 sites in Yu County, and 13 sites in Guangling County, from the late phase of the Late Paleolithic Age to the Han Dynasty. These sites could be classified into four periods and groups according to archaeological cultures, such as the Paleolithic-Neolithic transition Age, the Neolithic Age, the Bronze Age and the Iron Age. The dates and corresponding typical sites are listed in Table 1.

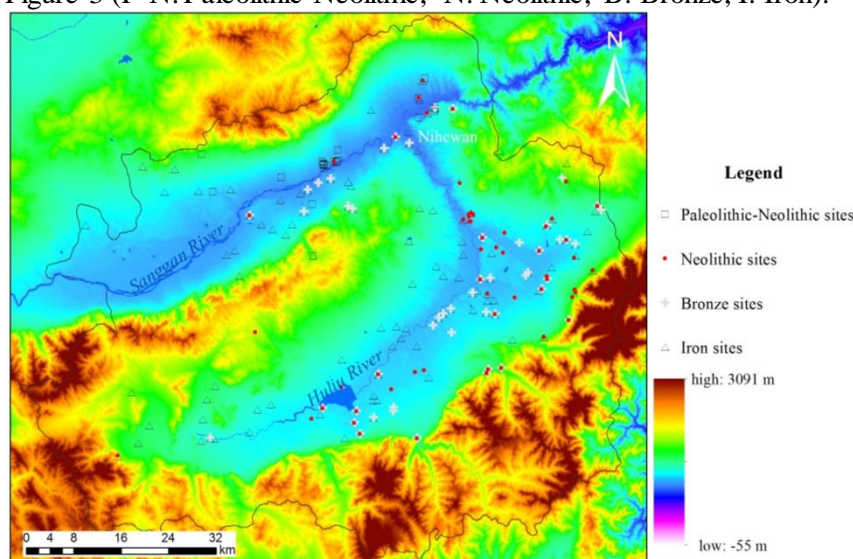
**Table 1.** Archaeological cultures and corresponding typical sites

| Periods                                 | Dates                                      | Typical Sites   |
|---|--|---|
| <b>Paleolithic-Neolithic transition</b> | approximately 21-8 cal ka BP in this paper | Xibaimaying[2], Yiduquan [2], Meigou, and Weidipo [15], Yujiagou [7][2], Hutouliang Group [6], Youfang [2], Jijitan [2][3], Erdaoliang [2], and so on [2][15].  |
| <b>Neolithic Age</b>                    | approximately 10-4 cal ka BP               | Jiangjialiang[2][10], Heitupo[2], Yujiagou[2], Sishilipo[8], Sanguan[11][8], Pipazui[11], Qianbao, Fanpo, Zhuangke, Shaizilingluo, Dongshuiquan, and so on [11] |
| <b>Bronze</b>                           | approximately 2-0.5                        | Sanguan[9][11], Shaizilingluo[11], Fanpo[11], Zhuangke[11],   |

|                 |               |   |
|-----------------|---------------|---|
| <b>Age</b>      | ka BC         | “Qianbao, Dashuimentou, Sishilipo, Sanguan, Longfengpo”[9], and so on [11]. |
| <b>Iron Age</b> | 770 BC–220 AD | Sanguan [11], Sishimutan[11], Xiakangzhuang [11], and so on.                |

### 3. Spatial-temporal distribution of archaeological sites

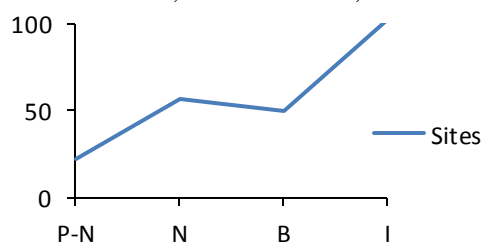
The number of studied sites is perhaps different from ancient times, but the spatial distribution before the Han Dynasty in the Nihewan-Huli River Basin could be mapped if enough sites are collected. The temporal and spatial distribution is shown in Figure 2 and Figure 4 based on the ASTER GDEM 30 m. There are approximately 22 sites in the Paleolithic-Neolithic transition Age (among them, approximately 16 Mirothic sites), 57 sites in the Neolithic Age, 50 sites in the Bronze Age, 101 sites in the Iron Age; some sites cover multiple periods. The number of sites in different periods is shown in Figure 3 (P-N: Paleolithic-Neolithic, N: Neolithic, B: Bronze, I: Iron).



**Figure 2.** The distribution of archaeological sites in different stages.

Black squares: sites in the Paleolithic-Neolithic transition, Red points: sites in the Neolithic Age, White crosses: sites in the Bronze Age, Triangles: sites in the Iron Age.

Some observations can be made based on the distribution from the Microlithic Age to the Han Dynasty, as shown in Figure 2: (1) archaeological sites are mainly located in the valleys and tributaries of the Sanggan River and the Huli River; (2) the distribution gradually expands from the Sanggan River basin to the Huli River basin; (3) the sites in the Huli River basin gradually expand from the region of the river's bend to the western headwater streams in the Heng Mountains; (4) before the Neolithic Age, the sites concentrated in the Nihewan Basin, however, in the Neolithic Age, only a few were located there, and since then, the Nihewan Basin became gradually depressed.



**Figure 3.** The number of archaeological sites in different stages

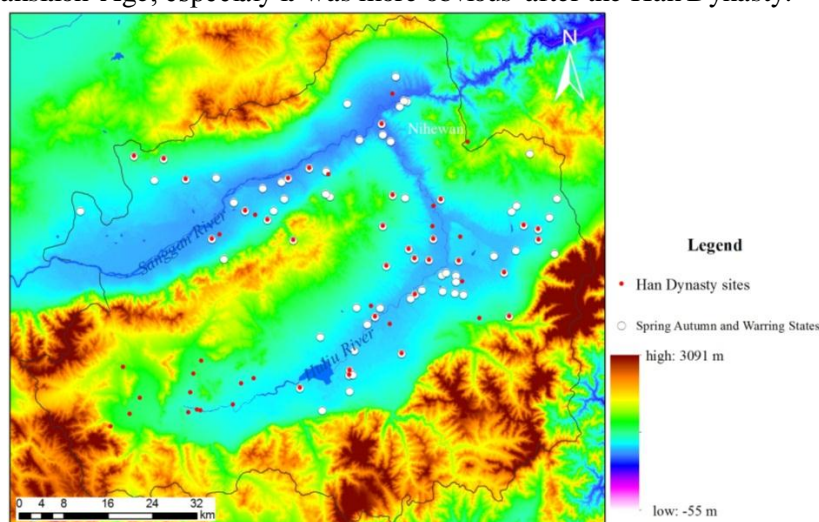
In the Paleolithic-Neolithic transition Age, the Paleolithic technology was predominant for a long time. The Small Stone and Microlithic culture appeared successively and coexisted in the Nihewan Basin, and the Microlithic culture became prominent gradually before the early Neolithic Age.

In the Neolithic Age, the archaeological sites were mainly concentrated in the east of the Huli River's bend region and south of the upper river. At least 15 sites were located in the piedmont during this period, of which 11 sites were located at the foot of the Xiaowutai Mountains, 1 site at the front of the Heng Mountains, 1 site in the south of the mountains between the Sanggan River and Huli River, and 2 sites at the front of the eastern mountains of the Huli River. Fourteen of fifteen sites were located over 1 km above sea level.



Compared with the Neolithic Age, the number of archaeological sites did not change very much in the Bronze Age, while the scope became a little larger, extending to the south bank of the Sanggan River and Huli River. Note that some piedmont sites disappeared during this period.

In the Iron Age, the total number of archaeological sites increased substantially. There were 76 sites in the Spring and Autumn and Warring States Periods, which were reduced to 55 sites in the Han Dynasty, as shown in Figure 4. In the Han Dynasty, more than 10 sites in the Sanggan River region disappeared and 13 sites appeared in the headwater of the Huli River and the western mountains, indicating expansion and development to the west of the Huli River Basin. The Huli River Basin flourished because the plain surrounded by mountains was suitable for agriculture and cultivation. Comparatively, the Nihewan Basin lagged behind the Huli River Basin after the Paleolithic-Neolithic transition Age, especially it was more obvious after the Han Dynasty.



**Figure 4.** The distribution of archaeological sites in the Iron Age.

Circle points: sites in the Spring and Autumn and Warring States Periods, Red points: sites in the Han Dynasty

#### 4. Relationship between the temporal-spatial distribution and the environments

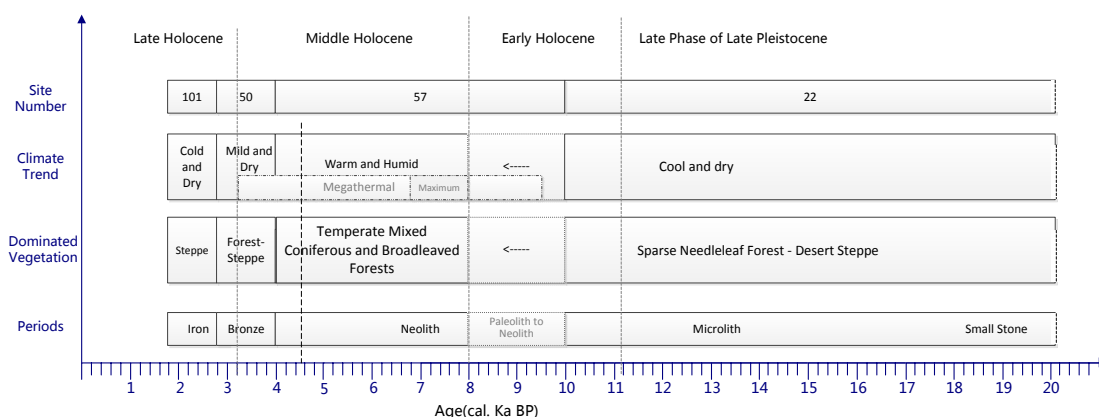
##### 4.1. Relationship between the archaeological sites and the environments

There are significant correlations between the spatial distribution of cultural relics and the Holocene environmental changes. As observed from the distribution mapping of archaeological sites, ancient relic densities had been high in the Nihewan-Huli Basin since the late phase of the Late Paleolithic Age, with an especially unprecedented boom after the early Neolithic Age.

In the late phase of the Late Paleolithic Age, the climate was very cold and dry in the LGM (Last Glacial Maximum, approximately 26.5-19 ka BP) [16]. The Holocene optimum reached a maximum during approximately 10-7 cal ka BP in north-central and northern east-central China [17]. There were noticeable climatic changes during 4.6-4.3 cal ka BP [18] or the abrupt climatic shift at 4.5 cal ka BP [19]. After the changes and events, the general climate became cold and dry. Neolithic cultural transformation occurred in approximately 4.2-4 cal ka BP ago [19].

Abrupt unsuitable climate changes and cold events might have led to the migration of population sites, and even cultural turnover. Spatial foothill sites moving to higher elevations might be associated with wet weather or flooding in the Neolithic Age, because a relatively large amount of precipitation was likely to cause larger water areas and river flooding in the typical intermontane basin. When the water levels dropped and stabilized, the population moved again to the river banks or the wetlands in the Bronze Age and the Iron Age. There was a survival suitable platform with a relatively higher altitude at the corner of the Huli River, where the general water expansion could be avoided, leading to a relatively high population density for several periods.

The relics from different periods, different types and different cultural backgrounds show close relationships between the archaeological cultures and the environmental changes. Comprehensive comparisons of the site number, climate and vegetation in the different periods are shown in Figure 5.



**Figure 5.** Comprehensive comparisons in different periods

The temporal and spatial distributions of archaeological sites were in good agreement with the main trend of the environmental changes. The archaeological sites were substantially increased in middle Neolithic Age. The agricultural and animal husbandry were more developed and the living technologies were improved although the cold trend of the climate, so the archaeological sites were almost increased and expanded in the Iron age.

#### 4.2. The temporal-spatial distribution under the regional differences

There were differences in the regional environments of the study area. Compared with the Huli River Basin, the vegetation and plants in the Nihewan Basin (Yangyuan Basin) were more sensitive to climate changes and human activities. In the late Paleolithic and early Neolithic Age, dominated by gathering and hunting, some forests grew in low mountainous areas [20], animals and plants were more prosperous and suitable for human living and survival in the Nihewan Basin.

After the development of new tools in the Neolithic Age, the relatively narrow geographical areas on the two sides of the Sanggan River were not conducive to large-scale original cultivation. Because of cold and drought events in the late Neolithic Age, some low mountainous forests quickly disappeared with human activities and never recovered [20]. The temporal and spatial distributions of archaeological sites show that cultural activities were significantly reduced, especially from the late Neolithic Age in the Nihewan Basin, when dense populations moved to the relatively flat and wide Huli River Basin. Agricultural technologies had some ability to reclaim land from the Iron Age; although populations slightly increased on the basis of the sites in the Nihewan Basin, large-scale development still did not occur because of the limitations of the geographical environments. The Nihewan Basin was more uncultured than the Huli River Basin after the Han Dynasty. In contrast, the Huli River Basin was suitable for various types of productions and livelihoods, so population and multicultural activities developed well.

## 5. Conclusions

The Nihewan-Huli Basin witnessed almost successive human cultural evolution and important ancient activities. The temporal and spatial distributions of archaeological sites are consistent with the main trend of the environmental changes, the sites and reflected cultural activities gradually moved from the Nihewan Basin to Huli River Basin. The research results will provide valuable clues for much future researches regarding cultural responses to geographical and climatic environments, prehistoric cultural exchanges, and even the origin and evolution of the Chinese civilization.

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### Acknowledgments

This research was supported by the National Science Foundation of China (NSFC grant no. 41271427) and the International Scientific and Technological Cooperation Program of China (ISTCP grant no. S2013GR0477). We thank ASTER GDEM, RSCM, and CHGIS for the background imagery. The ASTER GDEM dataset was provided by International Scientific & Technical Data Mirror Site, Computer Network Information Center, Chinese Academy of Sciences, (<http://www.gscloud.cn>). Thanks to Dr. Luo Lei for meaningful proposals.