Geographical Patterns of Chinese Ethnic Minority Population Composition and Ethnic Diversity

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Abstract: Ethnicity is a carrier of language and culture. Spatial distribution of ethnic diversity is fundamental for identifying and reconstructing the migration patterns and evolution histories of cultures and languages. Utilizing the Chinese 4th National Census (1990) data, we investigated the specific time geographical patterns of population and diversity of Chinese ethnic minorities. As anticipated, results show that Chinese minorities are chiefly concentrated in distant plateaus and mountains in the southwest, northwest and northeast of China. Further, population density centers of the 10 major minorities are rather scattered, alternatively dominating at different parts of the country. This study provides a first comprehensive quantitative test on a prevailing notion of ′six plates and three corridors′ on the empirical clustering patterns of Chinese ethnic minorities. There are more consistent evidences supporting this notion in the north of China, with the central and southern regions showing more complex patterns, potentially transformed by processes such as migration, fragmentation, and percolation. The results of this study suggest that a geographical approach can provide heuristic and complementary information for better understanding of historical social processes.
Keywords: ethnic minority; ethnic diversity; geographical distribution; classification

1 Introduction

Ethnic and racial diversities are a source of cultural pluralism. As there is little genetic variation among all humans on earth, ethnic identity is often distinguished by cultural traits (Fei, 1981; Pagel and Mace, 2004). With the accelerating economic globalization and technological development, both ethnic diversity and biodiversity are facing increasing threats (Sutherland, 2007). As a carrier of cultural diversity, ethnic diversity and its distribution and evolution have created the underlying basis for understanding and predicting the dynamics of cultural diversity.

China is a nation of multiple ethnicities, with Han ethnicity as the majority along with 55 other ethnic minorities sharing a history of close interactions in thousands of years. The relationship among the Chinese ethnicities is characterized by unity and division, expansion and contraction, with each ethnicity possessing its unique history of growth and decline, migration and dispersion, eventually forming a ′generally scattered, locally clustered′ ethnic distribution pattern in China (Guan, 1996; Li, 2007).

Initial researches on the geographic distribution of Chinese ethnic minorities began in the 1930s (Ling, 1935; Zhang 1935). After the founding of the People′s Republic of China, a large scale ethnic research began with identifying existing ethnicities all over the country (Fei, 1981). From this groundwork, researches on ethnic minorities′ geographical distribution and historical migration began. Fei (1983) was the first to summarize the geographic differentiation and clustering of Chinese

ethnic minorities as a ′six plates and three corridors′ pattern, composed of the grassland region of North China, the mountainous forest region of Northeast China, the Qinghai-Tibet Plateau, the Yunnan-Guizhou Plateau, the plains in the Central China and the coastal region of southeastern China, as well as the Tibetan-Yi Corridor, the Nanling Corridor and the Hexi Corridor. Fei (1989) further proposed a hypothesis of the ′unity pattern of the multi-components Chinese ethnicities′. By providing a general framework for analyzing the geographic distribution of Chinese ethnicities, this study had a profound impact on researches of Chinese ethnic minority populations, languages, cultures, and historical transformations (Zhang, 1985; Zhang, 1990; Xu, 1992; Guan, 1996). By providing detailed and reliable information on the distribution and population composition of Chinese ethnic minorities, the results of 3rd, 4th, and 5th national census directly stimulated related researches in last 30 years. Yuan *et al*. (1994) used the 4th national census data to analyze the education levels of Chinese ethnic minority and provincial variations. Zhang and Zeng (2005) looked into the period between the 4th and 5th national census to study the change of ethnic minority distribution, including the focus of population distribution, urbanization level, and dispersion levels of different ethnicities. Li (2006) explored the dynamics of Russian ethnic populations in the second half of 19 century. As the first comprehensive research conducted since the founding of the People′s Republic of China, ′China Ethnic Minority Distribution Atlas′ was published in 2002, marking a milestone in the field, and laying a solid foundation for future research on the geographical distribution of ethnic minorities (Hao, 2002; Chuai, 2005).

It should be noted that in earlier studies on Chinese ethnic minorities, qualitative descriptions were relatively abundant, but quantitative analysis was insufficient. Historical researches were quite ample, while studies on spatial distribution were somewhat scarce. With restrictions on the availability of data and analysis methodology, there was a lack of research on large scale spatial patterns of ethnic diversity and composition, and its underlying driving forces and processes.

Ethnic and population distribution is a continuously evolving spatiotemporal process. Since the 1980s, there have been enormous changes in all aspects of Chinese society, including economic growth, urbanization, fam-

ily planning *etc*., all of which have had substantial influences on the population variation and distribution of Chinese ethnic minority (Zhang and Zeng, 2005; Li, 2006; Luo, 2008). This paper is based on the data of the 4th national census in 1990. It utilizes statistical data from the county level to analyze the ethnic minority diversity and spatial patterns in China. The main objectives of this study are: 1) describing the distribution and diversity of Chinese ethnic minority populations at the end of 1980s; 2) detecting the geographic distribution of populations of Chinese major ethnic minorities, and regional differentiation of Chinese national ethnic composition; 3) testing the ′six plates and three corridors′ spatial pattern hypothesis of Chinese ethnic distribution raised by Fei (1983).

2 Materials and Methods

2.1 Data sources
We used national census data in 1990 for this analysis, to better reflect the traditional geographic distribution of Chinese ethnicities, avoiding the impact of large scale population migration driven by the Reform and Opening-up, as well as the rapid progress of transportation infrastructure in the last 20 years. Specifically, data regarding population distribution of the ethnic minorities comes from Chinese 4th National Census ′Tabulation on China′s Nationalities′ (National Bureau of Statistics of China, 1994), covering county level administrative units of China (county, autonomous county, county-level city, district in city). Regional population data of Taiwan Province were from ′The Republic of China Economic Yearbook 1991′ (Economic Daily, 1991). By compiling these sources, we formulated a database on Chinese ethnic minority populations in 1990, with the 2295 county administrative level as the basic statistical unit.

The vector data of the county level administration boundaries were available at NGCC (2007) with the scale of 1 ∶ 4 000 000.

2.2 Data analysis
With the county level data, we calculated the numbers of ethnic minorities in each county, population density of the minorities, population percentage of the minorities as a percentage of total county population, and the population percentage of specific minorities as a percentage of all ethnic minorities of the county.

Shannon-Wiener index (*H*) is a diversity variable combining both ethnic minority richness and the population composition of the ethnic minorities, measured for each county. It has been widely used to describe biodiversity at a particular measuring unit (Magurran, 1988).

TWINSPAN (Two-way indicator species analysis): a hierarchical multi-variable classification method mostly used in community ecology (Hill, 1979). This method is based on the percentage composition of species abundance of the samples (i.e. sampling plots of plant communities), by specifying a group of indicator species that most sensitively identify the difference of species composition between the communities, and using the indicator species as criteria of community clustering, it implements an iterative algorithm to the data, and classify the statistical units (plots) and objects (species) simultaneously, into a hierarchical classification scheme. It was the most extensively applied quantitative classification method in community ecology since the 1990s (Zhang, 2004). This method allows us to analyze ethnic composition using the county as the sampling plot, which is similar to the species composition of plant community. This method is described by Shen *et al*. (2000).

The software PC-ORD was used to implement TWINSPAN. The Han ethnicity is distributed throughout all 2295 county-level administrative units in China, and in most areas, is the absolute majority. To clearly reflect the patterns of ethnic minority distribution, statistics did not include the Han ethnicity and Han population.

The Spearman correlation coefficient and student′s *t*-test were used to describe the similarity among different ethnic groups. ArcGIS 9.2 was used to map the distribution of Chinese ethnicities and the spatial patterns of ethnicity diversity.

3　Results

3.1　Population density and proportion of Chinese ethnic minorities

Until 1990, Chinese ethnic minorities were mainly distributed throughout the western region of China. Areas with high percentages (> 50%) of ethnic minority population were concentrated in Guangxi, Yunnan-Guizhou Plateau, Qinghai-Tibet Plateau, Hengduan Mountain Ranges, Xingjiang, most of Inner Mongolia, and the eastern mountains of Liaoning and Jilin provinces. In the expansive eastern mountains and plains, ethnic minorities typically constituted less than 10% of population (Fig. 1a). In respect of ethnic minority population density, Guangxi, Guizhou, Yunnan, the south of Gansu, Ningxia, the southeastern Liaoning and southwestern Xingjiang all have quite high values, reaching 10–100 person/km^2, while the density of most other areas is only 1–10 or less (Fig. 1b). Thus, the spatial patterns of population density and overall population percentages of ethnic minorities are significantly different. However, the eastern mountainous region of Northeast China, the western Xinjiang, the eastern Qinghai-Tibet Plateau to the west Loess Plateau, Yunnan, Guizhou, and Guangxi
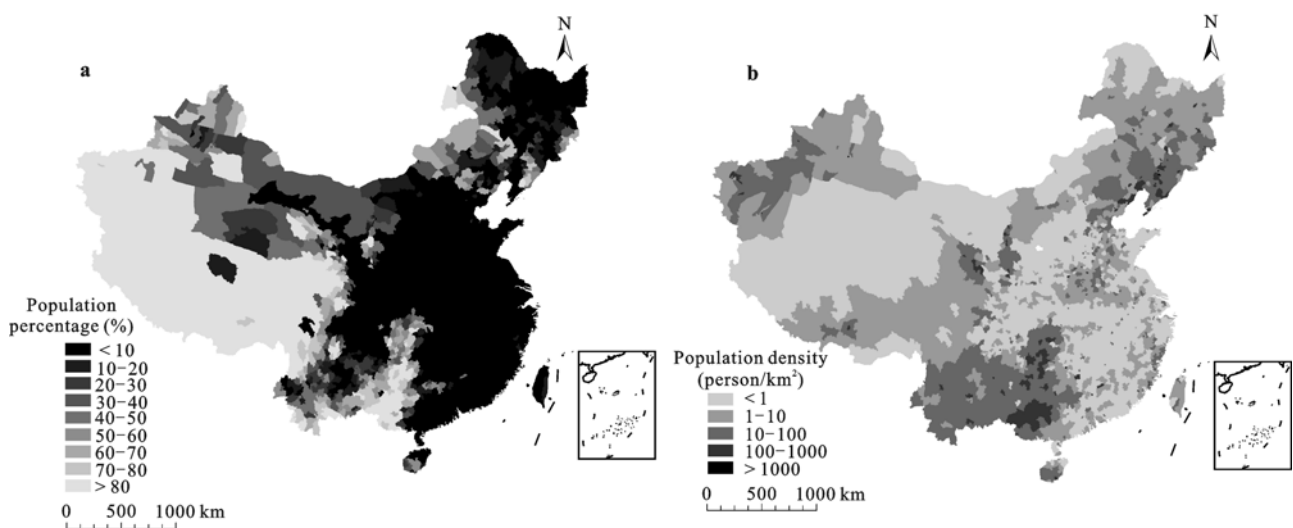

Fig. 1　Spatial patterns of population density (a) and population percentage of Chinese ethnic minority (b)

are all key areas of distribution of Chinese ethnic minorities, assessed by either population density or percentage of total population.

3.2   Spatial pattern of ethnic diversity

In 1990, the number of ethnic minorities in each individual county across China ranged from 1 to 55. The diversity of Chinese ethnic minorities showed the following spatial characteristics:

(1) In the 2295 county-level administrative units of China, there were only 17 with just one ethnicity, yet there were 2179 counties with 6 or more ethnicities. This fully reflects the 'generally scattered' inhabitance characteristic of Chinese ethnic minorities.

(2) Significant spatial variation. Separated by Hu Huangyong Line of Chinese population density, the diversity of ethnic minorities in the southeast higher than the northwest of this line (Fig. 2a), with the exception of the counties in Xinjiang, which in general have quite high ethnic minority diversity. This pattern indicates that the ethnic minorities live in a much more mixed status in eastern areas than northwestern areas (except the north of Xinjiang Province).

(3) There are several ethnic diversity centers. Counties with high ethnic minority diversity were often found in Yunnan, Guizhou, the junction between Guangdong, Guangxi and Hainan, the northern Jiangsu and Anhui, the northwest of Xinjiang; There are also smaller ethnic diversity centers in north-central of Northeast China, Beijing and surrounding areas, joint region between

Hunan and Guangxi, and the coast areas of the southeast of China. Comparatively, the Inner Mongolian Plateau, Loess Plateau, Sichuan Basin, Qinghai-Tibet Plateau, Tarim Basin, and the middle-lower Changjiang Plain are large areas of lower ethnic diversity. However, the ethnic minority diversity estimated by Shanon-Wiener index revealed a quite different pattern (Fig. 2b), counties with high level concentrated at northern Xinjiang, Qinghai, western Sichuan, northwestern and southern Yunnan, western Guangxi, Guizhou, and the surrounding mountainous regions in northeastern China, showing the real high ethnic diversity and balanced population composition.

(4) Cities are areas with concentrated ethnic minority inhabitance. The average number of ethnic minorities in county-level cities or metropolitan districts, ethnic minority autonomous counties, and regular counties, is 22.84 ± 8.68 (mean$\pm$S.D.), 15.32 ± 5.68 and 14.76 ± 6.73, respectively. In 139 counties with over 30 different ethnic minorities, 111 are urban areas (including large cities and county-level cities); county level unites with over 40 ethnicities are all urban areas. However, Shannon-Wiener index has low values in the cities.

3.3   Spatial pattern of major ethnic minority population

In 1990, the top nine ethnicities as a proportion of the total population of ethnic minorities are Zhuang (17.95%), Hui (10.26%), Manchu (10.01%), Miao (8.18%), Uyghur (7.56%), Yi (7.23%), Tujia (6.49%),
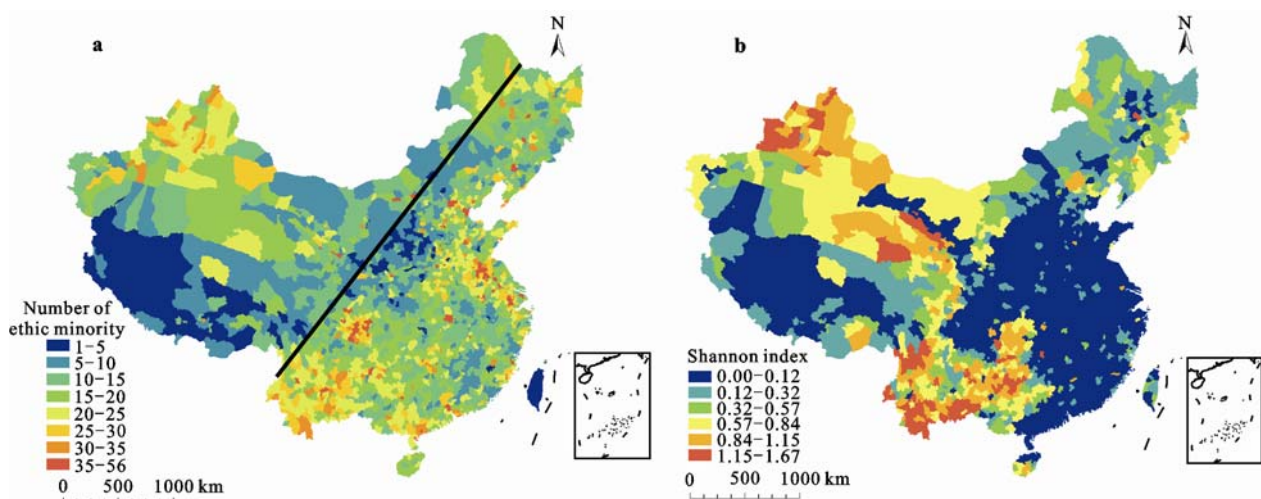
The black line is Hu Huangyong line of Chines population density (Hu, 1983)

Fig. 2   Number of minorities (a) and Shannon-Wiener index of minority diversity (b) at county level in 1990

Mongolian (5.48%), and Tibetian (4.91%), respectively. With the addition of She, the predominant ethnic minority in the coastal areas of Southwest China, the geographic patterns of population of the top ten minorities, as proportions of the total population of all ethnical minorities, can be seen in Fig. 3.

(1) The ten largest ethnic minorities add up to more than 90% of the total population of Chinese ethnic minorities. Each has quite an extensive distribution range, and exhibits a prominent center of distribution, confirming the 'generally scattered, locally clustered' distribution characteristic of Chinese ethnicities. For example, the most widely distributed ethnicity, the Hui, also has a definite population center in several provinces
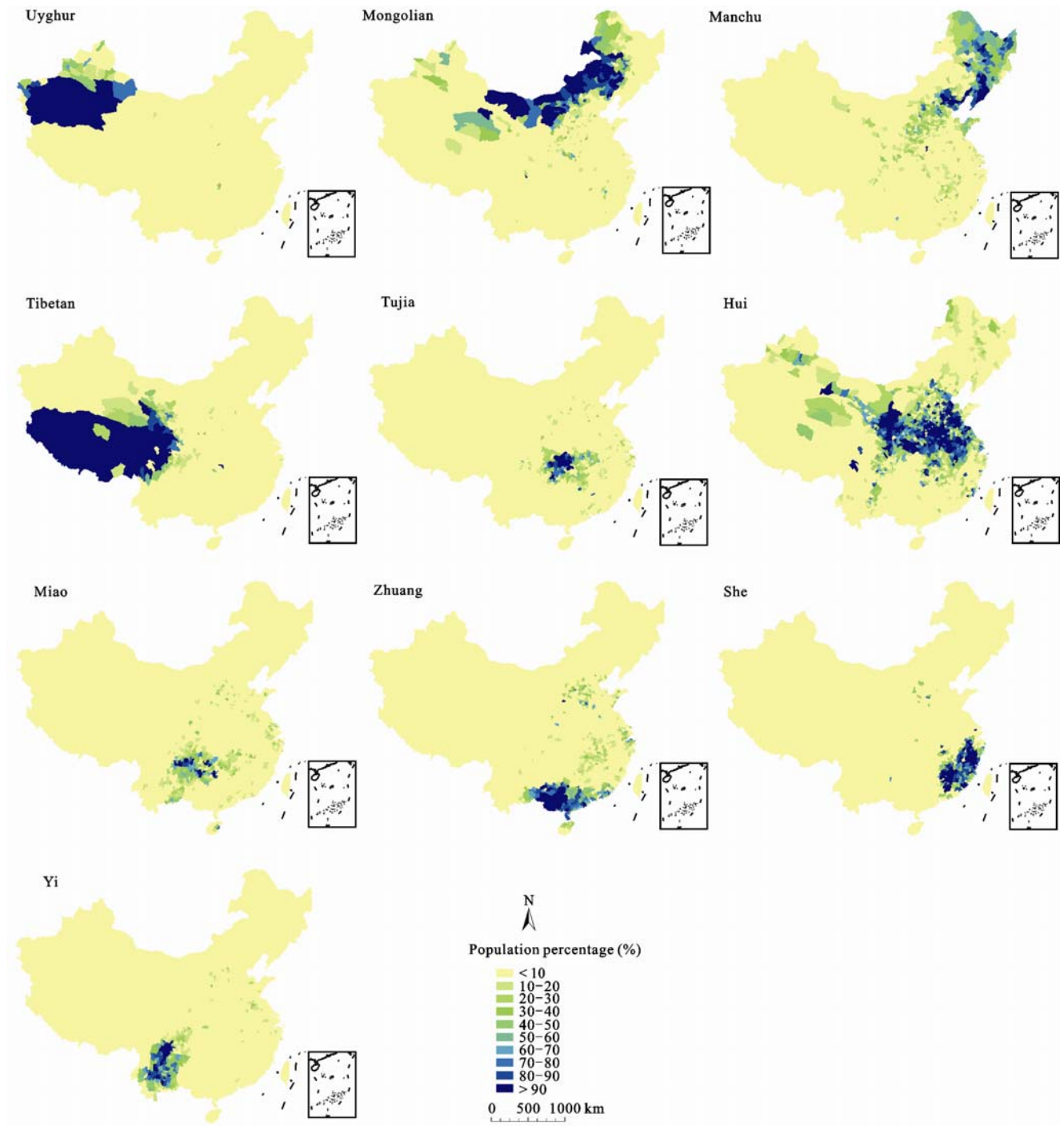

Fig. 3   Geographic distributions of population percentages of top 10 ethnic minorities

in North China, exhibiting population dominance among the ethnic minorities.

(2) In the context of widespread population dominance of the Han ethnicity, there are clear distinctions in the geographic distribution patterns of major ethnic minorities, forming a spatial pattern of dominance substitution, similar to the niche differentiation between species coexisting within the same community.

(3) In the north of China, several ethnic minorities dominate in a relatively extensive regions, such as Manchu, Mongolian, Uyghur, Tibetan, Hui, with quite clear boundaries in between. In contrast, the major southern ethnic minorities dominate in smaller ranges, and with much blurrier borders, resulting in a more complex pattern of intersections and percolation; examples include Tu, Miao, Zhuang, She, and Yi.

### 3.4 Spatial differentiation of ethnic minority composition

Based on the population composition of ethnic minorities, all county-level administrative units in China were clustered into 13 ethnic minority groups with the application of TWINSPAN. The geographic pattern of the ethnic minority structure in China is fundamentally

characterized as a spatially heterogeneous mosaic, with patches alternatively dominated by one of eight major ethnic minorities: Manchu, Mongolian, Uyghur, Hui, Tibetan, Yi, Zhuang, and She, each accompanied by other ethnic minorities with similar spatial distributions (Fig. 4).

According to Fig. 4, in the entire Northeast China and Inner Mongolia, the dominant ethnic minorities are the Manchu, Mongolian and Korean (A), combined amounting to over 90% of the total ethnic minority population in the region. In addition, there is Hui, Xibe, Ewenki, Hezhe and others in this area.

Dominant minorities in Northwest China are Uyghur, Kazak, and Hui. There are considerable numbers of ethnicities in northern Xingjiang, with the population of three largest ethnicities at similar sizes and summing up to 86% of the total ethnic minority population (B). In addition, there are also Dongxiang, Khalkhas, and Uzbek. In southern Xinjiang, the Uigur ethnicity stands out amongst the others (C), totaling 97% of the population of all ethnic minorities, with small population of Khalkhas and Tajik ethnicities.

On the Qinghai-Tibet plateau, Tibetan is clearly the sole dominant ethnic minority. In the vast majority of
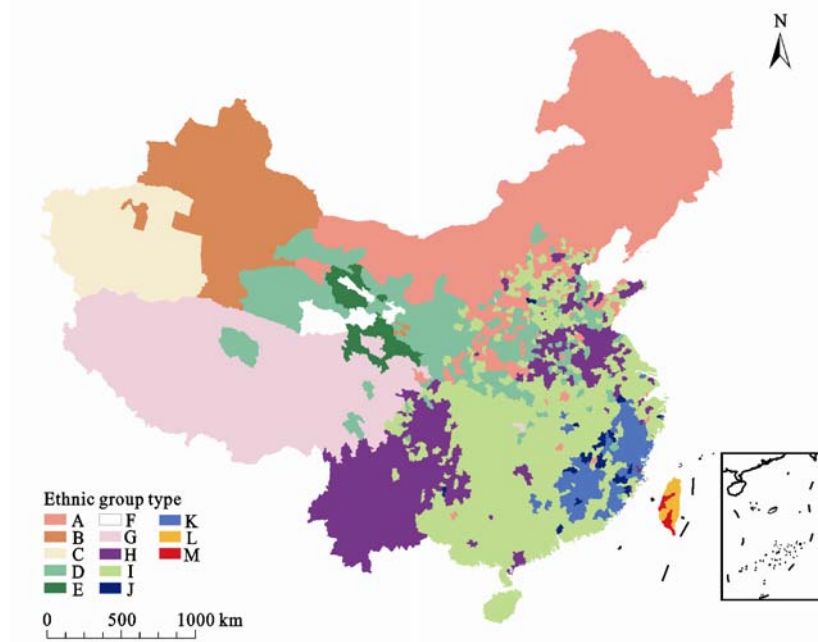
A: Manchu 50.69%, Mongolian 27.22%, Korean 13.33%; B: Uighur 38.15%, Kazak 27.36%, Hui 21.05%; C: Uyghur 96.83%, Khalkhas 2.19%, Tajik 0.58%; D: Hui 89.7%, Dongxiang 2.82%, Tu 2.73%; E: Tibetan 60.34%, Hui 29.76%, Salar 7.8%; F: Tibetan 56.18%, Tu 24.72%, Hui 11.49%; G: Tibetan 91.70%, Wei 5.32%, Qiang 0.94%; H: Yi 27.48%, Miao 12.66%, Zhuang 11.84%; I: Zhuang 42.47%, Tujia 18.38%, Miao 14%; J: She 68.85%, Zhuang 10.19%, Hui 8.64; K: She 81.78%, Yao 14.14%, Hui 2.15%; L: Atayal 67.08%, Cao 2.5%, Ami 5.41%; M: Paiwan 33.33%, Bunun 31.9%, Caoren 13.03%

Fig. 4　Spatial heterogeneity of Chinese ethical minority composition

areas, Tibetans constitute over 90% of the population of all ethnic minorities (G); in northern Qinghai and southern Gansu, the population of Hui are proportionally higher, the populations of Tu, Qiang and Sala are also somewhat increased (E, F). On the south-east verge of the Qinghai-Tibet plateau, there are also the distributions of Moinba and Lhoba, but the proportions of their populations are under 10%.

The Hexi Corridor of Gansu Province and surrounding areas are dominated by the Hui, accompanied by several narrow-ranged ethnic minorities with small populations, including Sala, Tu, and Dongxiang (D). This area is surrounded by regions dominated by Tibetans, Mongolians, Uyghur, and southern ethnic minority groups, and forms a spatially intersected and embedded pattern with Tibetan dominated areas (E and F).

In the east of the Qinghai-Tibet Plateau, and the south of Inner Mongolia Plateau, the composition of ethnic minorities are very complex, but there are three dominant groups: the Yi dominant in the southwest (H), Zhuang/Miao/Tujia dominant in south-central (I), and She dominant in the southeast (J, K). Yet the ethnic composition of these three major areas has a definite similarity. Several major minorities such as Zhuang, Miao, Yao, Tujia, Bouyei usually coexist within close proportions of population. In Southeast China, the dominant area of the She is relatively distinctive, because the population of the She is far ahead, reaching 68.85% and 81.78% in class J and K, respectively.

Comparably isolated, the ethnic minority compositions on Taiwan Island and Hainan Island are quite different. Ethnic minority composition in Hainan Province is quite similar to the south of China, but Taiwan Province has a group of entirely distinctive island ethnicities, approximately divided into a highland and lowland groups. The dominant ethnicity in the mountainous area is the Atayl (L); the Paiwan and Bunun ethnicities are dominant in western part of the alluvial plain area and the southern area of Taiwan Province (M). However, the census data for Han and other mainland ethnic minorities are merged together here.

With regard to the spatial configuration of ethnic minority groups, the Northeast China (A), Northwest China (B, C) and Tibet (G) areas have continuous distribution, with consistent and clear boundaries between each other, where the southern ethnic minority groups have intensive intersections and much less obvious boundaries in between. Important points worth noting: 1) the ethnic minority group A, D, H and I intersect in a north-south direction in the North China Plain, forming a highly fragmented spatial mosaic of multiple ethnicity distribution; 2) there is a consistent boundary between the ethnic minorities of the Qinghai-Tibetan Plateau and Hengduan Mountain Ranges; the former is dominated by Tibetans (G), the latter is a multi-ethnic group mixture led by the Yi (H). Yi people, however, have two separated dominant distribution area, at Southwest and North China, respectively; 3) the region from the northeastern corner of the Qinghai-Tibet Plateau to southern Gansu-Shaanxi provinces is a point of convergence of multiple ethnic groups.

Based on the ethnic population composition in 1990, the Spearman similarity coefficient matrix was obtained for the above mentioned 11 ethnic minority groups (Table 1). The general findings are: 1) class B acts as the transient type between Uyghur (C) and Hui (D), to-

Table 1   Correlation matrix of 11 ethic groups

	A	B	C	D	E	F	G	H	I	J
B	0.011									
C	−0.029	0.731***								
D	0.060	0.388**	−0.018							
E	−0.006	0.137	−0.027	0.445***						
F	0.008	0.032	−0.030	0.192	0.877***					
G	−0.028	−0.032	−0.020	0.011	0.892***	0.895***				
H	−0.005	0.031	−0.055	0.266*	0.079	−0.009	−0.029			
I	−0.021	−0.049	−0.039	0.011	−0.034	−0.051	−0.039	0.353**		
J	0.068	0.003	−0.027	0.098	0.022	−0.012	−0.021	0.044	0.102	
K	−0.030	−0.033	−0.023	0.002	−0.021	−0.031	−0.023	−0.033	−0.007	0.968***

Note: ***, ** and * are significant at the 0.001, 0.01 and 0.05 level, respectively

gether forming the Northwest Muslim ethnicity plate, but C and D are very different; 2) The Tibetan plate is composed of the predominant center of the Tibetan ethnicity G, and the marginal type E, F on northeastern side, which is merged with Hui and other local ethnicities; 3) there exists a definite similarity between the plates dominated by the Yi (H) and Zhuang (I) in the south of China, and both have low similarity with the East of China plate dominated by the She (J, K), which reflects the unique nature of the latter.

4 Discussion

4.1 Differentiation and combination of Chinese ethnic minority distribution

As one of the most important hypothesis of Chinese ethnology, the ′unity pattern of multi-component Chinese ethnicity′ proposed by Fei (1981) indicate that, the Chinese ethnicities possess regionalized origins and distinct histories, but has grown into a converging complex throughout the long historical development and intensive interactions. Later, Fei (1983) summarized the habitation patterns of Chinese ethnic minorities as composed of six plates and three corridors. According to our analysis of the spatial variation of county-level population composition of the ethnic minorities (Fig. 3 and Fig. 4), the differentiation pattern of the ethnic minorities is quite clear: the Manchus dominate in the forest areas of Northeast China; Mongolians dominate in the Northern grasslands; Tibetans dominate the Qinghai-Tibetan Plateau; Yi dominates in the Yunnan-Guizhou Plateau; and Uyghur, combined with Kazak occupied Xinjiang Province. In the southern China, there are three ethnic minority plates paralleling from west to east, dominated by Yi-Miao-Zhuang, Zhuang-Miao-Tujia, and She-Yao- Zhuang, respectively. Although a Hexi Corridor is indicated by the corridor area dominated by Hui, there is no clear ′Nanling Ethnic Corridor′ found. The Yi dominated area lies in the intersection between the Hengduan Mountain Ranges and the western section of Sichuan Basin. It is complex in ethnic structure and relatively balanced in population composition of the ethnic minorities (with Yi constitutes 27.48% of the minority population). Thus, it fits into the ′Tibetan-Yi Corridor′ and ′Six Rivers Basin′ in light of the boundaries and ethnic composition as pointed out by some scholars (Li, 2006). It is worth noting that in Fei (1981) proposed Central Plains ethnic region, due to profound historical factors, the distribution patterns of ethnic minorities are very cluttered and disorder, prominently characterized by intersecting and embedded distribution of the ethnic minorities extending from the north and south, with a high value of ethnic minority richness and low Shannon-Wiener diversity revealed at northern Anhui and Jiangsu, for reason to be explored with further effort. In addition, the population distribution of ethnic minorities of Taiwan Province has its own distinct insular characteristics, illustrating the results of long-term isolation, yet in Hainan it is not as distinct. In addition to different historical environmental evolution, the difference between the two islands might also require interpreting the influences of distinct cultural and social historical trajectories.

Therefore, based on the data of ethnic minority geographic distribution in 1990, Chinese ethnic minorities cohabitation pattern can be summarized in nine areas and one corridor: 1) Manchu dominant area in Northeast China; 2) Mongolian dominant area in Inner Mongolia; 3) Uyghur dominant area in Xinjiang; 4) Tibetan dominant area in the Qinghai-Tibet Plateau; 5) Yi dominant area in Southwest China; 6) Zhuang-Miao-Tujia area in South-central China; 7) She dominant area in Southeast China; 8) multi-ethnicity intersection area in North China; 9) Atayal-Paiwan area in Taiwan Province; and 10) Hui dominant area in Hexi corridor.

4.2 Migration and intersection of Chinese ethnic minorities

According to the geographic variations of ethnic minority composition (Fig. 3 and Fig. 4), in relatively flat eastern China, the spatial infiltration between ethnic minorities occurs mainly along a north-south direction. Tibetans, not spreading to the southeast, principally spread along the southwest-to-northeast direction on the Qinghai-Tibet Plateau, and gradually transform to Hui dominated region, reflected by the shift from class G to class E and F. In contrast, the Hui mainly spread in a northwest-southeast direction, along the Hexi Corridor mostly in Gansu Province, implying a different driving force. It is worth noting that the Yi dominates among the ethnic minorities at two separate areas, in both the Southwest and North of China, distinct from the distribution patterns of other ethnicities. To understand the reason for this phenomenon, further research is still

needed.

To summarize the above mentioned patterns, it is obvious that the joint area between the northeastern end of Tibetan-Qinghai Plateau, the south end of the Hexi Corridor, and the southwest end of Loess Plateau is a confluence point of Chinese major ethnic groups. On the one hand, in the southwest-northeast orientation, the Mongolians, Hui, and Tibetans merged with each other (Wu and Wang, 2001), and the ancient Qiang people migrated along the Hengduan Mountain Ranges and valleys to the south (Bai *et al*., 2006). This region is also the front of Zhuang-Miao- Yao-Tujia and other southern ethnic minorities spreading out to the North, and above all this area are the key contact points for Han extending out to the western section, and the northwest ethnic minorities entering into Central China (Zhang, 2006a). There has been ample discussions about the multiple functions and profound influences of this area on the ethnicity blending, religious dispersal, political and cultural conflicts in ancient China (Wu and Wang, 2001; Jia, 2003; Bai *et al*., 2006; Shi, 2008).

4.3 Characteristic of She and migration path along Nanling corridor

Nanling ethnic minority corridor, as suggested by Fei (1983), is closely related to the blending and intimate coexistence of southern ethnic minorities, and also related to the She minority′s origin and historical migration routes (Wang, 2006). The latter has been subjected to several controversies and discussions (Zhang, 2006b). Assessed by the population distribution today, She minority was widespread over southeastern Zhejiang, Jiangxi, Fujian and northern Guangdong, and its relationship with the Yao was indeed very intimate. The existence of She is quite common within the range of the ancient Yue state, including the Hangzhou Bay rim, even reaching the south shore of Changjiang River, but around the Wuling Mountains, from western Hunan to eastern Sichuan, they have completely no trace left. Obviously, there is no clear evidence from this study that the She originated in the Wuling Mountains and migrated to its present range through the eastern section of Nanling Mountain Range.

4.4 Strengths and limits of ethnic distribution analysis

Temporal dimension analysis and testing is the dominant approach in the studies of ethnic origins, differentiation, and migration. However, as spatiotemporal processes, the historical development of ethnicities and their geographical interactions will inevitably preserve their spatial characteristics. This paper makes use of spatial information from census data to extract the spatial variation of ethnic structure at a specific temporal profile, providing an unconventional path to evidence, and mutually compliment to the classic ethnologic approach focusing on time-dimensional information.

Geographic pattern and processes are scale dependent (Wiens, 1989). The analyses in this research are based on census data at the county level administrative units, and therefore can not sufficiently reflect the composition and distribution pattern at even smaller scales. For example, the results of this study pose a question on the existence of Nanling Ethnic Corridor, but with the county-level spatial resolution of our data, it is unlikely to remove the possibility of this corridor structure existing at a finer scale. In addition, the proposed ′Tibetan-Yi corridor′ by anthropologists appears as a spatially extensive region in this study, roughly covering the Hengduan Mountain Ranges in a broad sense. Therefore, the pattern uncovered is normally specific to the range and resolution of data collection and analysis.

Chinese ethnic minorities have a long, profound, and complex history of exchange, differentiation and integration. Therefore, the original, distributional and cultural characteristics are intimately related among the ethnicity groups. This is especially true among the southern ethnic minorities, with overlapping geographic distributions and unclear borders. The geographic patterns of multiple ethnicities at a specific time is only a cross section resulting from constant distribution, evolution and migration processes of different ethnic groups throughout various historical periods. It can not directly reflect the concealed and obliterated evidences of the processes, and the ethnic elements. On the other hand, natural forces, culture, and economic aspects are all mechanistic drivers responsible for the complex ethnic structure and the geographical patterns. Examples of this include the permeation between the Hui and Tibetans and the convergence of many ethnic minorities in cities. The results of ethnic geography objectively reflect the statistical characteristics of distribution patterns of a particular period, providing spatial evidence for the historical changes of all ethnicities, yet these patterns do not possess historical and mechanistic interpretations. Thus, reasonable explanation of the results requires fur-

ther collaboration with evidence from ethnology and related disciplines, as well as further explorations and discussions.

One last but possibly most important point is the effect of the reliability of ethnic identification on the results, regarding the relationship and interaction between the ethnic minorities. It is believed that plenty of uncertainty is still remain unresolved in the identification and discrimination between many intimately related Chinese ethnic minorities (Huang, 1995). However, as the census data collected every 10 years is the sole available source of quantitative information about the distribution and population of all the Chinese ethnic minorities measured over all county-level administrative units, it provides an acceptable description of the spatial structure of ethnic distribution in China, and acts as an important base for further exploration on specific mechanistic questions.

Population data based on ethnic identification and the induced quantitative analysis take all ethnic groups as units independent of each other, i.e. assuming the similarities between any two ethnicities are identical. This assumption can bias the result because of phylogenic dependence among the objects (Huelsenbeck and Crandall, 1997), and this is especially true for interpretation of the distribution patterns of southern ethnicities. As Fig. 4 and Table 1 indicated, there is almost no relationship between the She dominated southeast class J and K, and the Miao and Hakkas dominated central-western class H and I. This result obviously conflicts with the classic statements such as ′Miao, Hakkas and Tujia have the same ancestry′, which reflect the genetic relationships within ethnicities (Zhang, 2006b). Therefore, the results might amplify the differences between the two ethnicities, yet can conceal other associations. This requires caution in interpreting the spatial pattern with regard to the underlying ethnological mechanisms.

5   Conclusions

According to the data from Chinese population census in 1990, Chinese ethnic minorities were mainly distributed in the plateaus and mountains of the northern, northwestern, southwestern to southern China, yet large to intermediate sized cities were also ethnic diversity centers. In general, the geographic patterns of Chinese ethnic minorities support the statement of ′generally scattered, locally clustered′ and ′general scattered living′

pattern. Each of the major ethnic minorities dominates the population composition at a particular region, creating a spatial mosaic of substituted dominance, which is consistent with the results of population based cluster analysis. The spatial configuration of Chinese ethnic communities can be summarized as ′nine regions and one corridor′. Boundaries among the northern ethnic regions are obvious and clear, where boundaries between the southern regions are blurry, showing more evident permeation. Notable geographic distribution characteristics include: 1) the intersection of the Hexi Corridor and Tibetan-Yi Corridor is also Chinese main ethnicity intersection point, reflecting transitions in several directions; 2) the ethnic minority geographic pattern of the Central Plains area is very tattered, forming a mosaic with mainly north-south oriented intersections; 3) southern ethnic minorities combine to form a east–central—west paralleling pattern, there is obvious permeation among these ethnic regions, but a Nanling ethnicity corridor is not detected; and 4) ethnic minority Taiwan Province composition and distribution pattern has notable insular characteristics, while that of Hainan island is not obviously different from the adjacent mainland. The analysis based on geographical distribution for transitions and relationships among Chinese ethnic minorities shed new light on Chinese ethnology, complementing the history oriented methods.

Acknowledgements

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