

STUDY ON THE DISTRIBUTION AND HABITAT CHARACTERISTICS OF BRANDT'S VOLE

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ABSTRACT

*Many species have suffered changed habitable area due to recent climate change or/and human activities. Brandt's vole (*Lasiopodomys brandtii*) is same as it. The species is undergoing a continuous habitat change as a consequence of the human's production, climate change and retrogressive succession of grassland ecosystems. The distribution of the Brandt's vole was update in China and Mongolia. Based on the historical distribution map, which was made by overlaying the historical data with vegetation type's map of the grassland resources in China and Mongolia. And the distribution map was modified according to the on-site investigate data in recent years. The current species' distribution was range Hulunbei'er, northern Xilinguole, which comprise a landscape through the east of Dornod Aimag, Mongolia, and southern Hunshandake Sandy Land in China which just includes the areas around the Zhengxiangbai Qi. There were no the species in the east of Daxinganling Mountains, Liaoning, Shanxi province and Xinjiang Uyghur Autonomous Region of China. The species' distribution is discontinuous in Mongolia, including western, middle and eastern Mongolia. The western distribution along Hangay Mountains and extends for the west, the northern boundary extended to between Ider river and Chulouk river. Southward reaches of the Malhin along the plain between Hangay Mountain and Altay Mountain. The middle and east of the species' range lie in the part areas of Tov, Hentiy, Dundgovi, Dornogovi. extends to Hulunbei'er and northern Xilinguole eastwardly and southwardly respectively, northward reaches of the Trans-Baikalia, Russia.*

KEY WORDS: Brandt's vole, Geographical distribution, Habitat fragmentation, Changing Status

INTRODUCTION

Climate change and human activities have indirect effects on the geographic range for many species through the sensitivity of habitat or food supply to temperature and rainfall (Iverson & Prasad 1998; McCarty 2001). Some species have suffered reduced habitable area due to climate or/and human activities (Parmesan 2006).

Brandt's vole, (*Lasiopodomys brandtii*) is a dominant rodent species of typical steppe habitat that extends from the central part of Inner Mongolia through the middle and east of Dornod Aimag, Republic of Mongolia, to the southern borders of Mongolia in Trans-Baikalia, Russia (Shenbrot & Krasnov 2005). Many works about its distribution have been done (Allen 1940; Vinogradova & Gromov 1959; Shi 1988; Ma 1990; Cobet 1991; Dawaa 2005). But some reports are not consistent with others, and the habitats reduce have happened in recent years.

Otherwise, Brandt's voles distribution is discontinuous, they prefer degraded grasslands

(Zhong et al. 1991), which are interspersed with less favorable habitat due to low grazing pressure by livestock (Luo et al. 1975; Zhong et al. 1985; Zhong et al. 1999), the species is also well-adapted to colonization of isolated, patchy, ephemeral habitats. In recent years, climate change and the human activities including overgrazing, land reclamation and digging herbs have caused the change of ecological environment in grassland in China (Li 1997; Li et al. 2001; Sun et al. 2010; Li et al. 2009). For example, the area occupied by heavily degraded grassland exceeded 60% of the total in Xilinguole in 2007 (Li et al. 2007). Investigation of Brandt's vole distribution have indicated that some habitats are now permanently destroyed in some isolated sites, particularly in the southern Taipusiqi area (Zhang et al. 1995), where we studied them from 1992 to 2003. Since 2003, we have not captured any voles there. It's necessary to modify previous knowledge of Brandt's vole distribution for management of the species.

MATERIAL AND METHODS

Make the historical distribution map

Historical distribution map was drawn on the basis of the Brandt's vole distribution in China (Ma et al. 1990) and Mongolia (Enkhbold 1998, 2013), Shenbrot and Krasnov's map (2005) was also referenced, which were transformed into digital data, and overlaid the geographic information system (GIS) layer map of China and map of Mongolia (<http://www.openstreetmap.org> and www.mapcruzin.com). Then overlaid the data with vegetation types map of the grassland resources in China at scale 1:1,000,000 (Su 1993; <http://mapsof.net/china/static-maps/jpg/china-natural-vegetation-map/full-size>) and a ground vegetation types map of Republic of Mongolia at scale 1:1,000,000 (Plant Protection Institute et al., 1998)

(<http://nomadicjourneys.com/about-mongolia/map-of-mongolia/vegetation-map>),

The biggest overlap areas were regarded as the basal historical distribution.

Identify the distribution areas by trapping

All available information of the species distribution was collected from historical references and specimens location data, including the collected specimens district or GPS sites and the research district or GPS sites about Brandt's vole. These sites were input the basal distribution map in the GIS. Then select the location in which field trapping should be taken. The surveying was carried out in the sites according to the following rules: (a) distribution data can be referenced, but the vegetation cover are different to the habitat selection of Brandt's vole obviously. (b) the

sites in which habitat was obvious changed compare with the last references record.

From 2004 to 2010, the main distribution areas were investigated in Inner Mongolia of China and the middle and east of Republic of Mongolia. For each selected sites, we examined the signs of presence of Brandt's

vole, such as tweet, runs, burrows, as well as definite road traces were found. Line traps was laid down to test and confirm the presence of the vole. Record the GPS date of tapping sites, uploaded into the GIS map of the historical distribution map. Then get to the current distribution picture of Brandt's vole.

RESULTS

Brandt's vole main historical distribution areas

All historical distribution map of Brandt's vole show that the species mainly distributed on Mongolian plateau, range from 52°N to 41°N, and from 124°E to 92°E. But there are some different areas in different exhaustive maps (Shenbrot&Krasnov 2005; Shi 1988; Ma *et al* 1990; Соколов&Орлов 1980; Enkhbold 1998). In China, the historical distribution areas include Hulunbei'er, northern Xilinguole, southern Hunshandake Sandy Land and East foot areas of Daxing'anling Mountains (Fig.1). The main districts are in Inner Mongolian Autonomous Region, Hebei province and Liaoning province (Fig.1). And few reports think there is the species in Shanxi province and Xinjiang Uygur Autonomous Regions in China (Table 1), but it was not confirmed by other researchers. The best possible historical distribution map was drew as in Fig.1. The references recorded Brandt's vole in Mongolia showed the variety of the distribution, especially in the middle and west of Mongolia. It is along the south of Khangai

Range, extended to the north of the Altay Mountain Range (Enkhbold 1998), the distribution area of Selenge Aimag and Central Aimag are joined together (Shenbrot&Krasnov 2005; Enkhbold 1998). But the areas are separated in the picture of Соколов and Орлов (1980), and only distribute around Khangai Range (Shenbrot&Krasnov 2005; Соколов&Орлов 1980). Westward, the distribution extend to the frontier of Mongolia and Russia (Enkhbold 1998; Соколов&Орлов, 1980), it just extends westward to Kirghizia in Uvs Aimag in Shenbrot and Krasnov's map (2005). In east Mongolia, Brandt's vole distributes are over southern Kente, north of East Gobi, Sukhbaatar and Dornod provinces, the distribution extend northward to Russia along the Uldz River basin, and adjoined eastward Hulunbei'er and Xilinguole, in China. According to the rules of the biggest overlap areas between all historical distribution data and the vegetation types map of Mongolia, the picture of basal historical distribution show as in Fig.1

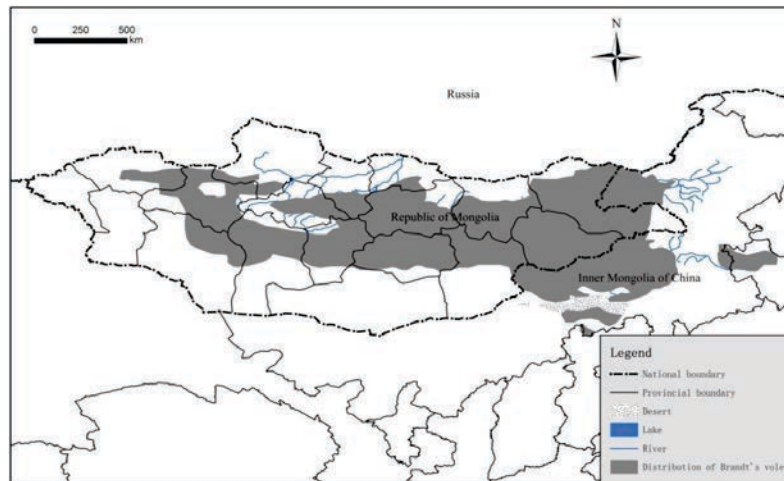


Figure. 1 The distribution of Brandt's vole in China and Mongolia (According to Shenbrot and Krasnov 2005)

Shi 1988; Ma *et al.* 1990; Соколов and Орлов 1980; Enkhbold 1998. Note: In the pictures of Brandt's vole distributions by Ma *et al.* (1990), Mongolia was marked as People's Republic of Mongolia and Russia was marked as Soviet Union.

Current distribution of Brandt's vole and the regional variation

Local investigation sites including Inner Mongolian Autonomous Region, Hebei province, Liaoning province in China and Тив, Увирhangay, Arhangay, Bulgan, Selenge, Hentiy, Dornod, Suhbaatar and Ulaanbaatar in Mongolia. Total 316 GPS sites were records, where the trap investigation were operated. And the west distribution data of Mongolia were supplied by Mongolia Institute of Plant Protection. The results showed that the distribution have changed a lot according to the field investigation data from 2004 to 2010.

The current main distribution region of Brandt's vole in China are the dry grassland in eastern Hulunbei'er, Xilinguole and south of Hunshandake Sandy Land. Hulunbuier distribution zone includes Xinba'erhuzuoqi, Xinba'erhuyouqi, Chenba'erhuqi, Ewenkeqi, Haila'er Area, and Manzhoulicounty. The eastern boundary can't exceed the border

between steppe and meadow grassland in the west of Daxing'anling Mountains because of the vegetation (Shi 1988). Northward, the boundary extends to Xiwuzhuer- Manzhouli line in the north of the Haila'erriver, and connects with Lake Baikal areas. The southeastern boundary reached Normankhan-Xilinbel line. Xilinguole distribution zone includes Sunitezuoqi, Abagaqi, Xilinhot, Xiwuzhumuqinqi, Dongwuzhumuqinqi and Keshiketengqi (around the Dalai Lake). This zone is connected to the east of Mongolia and the west boundary to the line between Bayane'erdun and Sunitezuoqi. Southward, it extends to the north of Hunshandake Sandy Land. eastward and northward, the boundary is to the line of Huanggangliang-Baorigasitaiguole-Wulagaiguole-Narengaole, where are the boundary of between steppe and meadow grassland (Shi 1988). Hunshandake Sandy Land distribution included Zhengxiangbaiqi, Zhenglanqi, Duolun, south of Taipusiqi and the north of Bashang grassland of Hebei province in the last 20th century. Now, Brandt's vole just be found in some patches of Zhengxiangbaiqi. where is small and isolated from others since the population monitoring in 2004

According to the ecological character of

Brandt's vole, vegetation is one of the main factors that affect the distribution of Brandt's vole. In the steppe grasslands, the dominant plant are *Stipakrylovii*, *Artemisia frigida*, *Cleistogenessquarrosa*, *Carexduriuscula* and *Caraganamicrophylia* in the habitat of the species (Luo 1975; Shi 1986). In the semi-desertification grasslands, The dominant plant is only *Artemisia frigida* in their habitat. In old northern Xilinguole distribution picture, it included most area of Hunshandake Sandy Land southward and extends to Suniteyouqi and Xianghuangqi westward. But where are semi-desertification and the vegetation didn't suit Brandt's vole according to the data from Chinese grassland map (National Animal Husbandry Service 2008).

Although Hulunbuir and Xilinguole distribution were isolated in Chinese administrative map, Hulunbei'er distribution included part of the Daxinganling Mountains and Hulun Lake between the Xilinguole and Hulunbei'er distributions in China, they were connected as a consecutive natural region through Sukhbaatar and Dornod in the east of Mongolia (Fig.2).

Some references report Brandt's vole distributed in the middle part of Jilin province (Huang *et al.* 1995; Han *et al.* 2005; Wang 2003), Liaoning province (Wang 2003), Kangxiwa in Xinjiang Uyghur Autonomous Region (Huang *et al.* 1995; Han *et al.* 2005) and Shanxi province (Plant Protection Station, China Ministry of Agriculture, 1994). The species distribute in the east of Daxing'anling Mountains (near the Baicheng, Jilin province) (Fig.1), where was concluded by the specimen from the First Endemic Prevention Research Institute, Jilin (Table 1). local investigation were operated in the recorded distribution around Baicheng in 2005, there is no voles there. Otherwise, the grassland belongs to the agro-pasture ecotone, where didn't suit

Brandt's vole. The specimen in Jilin were collected from Huolingol located in Wulagai River, Inner Mongolian Autonomous Region, where were devolved to Jilin province during 60s to 70s in the 20th century. And the climate and vegetation in Xinjiang, Liaoning and Shanxi are obvious different to the habitats surrounding of the species, and the views never be supported by the historical record book such as Zoography of Xinjiang Rodent (Wang & Yang 1983), Shanxi Zoography (Fan & Liu 1996) and Fauna Sinica Mammalia (Luo *et al.* 2000). This vole maybe confuse with the mandarin vole (*Lasiopodomys mandarinus*) in Shanxi and Liaoning provinces and the root vole (*Microtus oeconomus*) in Xinjiang Uyghur Autonomous Region.

The distribution in Republic of Mongolia was divided into two disconnected parts: middle and eastern distribution and west distribution. The west boundary of middle and eastern distribution is the east of Erdenesant – Bayanenzhule, it extends eastwardly along with the Herlen River. Northward, the distribution of Sergelen and Hulunbuir'er in Dornod extends to Baikalia basin of Russia. And connected with Xilinguole distribution southward and Hulunbei'er distribution eastward in China. The west distribution are around the Khangai Range, it extends westward along with the Khangai Range, reaches to the areas between mid-lower valleys of Chuluut River and Ider River in the north of Khangai Mountain. In the south foot of Khangai Mountain, The west edge of distribution didn't reach to the border of Mongolia-Russia, the southern boundary is along the north edge of Khangai Range. the northern boundary lies on the southern foot of Altai Mountains. The gap belt between middle and eastern distribution and west distribution was about 100km (Fig.2).

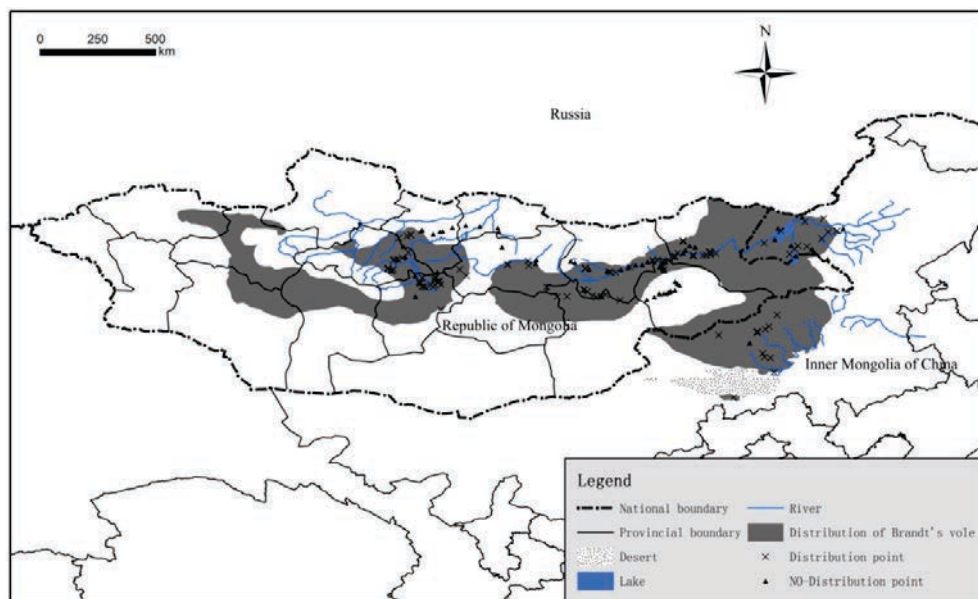


Figure. 2 The current distribution of Brandt's vole in China and Mongolia

DISCUSSION

The main distribution of Brandt's vole in China is in eastern Inner Mongolia, where is mostly a huge grassland. The climate is cool and dry, annual average temperature ranges from -1 to 10°C, and annual rainfall varies from 200 to 400 mm. The dominant plant species are *Caraganamicrophylla*, *Cleistogenessquarrosa*, *Stipakrylovii*, *Aneurolepidiumchinense* and *Artemisia frigida* (Wu *et al.* 2009). This vole is interspersed with slightly developing grasslands or areas subject to low grazing pressures and are less suitable environments (Luo *et al.* 1975). The habitat is relative to the attributes of the plant community, especially the plant cover, species composition and height of vegetation (Zhong *et al.* 1999). It prefer the typical steppe with the *Artemisia frigida*, *Allium polyrhizum* and *Cleistogenessquarrosa*, and where vegetation cover is in the range 15-20% (Zhong *et al.* 1991). It slide over the surroundings which vegetation cover is less than 5%. There are almost no the species in the grassland where are dominant plant species such as *Carex tristachya*, *Achnatherum splendens* or overgrown weeds (Xilinguole Disease Control agency 1975). The

habitat has a clear characters of surroundings, it don't enter the forest and desertification grassland (Liu 1979). So it is sound that overlaid the historical data with vegetation types map of the grassland resources in China and Republic of Mongolia, and some distribution on the Khangai Range should be modified (Fig.1, Fig.2). Although the limitation of map scale bring on some stain which some unsuitable habitat patches were included in the historical distribution picture, the result of field survey indicated most of the distribution can match the vegetation map well and modified distribution is actual.

In recent years, human activities including overgrazing and land reclamation have resulted in the retrogressive succession of grassland ecosystems (Li 1997; Li *et al.* 2001; Wang *et al.* 2007). Climate change, in particular high temperature and aridity, has accelerated the process of grassland degradation (Li *et al.* 2004; Li *et al.* 2007). That destroyed some habitats of Brandt's vole, and caused the fragmentation and reduce of the distribution (Wu & Li 2003). Comparing the current picture (Fig.2) with historical distribution (Fig.1) of

Brant's vole, the tendency of habitat fragmentation is clear. whole distribution of the species has been parted into 2 areas. One part is the west distribution of Mongolia, and another is the middle and eastern of Mongolia and Hulunbeier and Xilinguole of China. The south of Hunshandake Sandy distribution have diminished, our investigation have indicated that some patches are now permanently destroyed in some isolated sites such as Zhenglanqi, Duolun, south of Taipusiqi and the north of Hebei province. Where belong to the southern of Hunshandake distribution, and just little patches could be found in Zhengxiangbaiqi now (Table1). The gap belt between middle and west distribution (Fig.2) resulted from large areas of grassland was assarted for agricultural zone in Selenge and Aymang of Mongolia. Otherwise, Habitat fragmentation affected the population ecological process in different patches. In the field, we found the sympatric species marmot in the grassland around Khangai Mountains, the similar phenomenon also was found in the north of Xilinguole, China. But it's very

different with the habitats of middle and eastern distribution in Mongolia and Hulunbeier distribution in China. And it different with that of the former. That may be a sign of disturbance of the species habitats.

The distribution of Brant's vole is a result of species migration and adapting to environment. It prefer the low vegetation height and cover and the habitat are closely connected with plant communities (Zhou *et al.* 1982), the type of scattered distribution susceptible to interference by environment change and human activity. Grazing and land reclamation causes degradation of grassland on Mongolian plateau, meanwhile, the rodents' devouring and digging activities aggravate the degradation of the grassland, that can lead ultimately to desertification. Where will not suitable to Brandt's vole. Along with the increase of human activity in the grassland, the changes are likely to continue in many regions. Overall, local investigation evidence suggests that is obligatory to modify the distribution map of Brandt's vole in a fine scale.

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