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Structure characteristics and influencing factors of rodent community in Kangbo ranch

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ABSTRACT

The purpose of this study was to understand the structure characteristics of rodent communities in different habitats of Kangbao ranch, and to analyze their influencing factors, so as to provide evidence for rodent control. Using rodent density was monitored by night trapping method from April to July of 2010 to 2013, rodent monitoring was conducted for five habitats including ridger, grass bank, farmland, woodland and wasteland. A total of 146 rodents were captured in this pastoral area, which were identified as belonging to 7 species of 5 genera and 3 families of 1 order, black line hamster and little hairy foot mouse were the dominant species in this area, and the number of rodents captured in the three main habitats of grassland, arable land and woodland accounted for 86.99% of the total rodents.The rodent density of five habitats is: Farmland > woodland > wasteland > ridge.In the grassland, the most diverse and complex community structure was found, and the farmland, woodland and ridge were reduced successively.The rodent community in wasteland has the lowest diversity and the simplest community structure. The result showed the density of rodents in Kangbao ranch was low, and the structure of rodents communities in different habitats was clear. We will continue to strengthen the monitoring of rat densities, classify and classify them, and prevent and control them scientifically, so as to reduce the occurrence and spread of rodent borne diseases.

Keywords: Kangbo ranch; Habitat; Rodent community; Population density; Structural features

INTRODUCTION

According to the United Nations Food and Agriculture Organization (FAO), rodents damage to Agriculture accounts for 10-20% of total crop production worldwide (Wang, 2005). Since the 1980s, the occurrence frequency of rodent disasters in China has been increasing, and the influence scope is expanding day by day. In particular, the area of agricultural rodent outbreak in this century has exceeded 0.33 billion hm2 per year, and the grain loss is nearly 10×10^6 kg (Yang et al., 2013; Feng and Gao, 2013; Wang, 2008; Yang, 2009). Rats bite the cable insulation material cause short circuit, drill into the transformer cause combustion and explosion, damage the high-voltage line caused by strong magnetic field induction break-

down, burning equipment, and many urban fires caused by unknown reasons are mostly related to rats bite the circuit fire. Mice are also the main carriers and disseminators of bacteria and viruses. At present, at least 25 kinds of human diseases related to mice have been identified in China, involving 79 kinds of mice (Chen, 2017; Chai et al., 2006). According to statistics, the number of deaths due to infection with rodent virus in the world is far more than those directly caused by war (Wang, 2006). Therefore, rodents are one of the main biological disasters that restrict social and economic development and harm human health.

In view of the increasing scope and extent of the effects of rodents in recent years, the study of rodents has gradually become a hot issue that attracts wide attention and interdisciplinary.The community ecology theory is used to study the structure of the rat community, to clarify the structural characteristics and functions of the rat community in different habitats of the ecosystem, and to explore the regional characteristics of the rat activities (Zhang et al., 2013; Oliver, 2003).Although the rodent community structure is significantly different under different habitat conditions and species richness is obviously different, the diversity of species in different habitats is not obvious. Chinese scholars have carried out investigation and research on rodents in some typical regions: rodents are widely distributed in the mountains of eastern fujian, and the living space of each species ranges from low-altitude residential areas to high-altitude forest irrigated areas, and the species changes with the population in different height zones (Hong, 1987). In low-lying areas, the population structure of rodents has obvious changes with the seasons, which is the main hidden danger of the development of the storage industry. It is necessary to strengthen the defense and do a good job in the risk assessment of disease transmission (Xin, 2012; Taylor, 2004).Cool forest ecotone habitat complexity is high, is one of the important regional distribution of rodents and other rodent species diversity, is to study an ideal place for rodents community structure and activity habits, Chinese scholars discussed the distribution situation of the mice in different habitats, reflects their choice of different habitats, and small rat species composition and the complexity of the habitat has close correlation (Xu et al., 2009). Although the investigation of multi-area rodent communities has been carried out, the differences in their regional distribution and spatial community structure have also been studied. As a widely distributed species, the differences in structure and diversity caused by changes in habitat conditions still need to be further explored.In addition, China's farming-pastoral ecotone is one of the areas with complex habitat in the global terrestrial ecosystem.Rat also become an important restricting factors limit the area of animal husbandry, in order to master the spatial distribution and activity of rats, koho ranch in northwest of hebei province in July 2010-4-2010 rats monitoring results were analyzed, and the mastery of the pastoral areas rodent population structure characteristics and density, and analyze its influencing factors, provide the basis for koho pasture rodents prevention and control work.

2. Materials and Methods

2.1. Study Areas

Koho ranch is located in the northwest of hebei province, belonging to koho county, zhangjiakou is located in the southeast margin of JiMeng constraints for Inner Mongolia plateau, with a fold mountain arch, commonly known as "bashang plateau", geographic coordinates to 51 '114 ° 43' - 114 ° E, 42 ° 00 '- 42 ° 09' N (figure 1) (Guo, 2009).The area of the sample is 116.67km2, and the topography slopes slowly from northeast to southwest, with an elevation of about 1,450 m.Sample area in east Asia continental monsoon climate temperate arid zone, cold and spring sandstorm is more, about 300 mm annual rainfall, and mainly concentrated in the summer, the annual average temperature 1.2 ℃, frost-free period for 114 days.In the pastoral areas, the main vegetation of the steppe was leymus chinensis, cold pole, cryptophilus chinensis and gramineus chinensis.The animals are mainly rat, goat, Wolf, eagle, rabbit, sheep, horse, cow and goat.Soil is typical meadow chestnut soil with loose soil and is an important pasture in north China.The disastrous weather is mainly drought, wind sand, hail and frost, especially drought, which is known as "nine droughts in ten years" (Liu, 2013).

The habitat condition of arid meadow is the place where the rodents move frequently.

Figure. 1 the location of the Kangbao ranch

2.2 Data

The monitoring data of rodents were downloaded from the official website of the rodent prevention and control base of China CDC, the GPS positioning data of the rodent distribution points reported in the journal and the geographic description information of the rodent collection site. The research data were collected from the related journals, journals and academic papers on rodent community research in China since 2000. According to the general planning information of Kangbao ranch in 2015, the total land area of Kangbao ranch is 11664.5hm2, including 2814hm^2 of cultivated land, 1753hm^2 of forested land, 6627hm^2 of pasture, and 470.5hm2 of other land. The proportion of farming, forestry and animal husbandry is 1: 0.62:2.36, mainly grazing and combined farming and animal husbandry.In view of the structure characteristics of rodents in the pastoral areas, this study focused on the monitoring of rodents by selecting five types of habitat in the sampling area, including ridges, grassland, arable land, woodland and wasteland.

2.3 Quantitative Metrics and Analysis

In this study, the density of rodents was monitored by night trapping method. Investigators in 2010-2013 a year in July 4 - the area of rats surveillance, unified use steel plate mousetrap (12 cm × 6.5 cm), raw peanuts as bait, using the straight line cloth, every 6 m cloth mousetrap 1 (if using cloth clip parallel straight lines, the distance between the two lines of not less than 20 m), in the middle of a month cloth, put in the morning, evening to select reserve survey habitat one-time cloth 100-300 valid mousetrap, if encounter the weather postpone (Xing et al., 2015; Wu, 2011; Jiang et al., 2013). On that day, the captured rodents were classified and the capture rate was calculated, and the habitat type and weather conditions were recorded.

Using the Shannon-wiener diversity index (H), Pielou evenness index (E), Simpson dominance index (C) and Menhinick richness index (D) were introduced to analyze the diversity of rodent communities in different habitats of Kangbao ranch. The calculation formula of the four indexes (Guo et al., 2016, Zhao, 2016; Liu and Zhao, 2009; Xin et al., 2013; Ma et al., 2016) is as follows:

$$H = -\sum (P_i \ln p_i) \quad (1)$$

$$E = H / \ln S \quad (2)$$

$$C = \sum P_i^2 \quad (3)$$

$$D = \ln S / \ln N \quad (4)$$

Where $P_i = n_i / N\ n_i$ is the number of individuals of the population, *i* class group, *i* represents the community, is the total number of individuals of all groups in the community, the number of groups.

In order to quantitatively describe the composition characteristics of rodent population in Kangbao pasture, the density index of rodent population was introduced to describe the population structure and the status of each rodent in the population (Wu et al., 2011; Zhang et al., 2013; Pang et al., 2015). On this basis, the population structure of rodents of different land use/cover types was studied.

$$\text{Population density} = \frac{\text{Number of individual mouse species acquired}}{\text{The total number}} \times 100\% \quad (5)$$

$$\text{Rodent abundance} = \frac{\text{the number of capture}}{\text{Habitat area}} \times 100\% \quad (6)$$

The grades of each rodent community were divided according to the percentage of the number of individual rat species in the total catch in different habitats, in which the number of individual rat species accounted for more than 10% of the total catch, the dominant rat species was divided into the dominant rat species, the common mouse species was divided into 1% ~ 10%, and the rare mouse species was divided into the rare rat species.

3. RESULTS

3.1 Rodent population composition in Kangbao ranch

According to the monitoring of five habitats of Kangbao ridges, grassland, arable land, woodland and wasteland from April to July, 2010 to 2013, a total of 5000 effective rodent traps were arranged, and 7 species of rodents were trapped, 146 were captured, which were identified as belonging to 7 species of 5 genera in 3 families of 1 order (Wang, 2005). The dominant species of mice were domestic rat, black line hamster, little hairy foot mouse and black line hairy foot mouse, accounting for 83.56% of the total catch. The common species are long-clawed gerbils, five-toed sprays and meridian gerbils, which respectively account for 1.38%, 7.53% and 7.53% of the total catch (figure. 2).

Rodentia
Mundae
Mus
Musmusculus Linnaeus, 1758
Meriones
Meriones Nnguiculatus Milne-Edwards,1867
Meriones meridianus Pallas,1773
Cricetidae
Cricetulus
Cricetulus Barabensis Pallas,1773
Rattus
Phodopus roborovskii Satunin,1903
Phodopus sungorus Pallas,1773
Dipodidae
Allactage
Allactage sibirica Forster,1778

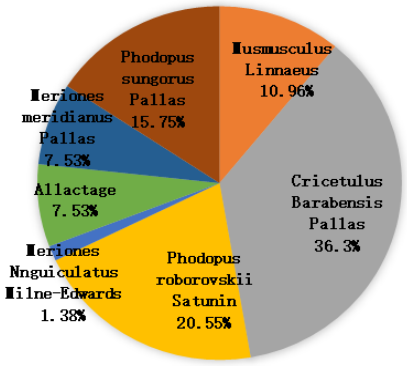

Figure 2. The composition of rodent species in Kangbao ranch

3.2 Rodent density in different habitats in Kangbao ranch

From April 2010 to July 2013, total of 50 monitoring sites of one hectare were selected in the survey sample area. The five types of habitat areas in the area were 7hm^2 ridge, 11hm^2 meadow, 16hm^2 arable land, 12hm^2 woodland and 4hm^2 wasteland. The average density of rodents in the five habitat monitoring sites was 2.92 per hm^2. Among them, there are 1.71 ridges/hm2, 4.64 grass land/hm^2, 3.19 cultivated land/hm^2, 2.08 woodland/hm^2 and 1.75 wasteland/hm^2 (Table 1).

Table 1. Rodent density in different habitats in Kangbao ranch between April 2010 and July 2013

Habitat type	area (hm^2)	Average density (number/hm^2)
Ridges	7	1.71
meadow	11	4.64
Arable land	16	3.19
Woodland	12	2.08
Wasteland	4	1.75
Total	50	2.92

3.3 Rodent population structure in different habitats in Kangbao ranch

According to the five habitats of Kangbao ranch, there were 12 rodents trapped in ridgefield, accounting for 8.21%. A total of 51 mice were caught in foreland, accounting for 34.94%. A total of 51 rodents were trapped in cultivated land, accounting for 34.94%. There were 25 rodent species in woodland, accounting for 17.11%. In total, there were 7 rodent species in wasteland, accounting for 4.80%. In addition, the Zulu gerbil was not caught in the ridges, woodlands and wasteland. In the cultivated land, woodland and unreclaimed land, there were no long ungual gerbils. In the lifetime of the wasteland, there were no juvenile pterodactyls (Table. 2).

Table 2. Composition of rodent species in different habitats in Kangbao ranch

Rodents type	**Ridges**		**Meadow**		**Arable land**		**Woodland**		**Wasteland**		**Total**		**abundance**
	Number	Proportion (%)	Catches number (只)	Number	Proportion (%)	Catches number (只)	Number	Proportion(%)	Catches number (只)	Number	Proportion (%)	Catches number (只)	
Musmusculus Linnaeus	2	1.37	7	4.80	2	1.37	3	2.05	2	1.37	13	10.96	+++
Cricetulus Barabensis Pallas	1	0.69	10	6.85	27	18.49	13	8.90	2	1.37	53	36.30	+++
Phodopus roborovskii Satunin	2	1.37	18	12.32	9	6.17	1	0.69	0	0.00	30	20.55	+++
Meriones Nnguiculatus Milne-Edwards	1	0.69	1	0.69	0	0.00	0	0.00	0	0.00	2	1.38	++
Allactage sibirica Forster	3	2.05	2	1.37	3	2.05	2	1.37	1	0.69	11	7.53	++
Meriones meridianus Pallas	0	0.00	7	4.80	4	2.73	0	0.00	0	0.00	11	7.53	++
Phodopus sungorus Pallas	3	2.05	6	4.11	6	4.11	6	4.11	2	1.37	23	15.75	+++
Total	12	8.21	51	34.94	51	34.94	25	17.11	7	4.80	146	100.00	

3.3 Rodent population structure in different habitats in Kangbao ranch

3.4 Diversity of rodent communities in different habitats in Kangbao ranch

Table 3 shows that all indicators of the mouse community in woodland are in the middle position. The diversity index of Shannon Wiener (H), Pielou evenness index (E) and Menhinick richness index (D) of the rat community were all the highest, indicating that the difference of the rat community was the least, and the species richness and evenness were better. All the indexes of rodents in wasteland were the lowest, which indicated that the conservation ability of the wasteland to the diversity of rodents was low. To sum up, the rodent community is the most diverse and complex in the foreland. Farmland, woodland and ridge were reduced successively; The rodent community in wasteland has the lowest diversity and the simplest community structure.

Table 3. diversity of rodent communities in different habitats in Kangbao ranch

Habitat type	Shannon-diversity index (H)	Pielou-Evenness index (E)	Simpson-Dominance index (C)	Menhinick-Richness index (D)
Ridges	0.3456	0.1929	0.0013	0.3595
meadow	0.9574	0.4920	0.0264	0.3905
Arable land	0.8519	0.4755	0.0410	0.3595
Woodland	0.5193	0.3227	0.0103	0.3229
Wasteland	0.2107	0.1520	0.0006	0.2782

DISCUSSION AND CONCLUTION

From the above monitoring results, it can be seen that the habitat difference has a significant impact on the rodent community structure and the composition of rat species.For example, house mouse, black line hamster, little hairy foot mouse and black line hairy foot mouse are the dominant species in the pasture. Although they account for 83.56% of the total amount of trapping mice in the pasture, little hairy foot mouse is not caught in the wasteland, which can be judged as a rare mouse species in the wasteland.The long-clawed gerbil, five-toed dormouse and meridian gerbil are the common species in the pasture, accounting for 16.44% of the total trapping rodents in the pasture.Gerbils are also found only in ridges and grass beds.Study also found that striped hamsters, xiaomao foot rats, mice, the black wool foot mouse, meridian gerbils mainly inhabit semi-desert areas, dry grassland vegetation coverage and the brush between sand dunes, because grass land, cultivated land, forest land vegetation coverage is higher, more moisture and slope is appropriate, provides a good growth, which rodents habitat and breeding environment, and the ridge and desert vegetation scarce, surface exposed degree is higher, relative to the other three kinds of habitat conditions is bad, not suitable for survival rats and mice, and this also happens to coincide with the results of the survey.

The diversity of vegetation types in the whole pastoral area provides sufficient environmental conditions for the common survival of multiple rodents. Good vegetation coverage not only provides abundant food sources for rodents, but also provides natural shelter (Chen et al., 2016).In summer, the grassland and cultivated land of Kangbao ranch grow well. Abundant grass seeds meet the food needs of rats and mice.The forest habitat of Kangbao ranch is mainly dominated by trees, and the vegetation coverage on the ground is much lower than that of grass land and cultivated land.However, the vegetation coverage of ridges and wasteland was lower, and the rodents lacked natural shelter and food sources, so the harvest was minimal.

Most rodent habitats are distributed in the wild, requiring a certain slope on the topography to facilitate nesting and withstand rain invasion (Zhang et al., 2008).For example, the black line hamster mainly lives in the dry environment with higher topography, and its caves are often built on the ridge, furrow and ridge above water surface, river surface or lake surface.These rodents inhabit a wide range of environments, especially in sandy soil.The habitats of Kangbao pasture ridge and grass bank have a certain slope, and the soil contains sand grains and less water. These habitats become a good habitat environment for rodents. Therefore, black line hamster activities cover all kinds of habitat such as grass bank and woodland.This is consistent with the results that the researchers caught more and more rodents in the habitats such as ridges, grassland, artificial grassland and forest belt.

Climatic factors have an important influence on rodent activities.For example, rodent reproduction shows obvious seasonal reproduction characteristics: spring and summer mass reproduction, into winter to stop breeding.Temperature is mainly reflected in the effect on the body temperature of mice, and also determines the strength of metabolism of mice.Spring and summer when the temperature is appropriate, a variety of rodents breeding and activities peak.Such as koho pasture advantage of striped hamsters and xiaomao foot mouse is suitable for the temperature in more than 12℃, the most suitable breeding temperature is about 19℃(Xu, 2013), reduce the temperature difference is greater than 10℃ activities. In addition, precipitation in the atmosphere directly affects the growth of plants in the pastoral areas and indirectly restricts the activities of rodents.Summer rainstorms can also submerge rodents, destroying their nests and affecting their breeding and growth activities. Located in the central temperate continental monsoon climate zone, the spring temperature is rising fast, summer and autumn temperature is high, precipitation is less, dry climate conditions for rodents to provide a suitable habitat environment and breeding conditions.

From April to July, 2010 to 2013, a total of 146 rats of 7 species were collected from the monitoring of five habitats of Kangbao pasture ridges, grassland, cultivated land, woodland and wasteland, and identified as belonging to 7 species of 5 genera and 3 families, 1 order, 3 families. Among them, small house mouse, black line hamster, little hairy foot mouse and black line hairy foot mouse are the dominant mice species in Kangbao pasture. The long-clawed gerbil, five-toed dormouse and meridian gerbil are common species of gerbils.

The density of rodents in five habitats was as follows: > woodland > wasteland > ridge, which was lower than the average density of rodents in Kangbao pasture. There was no obvious dominant mouse species in the three habitats of ridge, woodland and wasteland. The little pterodactyl is the dominant mouse species in the turf. The black line hamster is the dominant mouse species in the cultivated land. In the five habitats, the foreland rodent community has the highest diversity and the most complex community structure. Farmland, woodland and ridge were reduced successively. The rodent community in wasteland has the lowest diversity and the simplest community structure.

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