Research on Animal Corridor Setting in Desert and Gobi Area

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Abstract. This paper, the authors take the design of wildlife corridor from Mingshui to Hami section of national expressway from Beijing to Urumqi as an example. The types, living habits and activity rules of local wildlife are analysed. The distribution of vegetation and water source along the highway was investigated, and the distribution of water source was taken as an important basis for the location selection of animal corridor. Considering the dry climate and strong wind along the route, the type of animal corridor is determined to be the underpass. Comparing with the utilization effect of Equus hemionus corridor on Qinghai-Tibet railway, the requirement that the clearance height of Mongolian wild donkey passage at Mingha high speed is more than 3.5 meters is put forward.

1. Introduction  
Highways are an important landscape type and have brought significant economic benefits to communities. However, highway construction may adversely affect wildlife survival through habitat fragmentation, loss, and reduced connectivity. This can lead to declines in wildlife populations and to the loss of biodiversity. Wildlife corridors are thought to be an efficient way to mitigate the isolation and fragmentation of habitat caused by highway construction and can provide safety avenues for wildlife movement between habitat patches, which facilitates gene dispersal and interflow. However, there has been little research on wildlife corridor design in China, compared to the western, developed countries. Most previous studies have focused on theoretical discussions on the types, size, design principles, and procedures for corridor construction, but the location, which is the key factor affecting corridor use by wildlife, has rarely been discussed. To verify the effectiveness of the animal corridor on the Mingshui-Hami highway, we have arranged 13 animal passages on the highway and installed infrared cameras to record the data of the animals passing through.
2. Study area

2.1. Climate
The study area is part of national highway from Beijing to urumqi, which start from Hami, and the endpoint is in Mingshui. Total length of this way is about 178.8 km, the main body direction from west to east, is located in east longitude 94°09′ ~ 96°09′, north latitude 43°~ 42°01′16″. The study area has a typical temperate continental dry climate, with little rain and many sunny days. The annual average temperature is 9.8 ℃, the annual precipitation is 33.8 mL, and the annual evaporation is 3300 mL. Spring is windy, cold and warm changeful. Winter is cold, low air layer is stable. The extreme maximum temperature is 43 ℃. The extreme minimum temperature is -32 ℃. The frost-free period is 182 days on solar energy resources. It is one of the areas with superior solar energy resources in China. The annual sunshine hours range from 3300 to 3500 hours, which is one of the areas with the most sunshine hours in China.

2.2. Animal resources
According to statistics, the research objects include 59 species of wild animals, including 5 orders and 21 families, 59 species of beasts, 43 families and 161 species of birds, 16 orders and 43 families, 18 species of fish, 5 families and 10 species of insects, 13 orders and 96 families and 359 species of insects in a season, a total of 617 species of 174 families and 40 orders. Along the highway, there are two kinds of wild animals under state key protection, Equus hemionus and Capra ibex. In addition, along the highway there are a large number of national secondary protection animal, Gazella subgutturosa.

Equus hemionus
Habitat environment: it is a typical desert animal, mostly inhabiting the desert, semi-desert and desert grassland areas with an altitude of 801, 250 m. Habitats have natural water sources or are often observed near water sources.

Gazella subgutturosa
Habitat environment: it is a typical desert and semi-desert animal, living in the open area of the plateau with an altitude of 200-300m. Generally choose plain, relatively gentle hilly areas, mountain
valleys and plateau areas, and try to avoid steep mountains, the valleys and the places where people live.

Figure 2. *Gazella subgutturosa*  
Figure 3. *Equus hemionus*

3. Methodology

3.1. Corridor Location Selection

According to the wild animals along the route, water is the main characteristics for its activities of the destination, the location of the animal corridor and the distribution of water resources on both sides of Mingha highway is closely related. There is little precipitation along the Mingha highway, no perennial river with water, only temporary flood formed dry gully. However, the Mingha highway is located on the south slope of Tianshan Mountain, and there are many spring holes emerging from it. There are 24 spring holes distributed in the 200m range on both sides, among which there are 6 perennial water places, 5 irregularly water places and 13 dry places. At 24 but one place has dried up in spring is located in the proposed highway K60+130m on the right side, and other spring are far apart.

3.2. Choice of Corridor Type

Road animal corridor is divided into three types, which are upper cross corridor, lower cross corridor and gentle slope corridor.

The overpass is mainly built in the form of "overpass" to allow wildlife to pass over the highway. The underpass is mainly in the form of bridge, culvert, tunnel and culvert. Gentle slope corridor is a kind of corridor form to induce wild animals to cross the highway from the roadbed by modifying the roadbed and reducing the slope on both sides of the roadbed.

| Type     | Strongpoints                                                                 | Disadvantages                                                                                     | Contrast               |
|----------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|
| Overpass | 1. Safe for wildlife                                                         | The construction in the Gobi desert area has made unsafe factors to the safety of the passage and the passing vehicles |
|          | 2. Corridor environment is consistent with nature and has little influence on landscape pattern. |                                                                                                   | Not recommended        |
|          | 3. Corridor is less disturbed by the vehicles below, which facilitates the passage of |                                                                                                   |                        |
animals.

4. Corridor also serves as a transitional habitat for small animals.

Underpass

It can meet the needs of migration, foraging and reproduction of various types of animals, but it needs to be designed according to animal signs and habits. Easy to siltation and Recommended need regular maintenance

Slope corridor

1. It can meet the needs of migration, foraging and reproduction of various kinds of animals.
2. It can well connect the habitat of wildlife on both sides and reduce corridor effect.

Collision accidents Not recommended between vehicles and wild animals are likely to occur. There are wild animals miss the road, along the road travel danger.

3.3. Corridor Type Selection

There is no standard of animal corridor in China. According to the monitoring of animal corridor of Qinghai-Tibet railway, it is considered that the bridge with the net height of Mingha highway greater than 3.5m and the path greater than 8m can be used as the Equus hemionus corridor.

4. Results

Based on the investigation of the water source points along the route, 2 new and 8 new corridor for Equus hemionus. On average, an animal corridor is set up every 8.1km. Two adjacent corridor minimum spacing of 1.55km, the largest spacing of 13.99 km, can satisfy the wildlife.

Table 2. Animal Corridor for Selection

| Section | No.   | Mark       | Spacing | Height |
|---------|-------|------------|---------|--------|
| 1       | 1     | K4+120     | 2-13.0  | 2.30   |
| 2       | 2     | K14+380    | 1-8.0   | 3.25   |
| 3       | 3     | K16+753    | 2-13.0  | 3.17   |
| 4       | 4     | K23+111    | 1-8.0   | 3.37   |
| 5       | 5     | K35+795    | 1-13.0  | 2.56   |
| 6       | 6     | K36+016    | 3-13.0  | 2.42   |
| 7       | 7     | K37+570    | 1-8.0   | 4.65   |
| 8       | 8     | K46+243    | 1-8.0   | 3.53   |
| 9       | 9     | K46+534    | 2-8.0   | 2.56   |
| 1       | 10    | K57+100    | 2-13.0  | /      |

2
11 K70+000 / 
12 K71+500 2-13.0 / 
13 K73+000 / 
14 K84+420 1-13.0 3.02 
15 K85+490 1-13.0 3.95 
16 K91+000 1-13.0 3.26 
17 K95+685 1-13.0 4.94 
18 K102+205 13-30 6.58 
19 K111+100 / 

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