Evaluation on Utilization Effect of Highway Wildlife Corridor in Desert and Gobi Area

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Abstract: Taking the design of wildlife corridor from Mingshui to Hami section of national expressway from Beijing to Urumqi as an example. From January 2015 to May 2018, the project team monitored and studied the wildlife utilization of 13 corridors along the route from Mingshui to Hami. The results show that wildlife along the highway has begun to use Bridges, culverts and passageways to cross the highway.

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°C, the annual precipitation is 33.8mL, and the annual evaporation is 3300mL. Spring is windy, cold and warm changeful. Winter is cold, and low air layer is stable. The extreme maximum temperature is 43°C. The extreme minimum temperature is -32°C. 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.

Figure1. Mingshui to Hami highway

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 reptiles, 7 families and 2 orders, 4 species of amphibians, 2 orders and 2 families, 4 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.
2.3. Corridors

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.

| Section | No.  | Mark     | Spacing | Height |
|---------|------|----------|---------|--------|
| 1       | 1    | K4+120   | 2-13.0  | 2.30   |
| 2       | 2    | K14+380  | 1-8.0   | 3.25   |
|         | 3    | K16+753  | 2-13.0  | 3.17   |
|         | 4    | K23+111  | 1-8.0   | 3.37   |
|         | 5    | K35+795  | 1-13.0  | 2.56   |
|         | 6    | K36+016  | 3-13.0  | 2.42   |
|         | 7    | K37+570  | 1-8.0   | 4.65   |
|         | 8    | K46+243  | 1-8.0   | 3.53   |
|         | 9    | K46+534  | 2-8.0   | 2.56   |
|         | 10   | K57+100  | 2-13.0  | /      |
| 2       | 11   | K70+000  | /       |        |
| 2       | 12   | K71+500  | 2-13.0  | /      |
| 2       | 13   | K73+000  | /       |        |
| 2       | 14   | K84+420  | 1-13.0  | 3.02   |
| 2       | 15   | K85+490  | 1-13.0  | 3.95   |
| 2       | 16   | K91+000  | 1-13.0  | 3.26   |
| 2       | 17   | K95+685  | 1-13.0  | 4.94   |
3. Methodology
(1) Infrared camera monitoring. In this monitoring, passive infrared cameras are set up near 19 channels selected for all-weather monitoring of channel utilization. The camera works through infrared induction. When wild animals pass by, the infrared rays are blocked, and the induction device starts to work, which triggers the camera and automatically records the images. In January 2015, the project team carried out the installation and debugging of automatic infrared cameras in 19 monitoring channels. In April 2015 and July 2017, the camera was periodically maintained and the monitoring data were recovered. In May 2018, the monitoring and data were finally recovered.

(2) Trace method. Through the statistical analysis of the footprints, feces, hair and other animal traces around the passage and culvert, the project team recorded the footprints of different animal species, judged which were successfully crossing the road and which were refused to cross back to their original habitat, and thus determined the proportion of animals successfully crossing the road.

4. Results
(1) There is a negative correlation between human activities and the corridor utilization rate of wild animals. Wild animals will actively avoid the corridor with high human activities, but there is no correlation with the width of the corridors.

(2) The utilization rate of human activities and domestic animals around the road is higher, while that of wild animals is higher. The use of the same height channel is the opposite, which further explains that wild animals will actively avoid the higher activity of human and domestic animals.

(3) Large and medium-sized herbivores are more sensitive to the channel height than the width.

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