



Study on Environmental Protection of Highway Construction on Birds Nature Reserve

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ABSTRACT

The study of the effects of highway on birds found that, due to the negative effect of highway, the birds density of forestland and grassland decreased in different degree to about 60%. The overall density of all the birds fell to about 1/3, and the closer from the road, the lower degree of the birds richness. Highway corridor effect, especially traffic noise, affects birds breeding rate; when the equivalent consecutive sound level A on bird habitat is more than 50dB round the clock, the bird breeding density decreases from 20% to 98%, and the birds who born in the road area spread to the habitat which is far away from the road for breeding. Avian phototaxis caused many birds hitting on the lighted buildings or vehicles at night. The exposed power lines along the highway are also a risk factor for a pair of cranes, eagles and other large birds. Hence, it proposes highway construction environmental technology to reduce the adverse effects of the construction and operation of the highway on the birds, and also provides a reference for highway construction biodiversity conservation.

INTRODUCTION

The rapid development of Chinese highway exacerbated the effects of the cultural resources and natural environment along the highway. Deforestation and land occupation in highway construction, producing noise and dust in construction period, exhaust emissions and light pollution caused by the operation inevitably impact on wildlife along the route. How to protect the humanities and ecological environment, to reduce losses of the natural cultural resources and ecological destruction is particularly important.

Chinese scientific and technical personnel have carried out exploration and research about highway environmental protection, ecological restoration, protection of cultural resources and so on. But because of the late start, there are few studies on the effects of birds while the research on the impact of highway on animals is more general. The research contents are mainly about the effects of highway construction on the environment, wildlife habitat; while most of which just introduce in a rough, and not subdivide into one kind of animals to discuss the influence.

Therefore, studying the environmental protection technology of highway construction on Birds Nature Reserve has a certain practical significance for the evaluation of the impact of highway construction on birds. For building a similar road project, it has some reference on the conservation of biological diversity. And it is also with the requirements of Chinese industrial technology policy, and fully reflects the urgent needs of China's economic development and social construction.

THE IMPACT OF HIGHWAY TO BIRDS

The impact of highway on bird distribution: In highway construction process, forest land was occupied and trees were cut down. All of these would cause direct loss of bird habitat. All kinds of noise during road construction would make birds that live in the vicinity frightened. All these would force some birds to migrate, and then affect the distribution of birds (Fu & Wei 2010). The impact of traffic noise and traffic light on wildlife is also great. Reijnen & Foppen (1995) who did the research on the impact of road traffic on the breeding bird populations found that traffic noise was the major factor leading to the reduction of the number of birds distributed both sides of the road.

In a comparative study, interference distance and grassland bird density are related to traffic, and even traffic noise. When the traffic volume was 5000/day, the interference distance from the road was 20~1700m; when the traffic volume was 50000/day, interference distance from the road is 65~3530m. The bird species near the road have a significant decline. Forman's research on the landscape of outskirts in Massachusetts found that, when the traffic volume was 8000~30000/day, the road had a significant impact on the grassland bird (Forman & Deblinger 2000). But it had not a significant effect on grassland birds near continuous line when the traffic volume was 3000~8000 trips/day. The study in the Illinois found a rural road with averages daily traffic of about 300~3000/day; farmland *Eremophila alpestris* had a lower density on both sides of 200m of the road. In another two-lane paved road with a daily traffic of

about 500~700/day, the mortality of *Aphelocoma coerulescens* around or near the road region was significantly higher than other regions.

Dai Qiang etc. (2006) did a research on impact of animal habitat in wetland highway of Zoige. It showed the trend of the distribution of passerine and falcon passerine birds. The study indicated that greater the distance from the road, higher the density of these birds, and at 400m from the road it had a significantly higher density of passerine than those lived in place at 50m~200m from the road, but had less impact on the falcon passerine's species richness and density. The study by Gao (2008) on ecological impact on birds along the Huaiyan highway found that the dominant species of birds in 0m quadrat were less than those in 200m quadrat and 400m quadrat; for the same study site, the farther distance between Huaiyan highway and plots, the higher density of the birds. When using plots and season, or just use one of them to correct traffic, changes in traffic had no significant effect on the changes in the density and species of birds along the road. But the change of seasons and the difference in plots (habitat types) had a significant influence on the number and density of the bird species. All the birds were regarded as a whole in the 0m plots, changes in traffic volume had significant impact on the change in the density of birds along the road, while it had no significant effect on the change in the number of bird species. By using the noise prediction models to evaluate the impact of the noise of the highway in the East Dongting Lake Nature Reserve waterfowl, Chen et al. (2008) found that some of the local traffic noise interfered to a variety of waterfowl behavior, thus affecting waterfowl habitat in protected areas. Wang et al. (2012) studied the impact of road vehicle operation on the behavior of the birds in the road area and found that the bigger of the vehicle types, the more sensitive response of birds; and the larger the noise value, the stronger bird reaction behavior.

The impact of highway on avian breeding: Breeding is an important part in bird life history. Because reproductive success has a direct impact on population dynamics and the species continues (Weikang et al. 2000). When breeding, traffic would be more serious disturbance to birds, especially the traffic noise. Birds communicate mainly by song. The decline of the song transmission efficiency would affect identification between individual of birds, spousal relationships, territorial defense, population density and community structure. In high noise environment, the birds make acoustic signal which would overlap with frequency, amplitude and time of the noises and make propagation efficiency of the birds' acoustic signal to reduce (Ji & Zhang 2011).

Reijnin & Foppen (1994, 1995) and Reijnin et al. (1996) spent three consecutive years to get the monitoring data. It

showed that closer from the road, the greater the noise was; the lower the density of birds, and worst the pairing stability of the relationship between male and female. Forman et al. (2002) observed that birds were often foraging or looking at nest material at the roadside, but not breeding in the vicinity. They speculated that the traffic noise drowned out begging chirping of chicks and failed the parent-child communication which made chicks not to get adequate food, resulting in the decrease of reproductive rate. In the Netherlands, the research on the effects of car traffic on the density of breeding in Dutch agricultural grasslands showed a very important mode that whether it was in woodland or grassland next to road, about 60 percent of birds in the area had the characteristics of low density. Moreover, in the affected area, one third of the total bird density and species richness would be mutually exclusive, with the gradual closing to the road, the species will gradually disappear. When overall bird species became smaller, in a few years later, the effects of these roads would become more obvious. Forman & Alexander (1998) studied the ecological impact of Massachusetts suburban highway. The results indicate that within the range of 1200m near the road, the traffic volume achieved even more than 30,000 (a busy multi-lane road, the average speed at 80~85km/h), the number of birds and other normal reproduction significantly reduced, and even in the bird breeding season, it is difficult to find birds. In those relatively large traffic road, as the road traffic was from 15000 to 30000 (in two lanes road), the number of birds and normal breeding reduced in the range of 700m near the road. With traffic volume between 8000 and 15000, birds distributed everywhere, but within the range of 400m near the road, the propagation decreased. Finally, in the light of daily traffic (daily from 3000 to 8000 local connections streets) conditions, the distribution of grassland birds near the road not been significantly affected.

Habitat loss and degradation are great threats to the birds breeding and survival (Weikang et al. 2000). Habitat fragmentation caused the loss of habitat for wildlife, and the remaining habitat areas continuing to shrink. The distance between each massive habitat increased; the habitat near the block boundary area ratio increased, resulting in the reduction of wildlife populations; some species disappeared from small habitats, so that the remaining populations were more vulnerable. For birds, the fragmentation affected the distribution and abundance of insects, and the insectivorous birds would also be affected (Roland 1993).

THE IMPACT OF HIGHWAY ON AVIAN MIGRATION

Bird migration has an explicit direction, regular and long-distance relocation activities and birds carry out it with the season change. The migration is the highest risk behaviours

in life cycle of birds, constraining a variety of factors, for example, physical and natural enemies. But, migratory bird supply sites are often unintentionally destroyed by human activities, which create more difficulty to their migration. Sometimes it becomes a big problem for some species to survive. A lot of road construction, especially highway construction, played a certain role in the destruction and division to the ecological environment (Jian 2007). Deforestation and land occupation are major influences on ecological environment in the highway construction. Especially the highway construction in the forest, road expropriated land would permanently change the using function of the land. All existing vegetation would be destroyed. During the transportation process, chemicals released which alter the composition of plant species along the road from the fundamental. The food is an important factor affecting the bird migration. Some scholars believed that, because birds are warm-blood animals, they are less sensitive to temperature changes. Thus, the effect of temperature on bird migration was mainly about getting food. When temperature fell down, the plants stopped their growth that restricted to birds foraging activities to a large extent. This forced the birds to migration. In fact, birds are very vulnerable in the migration. Many human facilities would adversely affect them. Birds are usually migrating at night; sometimes the light will be seen as dawn lights, this phototaxis caused many birds hitting on buildings or vehicles with lights at night.

Vehicles also threaten migratory birds. On the road, which is leading to the Hailar in Ergun regions in China, in spring and fall, it is very common to see the migratory birds crashed into vehicles which are travelling on the road of the prairie. Some road constructions blocked the path of bird migration. The most direct impact of road traffic on animals is the death of them, that is the roadkill (Forman & Alexander 1998). The number of dead animals caused by road traffic is very large each year. For example, in the UK, in the 1960s the number of roadkill birds is 4 million every year (Hodson 1966). In the Netherlands, in 1990s, the number is about 2 million and in Sweden, the number is 8.5 million. In 2003, more than 1000 animals were unfortunately crushed to death by vehicles in Yangmingshan National Park in Taiwan, including valuable ling scops owl.

Due to the highway construction, many telegraph poles are set along the road, and the exposed power lines are also a risk factor to storks, eagles and other large birds. According to the Birdlife International report, 30 percent of Spanish eagle are electrocuted to death at the beginning fly each year. For less than 200 pairs of species in the world, it is very unfavourable to such a high mortality rate.

ENVIRONMENTAL PROTECTION TECHNOLOGY

OF HIGHWAY CONSTRUCTION ON BIRDS NATURE RESERVE

1. Highway crossing technology: According to the situation of Birds Nature Reserve, it puts forward the technology measures of noise reduction, damping, reducing the flying dust and light control, which are used in highway construction.
2. Road area ecological restoration: Through the investigation of bird food, it will choose bird-feed plants as the preferred plant species to restore the plant. By analysing the number and frequency of birds appearing after vegetation restoration, it will use ecological isolation technology and eco-planting, community steady recovery techniques in the ecological restoration of damaged areas, to make the road area ecological system integrate into nature reserves ecosystem as soon as possible.
3. Measures for the protection of birds in freeway construction: The avian distribution, propagation and migration are influenced by dust, residue soil, noise and lighting produced during the highway construction. In the process of construction, we must first analyse the noise, visual interference, the quality and quantity of food to reduce the impact on birds, and then take field monitoring methods to control the noise and visual interference during construction. And the construction measures should be proposed to protect birds.
4. Measures for the protection of birds in highway operation period: Firstly, it should study the adaptability of birds on the highway, and then through field investigation, we analyse the impact of vehicle flow and light pollution on density and species of birds along the highway. And finally, it comes up with protection measures in highway operation period.

CONCLUSIONS

The ecological and environmental problem is a major practical problem facing humanity around the world. Now, science and technology have changed quickly.

On one hand, it has brought the human civilization, social progress, rapid economic growth and global prosperity; and on the other hand, the natural resources and the ecological environment that human depends on for existence and development, have been more severely damaged. And people have tasted the bitter fruit of the natural ecological force. Highway construction is the need for economic development, but in order to protect the environment rather than building roads, it is impractical.

The prospects of ecological environment are not optimistic in China, it is necessary to combine the road construc-

tion with environmental protection. Coordination of highway construction and environment becomes a key means to resolve conflicts between road transport and environment.

This paper studies avian community composition and characteristics along the highway, not only to understand the influence of highway operating environment pollution (mainly noise, vibration, light, dust, exhaust, etc.) and traffic flow on the birds, but also to understand that the artificial green space along the highway is suitable for bird living. And then it proposes highway environmental technology to reduce the impact of road construction and operation on the birds along highway. The research results have a certain reference function to the similar highway construction project in the conservation of biological diversity, and are the strategic choice to achieve highway sustainable development which conforms to the situation in China. It has the extremely important theoretical and practical significance.

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