Short Communication
pISSN: 2288-9744, eISSN: 2288-9752
Journal of Forest and Environmental Science
Vol. 34, No. 2, pp. 176-179, April, 2018
https://doi.org/10.7747/JFES.2018.34.2.176

JFES
Journal of Forest and Environmental Science

Assessing Compliance with the Wildlife Crossing Guideline in South Korea

Donggul Woo, Heebok Park, Hyeong-Soo Seo, Ho-Gyeong Moon, Euigun Song, Anya Lim* and Tae-Young Choi*
National Institute of Ecology, Seocheon 33657, Republic of Korea

Abstract

To restore the connectivity of fragmented habitats, 415 wildlife crossings have been built between 1998 and 2014 in South Korea. However, their effect on wildlife conservation is still in doubt. As a first step to examine the effectiveness, our study aims to assess compliance with the guideline for wildlife crossing construction and management, developed by the Ministry of Environment Korea that provides fundamental information to understand the status and the problem of wildlife crossings in Korea and thus to provide practical guidance for the improvement. According to our survey, the Korea National Park Service complied with the guideline best (62.5%) while local government followed the guideline least (46.1%). In addition, the compliance rate was the highest for wildlife crossings in national roads (53.6%) followed by highways (53.2%) and local and municipal roads (52.2%). For the overpass wildlife crossings, the compliance rates for installation of an escaping facility in the drainage and prevention of pedestrian and vehicle access were particularly low. In case of underpass wildlife crossings, small ditches for amphibians and reptiles were not sufficient, and the linkage between wildlife fences and underpass were weak. In order to ensure the effectiveness of wildlife crossings, the effort to increase the compliance rate with the guideline is critical, and mandating the guideline could be a practical way to enforce the compliance.

Key Words: habitat fragmentation, road ecology, road kill, overpass, underpass

Introduction

The road density of South Korea is exceptionally high, 1.1 km/km^2 (Statistics Korea 2017), following the rapid economic growth since the 1960s (Kim and Hong 1997). The intensive road construction resulted in habitat fragmentation and loss and thus, negatively affected the biodiversity and ecosystems in South Korea. Wildlife crossings, a human-made structure to promote ecological and genetic interactions of wildlife, can alleviate the negative impact of roads by re-connecting the patched habitats (Glista et al. 2009; Beckmann et al. 2010; De Montis et al. 2018). Since the first wildlife crossing being implemented in 1998, and the number has reached to 415 in 2014 in Korea (National Institute of Ecology 2017). In the past 20 years, hundreds of wildlife crossings have been built. However, their effect on wildlife conservation, such as reduction of wildlife-vehicle collision and promotion of wildlife movement, is still in doubt. The questions involved the suitability of the locations, designs, and allocated budget for sustainable man-

Received: March 19, 2018. Revised: April 2, 2018. Accepted: April 3, 2018.

Corresponding author: Anya Lim
National Institute of Ecology, 1210 Geumgang-ro, Maseo-myeon, Seocheon 33657, Republic of Korea
Tel: 82-41-950-5854, Fax: 82-41-950-6136, E-mail: ppardus08@gmail.com

Corresponding author: Tae-Young Choi
National Institute of Ecology, 1210 Geumgang-ro, Maseo-myeon, Seocheon 33657, Republic of Korea
Tel: 82-41-950-5420, Fax: 82-41-950-5943, E-mail: wildlife@nie.re.kr

agement. In order to resolve these problems, the Ministry of Environment Korea initially prepared the guideline for wildlife crossing construction and management in 2003 (Ministry of Environment 2003) and updated it in 2010 to better reflect the characteristics of wildlife in Korea on wildlife fencing and crossing construction and thus to strengthen their effectiveness (Ministry of Environment 2010). Up to now, however, the wildlife crossings have been poorly monitored, and thus have not been well understood whether they appropriately complied with the guideline and are actually effective to reduce wildlife-vehicle collisions. Therefore, our study aims to assess compliance rates with the guideline for wildlife crossing construction as a first step to understand the status and the problem of wildlife crossing construction and management in Korea and thus to provide a practical recommendation for the improvement.

Materials and Methods

We surveyed 83 randomly chosen wildlife crossings, composed of 56 overpass wildlife crossings (hereafter overpass) and 27 underpass wildlife crossings (hereafter underpass), among 415 in South Korea between August and December 2014 (Fig. 1). We examined whether wildlife crossings appropriately followed the guideline for wildlife crossing construction and management, provided by the Ministry of Environment Korea (Ministry of Environment 2010). For the survey, we prepared a checklist based on the guideline. The survey list included 14 items for overpass and 11 items for underpass that critically influence the effectiveness of wildlife crossings, such as installation of drainage at the entrance, prevention of pedestrian and vehicle access, installation of wildlife fence around wildlife crossings, and use of similar materials with adjacent vegetation (Table 1). We analyzed and compared the compliance rate by guideline items, managing authorities, and types of roads.

Results and Discussion

Compliance rate by guideline items

While overall compliance rate with the guideline was 53%, the rate for the overpass was 51%, and the rate for the underpass was 66%. In respect to 56 overpasses, most of them maintained the minimum width of 7 m (86.3%), had soil depth over 70 cm for the stable growth of plants (88.2%), and installed wildlife fences with height of 1.2 m or above to prevent road kill (84.3%). However, in many cases, overpasses failed to have sufficient escaping facility in the drainage (9.8%), effectively prevent the access of people and vehicles (19.6%), separate the pedestrian and wildlife paths (19.6%), and make overpasses harmonizing with adjacent terrain and vegetation (19.6%). In respect to 27 underpasses, there was no sufficient small ditches for the movement of amphibians and reptiles (47.6%), and wildlife fences and underpasses ware not firmly connected (47.6%) to prevent road kill. In addition, only 57.1% underpasses had the openness ratio of over 0.7 and appropriate drainage system within underpasses. The summary of the survey result is in Table 1.

The result of compliance rate with the guideline showed that wildlife crossings often undermined small animals such as insects, amphibians, and reptiles as the design of wildlife crossings have largely focused on mammals. Considering that small animals use the underpass more often than the overpass (Beckmaan 2010), the current situation calls for urgent action to install ditches in the underpass to promote the movement and re-connection of microhabitat of small animals. Particularly, it is not feasible to improve the under-

Fig. 1. Example of overpass (left) and underpass (right) wildlife crossing.

Table 1. Compliance with the guideline by items

Type	Guideline items (Y/N)	Compliance rate (%)
Overpass	The minimum width over 7 m (*In case of 'major ecological corridors,' the minimum width over 30 m*)	86.3
	Prevention of pedestrian and vehicle access	19.6
	Installation of barriers to prevent lights and noise from vehicles	41.2
	Presence of a structure for insect, avian, and amphibian	21.6
	Installation of drainage at the entrance	56.9
	Installation of an escaping facility in the drainage	9.8
	Separation of pedestrian and wildlife paths	19.6
	Connectivity with adjacent terrain	78.4
	Harmony with adjacent terrain and vegetation	19.6
	Soil depth over 70 cm for the stable growth of plants	88.2
	Appropriateness of locality to connect habitats	82.4
	Installation of wildlife fences with height of 1.2-1.5 m or above	84.3
	Installation of wildlife fence close to the ground	66.7
	Attachment between wildlife fences and underpass	35.3
Underpass	Underpass height at least 2 m (*In case of four-land roads at least 3 m*)	71.4
	Openness rate of 0.7 and over	57.1
	Appropriate drainage system within underpass	57.1
	Installation of small ditches for amphibians and reptiles	47.6
	Harmony with adjacent terrain and vegetation	66.7
	Connectivity with adjacent terrain	66.7
	Presence of problems in animal movement	66.7
	Appropriateness of locality to connect habitats	81.0
	Wildlife fences with height of 1.2-1.5 m or above	61.9
	Installation of wildlife fence close to the ground	61.9
	Attachment between wildlife fences and underpass	47.6

Table 2. Compliance with the guideline by wildlife crossing categories

Category		Compliance rate (%)		
		Overpass	Underpass	Average
Road types	Highway	45.7	58.0	53.2
	National Road	55.3	47.4	53.6
	Others	45.3	74.9	52.2
Managing authorities	Ministry of Land, Infrastructure and Transport	55.1	47.4	53.4
	Korea expressway corporation	61.4	63.2	62.5
	Korea national park service	53.6	74.2	67.3
	Local government	42.2	75.8	46.1

pass structure, such as establishing drainage system and formulating the proper openness ratio, after completing the construction. Therefore, it is very critical to follow the guidelines as thorough as possible while constructing the underpass.

Compliance rate by managing authorities and road types

Different authorities manage different types of roads. For example, the Ministry of Land, Infrastructure, and Transport (MLIT) manages national roads, Korea Express-

way Corporation (KEC) is in charge of highways, local government manages local and municipal roads, and the Korea National Park Service (KNPS) is in charge of roads within national parks. Accordingly, wildlife crossings in different roads belong to respective authorities. The compliance rate was different by managing authorities.

While the KNPS complied with the wildlife crossing guideline well (72.8%), the compliance rate of local government was the lowest by 56.5% (Table 2). The wildlife crossings in the KNPS showed the highest compliance rate possibly because of the ecological importance in the surrounding areas. The lowest compliance rate of the wildlife crossings in local and municipal roads was likely due to lack of political interest. Local governments often constructed wildlife crossings not to improve wildlife conservation but to avoid negative reputation from the environmental impact assessment. The underpasses managed by MLIT were used for not only wildlife but also vehicles and showed the low compliance rate of 56.6%. Likewise, the overpass managed by local governments had the low compliance rate of 40.9% because the crossings focused on the convenience of the pedestrian.

The compliance rate with wildlife crossing guideline was different by road types. For the overpass, the compliance rates of highways, national roads and local/municipal roads were 65.7%, 57.4%, and 40.9% respectively. For underpass wildlife crossings, the compliance rates of highways, national roads and local/municipal roads were 59.1%, 56.6%, and 76.4%. The row compliance rate of the underpass in national roads is likely from the use of existing crossing facilities including pipes as a wildlife crossing. In case of local and municipal roads, the underpass showed higher compliance rate than the overpass. This could be due to the high rate of using the overpass as a pedestrian path, and thus the overpasses do not strictly comply with the guideline.

Our survey result clearly showed a room for improvement to comply with the guidelines for the wildlife crossing construction and management, especially for wildlife crossings in local and municipal roads managed by local governments. As the current guideline does not have legal force, mandating the guidelines may enhance the compliance rate and increase the effectiveness of wildlife crossings.

Acknowledgements

This work was supported by the grant of Ministry of Environment Korea for the NIE-Government Funded Research-2014.

References

Beckmann JP, Clevenger AP, Huijser MP, Hilty JA. 2010. Safe passages: highways, wildlife, and habitat connectivity. Island Press, Washington.

Choi TY, Yang BG, Woo DG. 2012. The suitable types and measures of wildlife crossing structures for mammals of Korea. J Environ Impact Assess 21: 209-218. (in Korean)

De Montis A, Ledda A, Ortega E, Martin B, Serra V. 2018. Landscape planning and defragmentation measures: an assessment of costs and critical issues. Land Use Policy 72: 313-324.

Glista DJ, DeVault TL, DeWoody JA. 2009. A review of mitigation measures for reducing wildlife morality on roadways. Landscape Urban Plan 91: 1-7.

Kim K, Hong S. 1997. Accounting for rapid economic growth in Korea, 1963-1995. Korea Development Institute, Seoul.

Ministry of Environment. 2003. Guidelines for design and management of wildlife crossing structures in Korea. Ministry of Environment, Gwacheon. (in Korean)

Ministry of Environment. 2010. Guidelines for design and management of wildlife crossing structures in Korea. Ministry of Environment, Gwacheon. (in Korean)

National Institute of Ecology. 2017. Wildlife Crossing Network. http://wildlifecrossing.nie.re.kr/. Accessed 10 Jan 2018.

Statistics Korea. 2017. Statistics System. http://www.index.go.kr. Accessed 11 Feb 2017.